

Environmental Impact Assessment

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India: Karnataka Rural Roads Improvement Project

Part 1 of 4 – Main Report

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CURRENCY EQUIVALENTS

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NOTE

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

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ABBREVIATIONS

AADT	–	annual average daily traffic
ADB	–	Asian Development Bank
ASI	–	Archaeological Survey of India
BAP	–	Biodiversity Action Plan
BDL	–	below detection limit
BIS	–	Bureau of Indian Standards
BMTPC	–	Building Materials and Technology Promotion Council
BOD	–	biochemical oxygen demand
C&D	–	construction and demolition
CEC	–	cation exchange capacity
CHA	–	Critical Habitat Assessment
CO	–	carbon monoxide
COD	–	chemical oxygen demand
CPCB	–	Central Pollution Control Board
CR	–	critically endangered
CRZ	–	coastal regulation zone
CTE	–	consent to establish
CTO	–	consent to operate
DBU	–	designated best use
DO	–	dissolved oxygen
DPR	–	detailed project report
DRRP	–	district rural road plan
EAAA	–	ecologically appropriate area of analysis
EC	–	environmental clearance
ECoP	–	Environmental Code of Practice
EHS	–	Environment, Health and Safety
EIA	–	Environmental Impact Assessment
EMP	–	Environmental Management Plan
EN	–	endangered
EOO	–	extent of occurrence
ESZ	–	eco-sensitive zone
FC	–	forest clearance
FGD	–	focus group discussion
GIS	–	Geographic Information System
GIIP	–	good international industry practice
GoI	–	Government of India
GoK	–	Government of Karnataka
GRM	–	grievance redress mechanism
GSI	–	Geological Survey of India
IBA	–	Important Bird and Biodiversity Area
IBAT	–	Integrated Biodiversity Assessment Tool
ICAR	–	Indian Council of Agricultural Research
IFC	–	International Finance Corporation
IMD	–	India Meteorological Department
IRC	–	Indian Roads Congress
IUCN	–	International Union for Conservation of Nature
KBA	–	key biodiversity area
KCZMA	–	Karnataka Coastal Zone Management Authority
KFD	–	Karnataka Forest Department

KRRDA	–	Karnataka Rural Road Development Agency
KRRIP	–	Karnataka Rural Road Improvement Project
KSDMA	–	Karnataka State Disaster Management Authority
KSNDMC	–	Karnataka State Natural Disaster Monitoring Centre
LC	–	least concern
m amsl	–	metres above mean sea level
MoEF&CC	–	Ministry of Environment, Forest and Climate Change
MoRTH	–	Ministry of Road Transport and Highways
MPN	–	most probable number
NAAQS	–	National Ambient Air Quality Standards
NBSS&LUP	–	National Bureau of Soil Survey and Land Use Planning
NDMA	–	National Disaster Management Authority
NGO	–	non-governmental organization
NH ₃	–	ammonia
NLI	–	National Landslide Inventory
NO ₂	–	nitrogen dioxide
NOC	–	no objection certificate
NT	–	near threatened
NTU	–	nephelometric turbidity unit
O ₃	–	ozone
PA	–	protected area
PIU	–	project implementation unit
PM	–	particulate matter
PMGSY	–	Pradhan Mantri Gram Sadak Yojana
PMU	–	project management unit
RoW	–	right of way
SAR	–	sodium absorption ratio
SO ₂	–	sulphur dioxide
SPCB	–	State Pollution Control Board
SPS	–	Safeguard Policy Statement
TDS	–	total dissolved solids
TSS	–	total suspended solids
UNESCO	–	United Nations Educational, Scientific and Cultural Organization
VU	–	vulnerable
WBG	–	World Bank Group
WHO	–	World Health Organization
WLS	–	Wildlife Sanctuary
WPAA	–	Wildlife (Protection) Act, 1972, as amended

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EXECUTIVE SUMMARY

A. Introduction

The Karnataka Rural Road Development Agency (KRRDA), under the Rural Development and Panchayat Raj Department, Government of Karnataka, is implementing the Karnataka Rural Road Improvement Project (KRRIP) with financial assistance from the Asian Development Bank (ADB). The Project aims to improve all-weather, climate-resilient and safe rural connectivity across Karnataka by improving 1,335 existing rural roads with an aggregate length of about 5,178 km and construction of 51 bridges across all 31 districts covered by 29 PIUs.

The Project has been classified as Category A for environment in accordance with ADB's Safeguard Policy Statement (SPS), 2009 because the Project is likely to have significant adverse environmental impacts that are irreversible, diverse or unprecedented, principally on biodiversity values in the Western Ghats. A substantial number of road stretches interface with forests, legally protected areas, eco-sensitive zones, Important Bird and Biodiversity Areas, Key Biodiversity Areas, the Western Ghats UNESCO World Heritage landscape and Ecologically Appropriate Areas of Analysis identified for Critical Habitat Assessment. The EIA and EMP therefore cover the entire Project scope of 1,335 roads, with enhanced assessment and mitigation for ecologically sensitive and critical-habitat sections. Additionally, cumulative impacts of KRRIP with ongoing/planned Jal Jeevan Mission rural drinking water supply project are assessed in the EIA.

The EIA has been prepared in line with ADB SPS 2009, applicable Government of India and Government of Karnataka regulatory requirements, and good international industry practice including the World Bank Group Environmental, Health and Safety (EHS) Guidelines. Where national standards and the WBG EHS Guidelines differ, the more stringent of the two has been applied; no less stringent level has been adopted for any parameter. The assessment is based on road screening, transect walks, secondary data review, representative baseline monitoring for air, noise, water and soil, GIS-based environmental and biodiversity sensitivity analysis, stakeholder consultations, and preliminary biodiversity surveys. The biodiversity baseline and Critical Habitat Assessment are ongoing and will be updated on completion of the remaining seasonal surveys and the final CHA. The survey calendar, the date for submission of the final CHA and the updated EIA and BAP to ADB, and the works that remain restricted until those documents are disclosed, are set out in paras. 10, 17 and 39 and are reflected in the loan covenants.

Rural road improvement is not listed as a standalone activity requiring prior environmental clearance under the EIA Notification, 2006. However, the Project requires compliance with applicable statutory permissions and approvals, including forest clearance or working permission/NOC where applicable, CRZ clearance for Road ID 1392, ASI/NMA or competent authority permission for roads within regulated areas of protected monuments, tree-felling permission, consents for construction plants, quarry and borrow-source approvals, labour and occupational health and safety compliance, waste management requirements and traffic management permissions. Project Road ID 4817 in Belagavi district passing through forest land and requires forest clearance for diversion of 0.748 ha under the Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 (formerly the Forest (Conservation) Act, 1980, as amended in 2023). In addition, the required working permissions/No Objection Certificates (NOCs) for 307 project roads located within or adjoining forest stretches, shall be obtained prior to the commencement of any civil works under the Project. Road ID 1392 in District Uttar Kannada requires CRZ clearance under the CRZ Notification, 2019, read with the CRZ Notification, 2011

to the extent the latter continues to apply pending approval of the Coastal Zone Management Plan for Karnataka. Road ID 4446 in Vijayanagara district falls within the regulated area of the centrally protected Group of Monuments at Hampi and requires permission from the National Monuments Authority and the Archaeological Survey of India under the Ancient Monuments and Archaeological Sites and Remains Act, 1958, as amended in 2010, before any construction work.

B. Description of Project

The Project comprises improvement of 1,335 existing rural roads with a total length of about 5,178 km across Karnataka and construction of 51 minor bridges. List of 51 bridges is provided in Appendix 2A. The roads are distributed across all physiographic regions of the state, including the Northern, Central and Southern Karnataka Plateaus, Malnad/Western Ghats region and Coastal Karnataka. The Project is designed to improve access to habitations, post-harvest centres, schools, healthcare facilities, Anganwadi centres, markets, administrative offices and other essential services.

The proposed works are primarily confined to the existing road right of way and include pavement strengthening, selective widening within available RoW, shoulder improvement, drainage and cross-drainage improvements, culvert and bridge rehabilitation or reconstruction, road safety measures, slope and embankment protection, and associated roadside works. The available RoW generally varies from 5 m to 13 m, and the design seeks to avoid additional private land acquisition to the extent feasible.

Road selection and refinement followed a multi-stage screening process considering connectivity need, availability of RoW, ecological sensitivity, forest and protected-area interfaces, and feasibility of avoiding or minimizing environmental and social impacts. The preferred alternative relies on improvement of existing alignments rather than new road construction, which substantially reduces land take, habitat fragmentation and resettlement-related impacts.

The road design follows PMGSY Environmental Code of Practice and relevant Indian Roads Congress standards, including IRC:SP:20-2002. Flexible pavement is proposed in non-habitation stretches, while rigid or cement concrete pavement has been adopted in selected habitation and problem stretches. Road safety provisions include signs, markings, speed calming, warning boards, hazard markers, crash barriers and pedestrian safety measures at settlements, schools, Anganwadi centres, health facilities, junctions and other sensitive locations.

The Project includes 10,992 number of drainage and cross-drainage interventions, including 3494 box culverts, 7175 pipe culverts, 323 minor bridges. Drainage works include 359 km of lined drains in village and built-up areas and 7,269 km of earthen drains in open sections; both drain lengths are cumulative for the two sides of the carriageway. These measures are intended to improve year-round road serviceability, reduce waterlogging, prevent pavement damage, maintain natural drainage and improve climate resilience.

Most road improvements are being undertaken within the existing RoW. One road, Road ID 4817 in Belagavi district, requires diversion of 0.748 ha of forest land, with the final extent to be confirmed through joint verification with the Karnataka Forest Department before the clearance application is filed. No civil works will commence in forest, legally protected area, eco-sensitive zone, CRZ, ASI-regulated or confirmed critical-habitat stretches until applicable statutory clearances, permissions, NOCs, updated safeguard documents and relevant site-specific management measures are in place. This restriction is carried into the EMP, the bidding

documents, the particular conditions of the civil works contracts and the Project Administration Manual so that it is enforceable against contractors.

C. Description of Environment

1. Physical Environment

Karnataka is located on the western edge of the Deccan Peninsula and includes five major physiographic regions: Northern Karnataka Plateau, Central Karnataka Plateau, Southern Karnataka Plateau, Malnad/Western Ghats and Coastal Karnataka. The Project roads are distributed across all these regions and therefore traverse varied terrain, rainfall, soil, drainage, ecological and settlement conditions.

The baseline assessment indicates exposure to natural hazards including 28 roads in areas prone to soil erosion, 173 roads in drought-prone districts, 16 roads in landslide-prone terrain, 176 roads in flood-prone areas, 564 roads in high lightning-exposure zones, and roads in the coastal belt exposed to high winds and cyclones. Roads in the Western Ghats, Malnad and coastal belts require particular attention to slope stability, heavy rainfall, drainage, landslide risk and erosion control, while roads in northern and interior dry districts require careful management of construction water demand due to drought and groundwater stress.

Ambient air quality monitoring was undertaken at 774 locations across the 1,335 project roads, selected by stratification across physiographic region, settlement density and proximity to sensitive receptors, and covering winter and summer seasons. Baseline air quality is generally influenced by rural background conditions, local traffic, road dust, agriculture and settlement-level emissions. PM₁₀, PM_{2.5}, NO₂, SO₂, CO and other monitored parameters were within the National Ambient Air Quality Standards, 2009 at all locations except six locations, where exceeded the 24-hour standard within a range of 4 mg/m³ of CO. PM₁₀ and PM_{2.5} concentrations exceed the WBG EHS and WHO guideline values at Road IDs 523 and 437 locations respectively, and the more stringent value has been adopted as the compliance benchmark for construction-stage dust control.

Baseline noise monitoring indicates that existing noise levels are typical of rural road corridors and are influenced by local traffic, markets, settlement activities, agricultural machinery and community activities. Noise exceedances are observed at certain settlement and sensitive-receptor locations. Construction noise will be temporary and localized but will require controls such as equipment maintenance, work-hour restrictions near sensitive receptors, avoidance of unnecessary night work, use of silencers and implementation of traffic management measures.

Surface water bodies including streams, canals, tanks, ponds, lakes and drains occur along or near many project roads, and a number of roads cross drainage channels. Groundwater is an important source for domestic and irrigation uses in several districts, including over-exploited and critical groundwater assessment units. Baseline water quality indicates localized variations in pH, turbidity, dissolved oxygen, BOD, coliform and selected groundwater parameters; therefore, construction water sourcing, silt control, spill prevention, wastewater management and protection of community water sources are key requirements.

2. Ecological Environment

The biological baseline confirms that the Project roads are existing rural roads and the direct construction footprint is largely within modified or previously disturbed roadside habitats.

However, 591 roads (44% of the network) are located within or near ecologically sensitive landscapes determined to be Ecologically Appropriate Areas of Analysis (EAAAs) identified for Critical Habitat Assessment. Further, 307 roads intersect reserved or protected forest, 86 fall within a notified eco-sensitive zone, 14 lie within legally designated protected areas; 171 roads fall within more than one category. The remaining 420 roads are within EAAAs determined to be critical habitats but outside legally designated protected areas, forest lands, or eco-sensitive zones. The disaggregation is presented in Table 4-17 of the baseline chapter.

The ecological sensitivity is particularly high in the Western Ghats, a global biodiversity hotspot and UNESCO World Heritage landscape. The preliminary CHA has identified critical habitat features associated with threatened and range-restricted species, including large mammals, herpetofauna, bats and other biodiversity values. The CHA is based on desk review, stakeholder consultations and first-season field surveys at this stage, and the determination is therefore preliminary. Pending completion of the four-season surveys and the final CHA, all stretches falling within an EAAA are treated as critical habitat on a precautionary basis and the works restriction in para. 10 applies to them. The final CHA and the updated EIA and BAP will be submitted to ADB and disclosed before the award of civil works contracts for any stretch within an EAAA.

A Biodiversity Action Plan (BAP) has been prepared as an overarching framework to achieve a net gain of the biodiversity values for which critical habitat is designated, and no net loss of biodiversity values in natural habitat, consistent with ADB SPS 2009, Safeguard Requirements 1, paras. 26 and 28. The BAP includes measures for avoidance of unnecessary vegetation clearance, restrictions on works in sensitive locations, management of invasive alien species, restoration of disturbed habitat, wildlife awareness, speed control, signage, monitoring of roadkill hotspots, and biodiversity monitoring and evaluation during implementation. For each designated biodiversity value the BAP sets out the measurable outcome, the baseline against which it is measured, the indicator, the verification method, the timeline, the responsible party and the budget line, so that no-net loss followed by net gain can be demonstrated rather than asserted.

The cultural heritage baseline identifies Karnataka's rich archaeological and cultural heritage, including UNESCO World Heritage sites and centrally and state-protected monuments.. Six roads fall within 300 m of centrally protected monuments on GIS screening. The 300 m buffer was adopted deliberately to capture the 100 m prohibited area and the 200 m regulated area under the AMASR Act, 1958, as amended in 2010, with a margin for mapping error. Of these, Road ID 4446 in Vijayanagara district is confirmed to fall within the regulated area associated with the Hampi heritage assets; none of the six falls within a prohibited area. Required permissions and heritage protection measures will be completed before works in these stretches.

D. Anticipated Environmental impacts and mitigation measures

The impact assessment covers pre-construction, construction and operation stages and evaluates potential impacts on physical, biological, socio-economic and cultural resources within the Project's area of influence as defined in Chapter 6. It also addresses cumulative and induced impacts along the improved corridors, and the ancillary and associated facilities on which the works depend, namely quarries, borrow areas, hot-mix and batching plants, storage yards and haul routes. Most construction-stage impacts are expected to be localized, temporary and reversible if the EMP, BAP, site-specific EMPs and statutory clearance conditions are effectively implemented. The principal adverse impacts relate to soil erosion, drainage disturbance, dust, noise, water pollution risk, construction waste, occupational and community health and safety, access disruption, vegetation clearance, biodiversity disturbance, cultural heritage risks and management of construction resources.

Construction-stage air quality impacts will arise from earthworks, scarification, material handling, haulage, operation of equipment and possible operation of hot-mix or batching plants. These impacts will be controlled through water sprinkling, covering of transported materials, proper storage of fine materials, equipment maintenance, valid PUC certificates, siting of plants away from sensitive receptors, compliance with CPCB/KSPCB requirements and regular monitoring.

Noise and vibration impacts will occur from construction machinery, compaction, excavation, demolition, material transport and bridge or culvert works. Sensitive receptors include schools, Anganwadi centres, healthcare facilities, temples, settlements and cultural heritage structures. Mitigation includes equipment maintenance, silencers and mufflers, restricted noisy activities near sensitive receptors, avoidance of night-time work where feasible, vibration monitoring near heritage and other vulnerable structures against peak particle velocity limits set for each structure category in accordance with DIN 4150-3 or equivalent, with defined work-suspension triggers and construction scheduling in consultation with communities.

Surface water and groundwater impacts may occur from silt runoff, drainage alteration, temporary diversions, construction wastewater, accidental fuel or oil spills, improper storage of materials, borrow and quarry activities and construction water abstraction. Mitigation includes sediment traps, silt fencing, protection of water bodies, prohibition of waste disposal into drains or water bodies, spill prevention, impervious fuel-storage areas, wastewater treatment through septic tanks or soak pits, and permission-based water sourcing that protects community water needs.

Biodiversity impacts include roadside vegetation clearance up to 2.5–3.0 m from the edge of the existing carriageway and within the available RoW, disturbance to habitats adjacent to the RoW, potential impacts to nesting birds and herpetofaunal species, alien invasive species introduction, disturbance near forest and protected areas, and potentially increased roadkill risk during operation. These impacts will be managed through the mitigation hierarchy, BAP implementation, road-specific biodiversity controls, prohibition of haul routes, diversions and detours through natural or critical habitat, restoration of disturbed areas, prohibition of hunting or collection of forest resources, and monitoring by qualified biodiversity specialists.

- Tree felling will be limited to unavoidable trees within the RoW and undertaken only after obtaining permission from the competent authority. Compensatory plantation and survival monitoring will be implemented as per statutory requirements, EMP commitments and Forest Department conditionalities, as applicable.
- Borrow areas, quarries, construction camps, material storage yards, plants and haul routes will be finalized by contractors during implementation and will require site-specific screening, permissions, environmental controls, restoration plans and approval through the contractor's site-specific EMP.

Community health and safety risks include dust, noise, work-zone accidents, temporary access disruption, traffic diversions, livestock crossings, waterlogging and increased vehicle speeds during operation. The Project design and EMP include road safety provisions, warning signs, speed calming, traffic management plans, pedestrian safety measures, access management, public information boards and contractor obligations to maintain safe access to residences, farms, schools, health centres and community facilities.

Occupational health and safety risks include equipment operation, excavation, working near traffic, bitumen handling, bridge and culvert works, dust, noise, heat stress, lightning, landslides

and work in watercourse areas. Contractors will implement OHS plans, PPE, toolbox talks, training, emergency preparedness and response plans, first aid, worker welfare facilities, labour camp standards, worker grievance mechanisms and compliance with applicable labour and safety laws. Heat stress will be managed through a defined wet bulb globe temperature threshold and a work-rest regime for summer works in the northern and interior districts. Labour and camp provisions are subject to ADB's core labour standards requirements and are auditable by the PIUs, the PISC and external monitors.,

Cultural heritage risks include vibration, dust, accidental damage and chance finds near archaeological and cultural properties. Mitigation includes pre-construction heritage verification, implementation of chance-find procedures, no-entry zones for heavy equipment near heritage structures, low-vibration methods where required, dust suppression, signage, speed control and completion of statutory permission processes for roads within regulated monument areas.

Operation-stage impacts are expected to include improved connectivity, reduced travel time, better access to markets and services, improved road safety and reduced dust from deteriorated surfaces. Potential adverse operation-stage risks include increased vehicle speeds, road safety incidents, roadkill risk in sensitive ecological locations, drainage maintenance needs, noise near sensitive receptors and vulnerability to floods or landslides in high-risk areas. These will be managed through road safety provisions, maintenance, drainage upkeep, pothole repair, biodiversity monitoring and community awareness.

E. Environmental Management Plan

A consolidated Environmental Management Plan has been prepared as an integral part of the EIA. The EMP translates the impact assessment into specific avoidance, minimization, mitigation, monitoring and reporting requirements for pre-construction, construction and operation stages. It incorporates embedded mitigation measures from the DPR and additional mitigation measures identified through the EIA.

KRRDA will function as the Project Management Unit, supported by the State Quality Coordinator, a full-time PMU environment specialist and social safeguards specialist, a PMU-level ecologist, the Project Implementation Support Consultant (whose terms of reference include a dedicated ecologist position), the Project Management Consultancy and 29 district-level PIUs (as Karnataka state has total 31 districts, 2 districts will be covered by 2 neighbouring PIUs), each with a designated environment nodal officer. The ecologist requirement is also carried into the civil works contracts for packages containing roads within an EAAA or an ecologically sensitive area. PIUs will supervise contractor compliance with the EMP, BAP, statutory clearance conditions and environmental monitoring requirements at package and site level.

Contractors will be responsible for preparing and implementing site-specific EMPs before taking possession of work sites. These plans will cover construction camps, borrow areas, quarries, material sourcing, traffic management, waste management, OHS, labour camp management, water sourcing, emergency response, biodiversity protection, chance-find procedures, monitoring, reporting and corrective action mechanisms.

A Biodiversity Action Plan and Biodiversity Monitoring and Evaluation framework will be implemented for roads in critical habitat and ecologically sensitive areas. A separate FIRM/NGO working in BAP area shall be engaged by the KRRDA during the construction and operation stages of the Project. The NGO/FIRM will support in implementation of BAP. Further the supervision, monitoring, reporting, adaptive management and verification of no-net-loss and,

where applicable, net-gain commitments shall be done by Biodiversity, PISC and external motoring Agency under the Project.

The environmental monitoring plan includes monitoring of ambient air quality, noise, surface water, groundwater and soil quality during pre-construction, construction and operation stages, together with compliance monitoring for borrow areas, quarries, camps, plants, tree felling, waste disposal, traffic management, work-zone safety, biodiversity protection, grievance handling and corrective actions.

Environmental safeguard requirements will be incorporated into bidding documents and civil works contracts. Non-compliances will be recorded with corrective actions, responsibilities and timelines. KRRDA, PIUs and consultants will undertake regular inspections, monthly and quarterly reporting, semi-annual safeguard monitoring reporting to ADB, and disclosure of monitoring reports in accordance with ADB requirements.

Independent or external monitoring will be undertaken to verify implementation of the EMP, BAP, environmental monitoring plan and statutory clearance conditions. External monitoring will also review corrective actions, plantation survival, biodiversity actions, contractor compliance and safeguard reporting quality.

The estimated EMP implementation budget is ₹326 million, and the Biodiversity Action Plan budget is ₹370 million, a combined ₹696 million or approximately ₹0.13 million per km, in addition to costs embedded in civil works contracts. Both amounts are provided for in the project cost estimate and the financing plan. Costs for mitigation, monitoring, training, reporting, statutory compliance, corrective actions and biodiversity management will be treated as enforceable project and contractual obligations. The budget for Biodiversity Action Plan is ₹370 million.

F. Public Consultation, Disclosure

KRRDA, DPR consultants, ADB TA team and the ADB project team conducted consultations across the project area. DPR-level consultations covered all 1,335 project roads either directly or through representative consultations at 391 locations between December 2025 and June 2026, with 9,435 participants including 3,048 women. Additional consultations were undertaken by the ADB TA team in 16 districts. A second round of consultations was held to disclose the findings of the draft EIA, including the biodiversity assessment and the proposed mitigation, at Udupi and Uttara Kannada districts between 6th to 11th July 2026 with 232 participants. A consultation-to-response matrix recording the issues raised and how each has been addressed in the design, the EMP and the BAP is at Appendix 23.

Participants expressed broad support for the Project due to expected improvements in connectivity, access to education, healthcare, markets, public services and livelihood opportunities. Key concerns raised during consultations are summarized below.

- Need for timely information disclosure, continued consultation and a transparent grievance redress mechanism.
- Protection of private land, field boundaries, utilities, water supply lines, community assets and cultural properties.
- Maintenance of access to houses, farms, schools, health centres, shops, livestock routes and agricultural transport during construction.

- Need for adequate side drains, cross-drainage, waterlogging prevention and protection of local water bodies.
- Control of construction dust, noise, waste disposal, traffic disruption, road safety risks, livestock crossings and biodiversity/wildlife-related risks near forest and sensitive areas.

The draft EIA, including this executive summary, will be disclosed on the ADB website at least 120 days before consideration of the Project by the ADB Board of Directors, as required for Category A projects under ADB SPS 2009, and simultaneously on the KRRDA web portal. The executive summary will be made available in English and Kannada through Gram Panchayat offices. The updated EIA, final CHA and updated BAP will be re-disclosed on the same basis on completion of the four-season surveys. In-person consultations will continue during pre-construction and construction stages, including for communities with limited access to electronic documents.

A project-specific GRM will be established to complement existing government systems and will operate throughout design, construction and operation. The GRM will be accessible at no cost, gender responsive, culturally appropriate and available without retribution. It will include three tiers: a site-level GRC, a PIU-level GRC and a PMU-level GRC, with resolution timelines of 7, 10 and 15 days respectively and defined escalation procedures. The GRM does not impede access to the country's judicial or administrative remedies, and affected people will be informed of ADB's Accountability Mechanism at disclosure and through the site-level information boards

The PMU, PIUs and PISC shall monitor contractor compliance through regular site inspections, environmental monitoring, review meetings, monthly progress reports and semi-annual environmental monitoring reports submitted to ADB within 30 days of the close of each reporting period for review and disclosure on the ADB website. Non-compliances shall be recorded in a non-compliance register with corrective actions, responsibilities and timelines, and tracked to closure in each SEMR. KRRDA shall have the right to withhold payment, stop work or apply other contractual remedies if contractors fail to comply with the EMP, site-specific EMP, clearance conditions, labour requirements or health and safety obligations.

G. Conclusion

The Project is expected to generate significant long-term benefits by improving all-weather rural connectivity, access to schools, Anganwadi centres, health facilities, markets, administrative services and livelihood opportunities across Karnataka. It will improve road safety, reduce travel time and vehicle operating costs, enhance serviceability during monsoon periods and support inclusive rural development.

The Project has been classified as Category A for environment under ADB SPS 2009, and the EIA/EMP covers all 1,335 roads. The assessment applies the mitigation hierarchy and identifies measures to avoid, minimize, mitigate, restore or compensate potential adverse impacts during pre-construction, construction and operation stages.

Key environmental and biodiversity risks relate to roads in forests, protected areas, eco-sensitive zones, CRZ areas, ASI-regulated zones, Western Ghats landscapes and critical habitat EAAAs. These risks will be addressed/managed through statutory clearances, updated CHA/EIA/BAP requirements, road-specific mitigation, contractor site-specific EMPs, biodiversity monitoring, and restriction of works in sensitive stretches until required approvals and updated safeguards are completed.

The EMP, BAP, monitoring plan, GRM, institutional arrangements and external monitoring provisions provide a structured framework for safeguard implementation. Environmental and biodiversity obligations will be integrated into bidding documents and contracts, with clear responsibilities for KRRDA, PMU, PIUs, PISC/PMC, contractors, Forest Department and external monitors.

Subject to effective implementation of the EMP, BAP, statutory clearance conditions, GRM, environmental monitoring programme and institutional arrangements, the Project is expected to deliver substantial rural connectivity and road safety benefits while managing environmental, social and biodiversity risks in accordance with ADB SPS 2009, applicable Indian laws and good international practice.

I. INTRODUCTION

A. Project Background

1. Karnataka has an extensive rural road network spanning over 200,000 kilometres (km), yet the overall condition and quality remain unsatisfactory. More than 58% of rural roads are still earthen or gravel, resulting in poor riding quality and frequent service disruptions during the monsoon season. Many roads lack proper drainage, slope protection, or climate-resilient features, making them highly vulnerable to damage from floods, waterlogging, and heavy vehicular use. As a result, all-weather connectivity is not assured in many villages, limiting reliable access to markets, administrative centres, health facilities, and schools. Insufficient maintenance funding has further exacerbated rapid deterioration. These deficiencies not only increase travel times and vehicle operating costs but also constrain rural economic activity and livelihood opportunities, highlighting the urgent need for investment in durable, climate-resilient rural transport infrastructure.

2. Rural connectivity projects are aligned with the Government of Karnataka (GoK)'s long-term vision to promote balanced regional development and reduce regional disparities, as articulated in the Vision 2030: Strategies and Action Plan for Karnataka and the mandate of the Kalyana Karnataka Regional Development Board. At the national level, the project complements the Pradhan Mantri Gram Sadak Yojana (PMGSY) and related rural infrastructure initiatives that prioritize all-weather rural connectivity as a foundation for poverty reduction and rural economic growth. The project is also consistent with India's climate policy framework, particularly its emphasis on climate-resilient infrastructure development. India's National Action Plan on Climate Change highlights the need for adaptation measures across vulnerable sectors. The project contributes to these objectives by integrating climate-resilient design features into rural road improvements.

3. A \$538.58 million loan¹ is proposed for Karnataka's road sector to construct and improve 5,178 km of rural roads. The selected rural roads are part of Karnataka's District Rural Road Plan (DRRP) and were assessed and prioritized using a multi-criteria analysis developed through PMGSYII. The project design focuses on building an all-weather, climate-resilient, and sustainable rural road network through (i) climate-resilient engineering designs (adequate drainage, raised road embankments in flood-prone areas, resilient pavement materials, slope protection in hilly terrain); (ii) strengthened institutional capacity for better planning, asset management, and maintenance of rural roads; and (iii) integration of innovative practices such as nature-based solutions, geotextiles and soil stabilization techniques tailored to local conditions. These interventions will ensure the roads remain serviceable year-round, even under extreme weather conditions, thereby protecting investments and connectivity benefits over the long term. The project integrates targeted climate adaptation measures to strengthen Karnataka's transport resilience and supports India's commitments under its Nationally Determined Contributions by enhancing climate-resilient infrastructure in vulnerable rural areas.

4. The project will upgrade about 5,178 km rural roads in all 31 districts of Karnataka to all-weather standards. The rural roads will improve connectivity between habitations, post-harvest centres, medical facilities, educational institutions, and administrative centres. This will improve access to essential services, enhance employment opportunities, and help reduce poverty,

¹ Out of a total cost of USD 538.58 million – the ADB share is 336.49 USD (62.5%); and State share is USD 202.09 (37.5%) under the Project

particularly in rural areas where over 55% of the state's population resides.² The project will strengthen connectivity for rural habitations, enhance infrastructure resilience, and promote inclusive development, as highlighted in the state's long-term strategic plans and action frameworks.³

5. There are two outputs under the project:

- (i) **Output 1: Existing rural roads upgraded with climate-resilient and safety features, and provisions for quality and maintenance.** The project will upgrade approximately 5,178 km of rural roads connecting post-harvest centers, health care centers, and educational institutions to all weather standards, with climate-resilient and safety features⁴. The selected rural roads are part of Karnataka's District Rural Road Plan (DRRP) and were assessed and prioritized using a multi-criteria analysis developed through PMGSY.⁵ The project will incorporate climate resilience measures such as improved cross and side drainage, increased surface elevations, and stronger embankments in the designs. Innovative practices such as nature-based solutions, use of waste plastic, geocells, sand soil stabilization techniques tailored to local conditions will also be incorporated; and
- (ii) **Output 2: Institutional capacity of KRRDA on planning, maintenance, and monitoring climate-resilience rural connectivity strengthened.** Capacity development will strengthen the Karnataka Rural Road Development Agency's planning and institutional systems by (i) updating and operationalizing the District Rural Road Plan (DRRP) and Comprehensive Rural Road Information System (CRRIS) with a GIS-based rural road database incorporating new roads, structures, and revised administrative boundaries; (ii) preparing and endorsing a state-level operations manual with climate-resilient, gender-responsive, and indigenous peoples inclusion measures; (iii) implementing road safety awareness campaigns covering 500 schools across all 31 project districts, in coordination with a ADB financed education project; ⁶ (iv) enhancing the knowledge and awareness of at least 250 KRRDA staff on road safety, social and environmental safeguards, gender mainstreaming in rural roads construction and maintenance, poverty and social inclusion, climate-resilient design and construction, climate-resilient road management and maintenance; ⁷ (v) preparing and adopting a gender- equality strategy and 5-year action plan for strengthening gender mainstreaming in rural roads construction and maintenance; and (vi) ensuring at least one woman member is represented in all decision-making committees during project preparation and implementation.

² <https://www.niti.gov.in/sites/default/files/2025-07/Summary-Report-Karnataka%20%281%29.pdf>

³ <https://planning.karnataka.gov.in/storage/pdf-files/SDG%20reports%202020/SDG-2030%20Final%20Corrected%20English-Dec2020.pdf>

⁴ Climate resilience measures such as improved cross and side drainage, increased surface elevations, and strengthening of embankments will be incorporated into the designs. Safety measures include cautionary and information signs, guard posts, and speed breakers.

⁵ The multi-criteria analysis includes population benefited, no. of facilities connected to (educational institutions, medical facilities, administrative centers) and pavement condition.

⁶ Under ADB's proposed Strengthening Karnataka Public Schools Program (P59125-001), 500 public schools across the state will be upgraded.

⁷ This would include road safety, social and environmental safeguards, gender mainstreaming in rural roads construction and maintenance, poverty and social inclusion, climate-resilient design and construction, and climate-resilient road management and maintenance.

6. The Karnataka Rural Road Development Agency (KRRDA) is the executing agency under the Karnataka Rural Road Improvement Project (KRRIP) (Project). The KRRDA functions under the Rural Development and Panchayat Raj Department, Government of Karnataka, and is headed by a Chief Operating Officer. For project implementation, KRRDA operates through a state-level Project Management Unit led by the Chief Operating Officer/Project Director and supported by the State Quality Coordinator and technical staff, while district-level implementation is undertaken through 29 Project Implementation Units (PIU).

7. The KRRDA is undertaking an improvement of existing rural roads across the Karnataka State and is seeking financial assistance from the Asian Development Bank (ADB) following ADB's environmental safeguard requirements under the ADB Safeguard Policy Statement (SPS), 2009 for the implementation of the improvement project (Project).

8. Based on the ADB SPS, the Project having 1335 roads has been categorised as Category A⁸ due to the presence of roads located in ecologically sensitive areas. The Project comprises 1,335 rural roads, of which 591 fall within Ecologically Appropriate Areas of Analysis (EAAAs) identified as critical habitat. Of these, 307 roads intersect forests, 14 roads traverse legally protected areas and 86 are in their eco-sensitive zones. The remaining 305 roads are located outside protected areas and eco-sensitive zones but fall within EAAAs identified as critical habitat. Considering the potential for significant environmental and biodiversity-related impacts across these road sections, the overall Project is considered as "Category A" for environmental safeguards. Accordingly, the draft Environmental Impact Assessment (EIA) report has been prepared to assess the potential environmental risks and impacts associated with the Category A roads proposed under the Project.

9. Since a subset of the roads fall within or in proximity to legally protected areas, forest lands, eco-sensitive zones, and internationally recognised areas of biodiversity, including the Western Ghats, a detailed baseline biodiversity assessment and critical habitat assessment (CHA) with primary surveys spanning four seasons – summer, monsoon, post-monsoon, and winter – of which, only summer season surveys have been completed at the time of this report. The biodiversity baseline and the CHA is thereby preliminary⁹ at this stage, and the EIA report will be updated by April 2027 after the results of the four-season survey and CHA are available under the Project. Updated EIA will include minor revisions to the Biodiversity Action Plan (BAP), based on the completed CHA. No civil works will proceed at road stretches passing through or falling in forest lands, legally protected areas, and critical habitats until the CHA is concluded and the updated EIA disclosed.

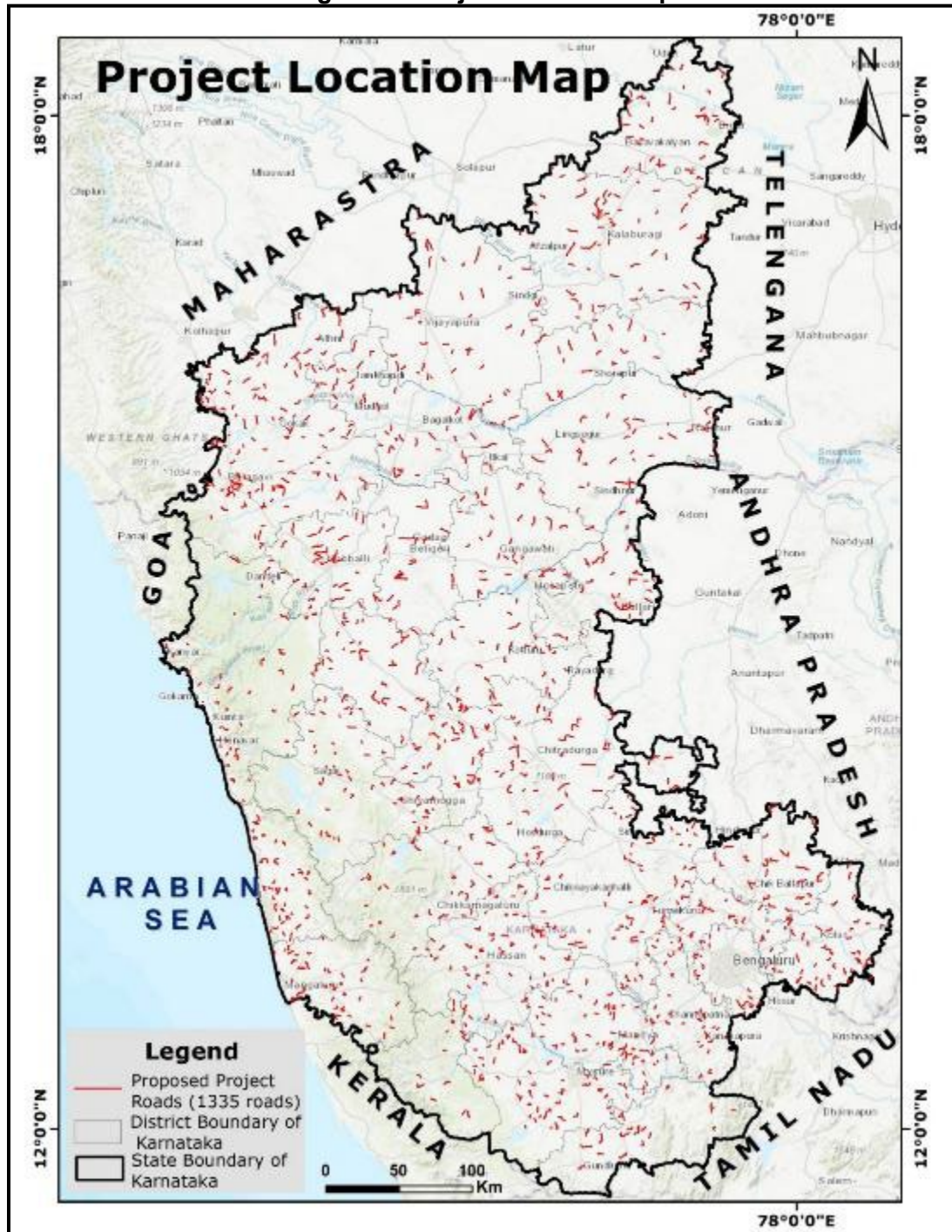
B. Project Overview

10. The state of Karnataka has a total geographical area of 191,791 square km accounting for 5.83% of the total geographical area of India. Karnataka is situated on the western edge of the Deccan Peninsula and is located approximately between 11.5° N and 18.5° N latitudes and between 74° E and 78.5° E longitudes. The state is bounded by Goa to the northwest, Maharashtra to the north, Telangana and Andhra Pradesh to the east, Tamil Nadu to the southeast and Kerala to the southwest. The western part is bordered by the Arabian Sea. Southern corner of the state is seated at an angle where the Western Ghats and the Eastern Ghats converge into the Nilgiri hills (Figure I-1).

⁸ Section V(B) of the ADB Safeguard Policy Statement, 2009: <https://www.adb.org/sites/default/files/institutional-document/32056/safeguard-policy-statement-june2009.pdf> (accessed on 25 May 2026)

11. The state extends to about 760 km from north to south and about 420 km from east to west.

Figure I-1 Project Location Map



12. The state of Karnataka comprises of parts of the Deccan Plateau, Western Ghats Mountain Range and the Coastal Plains. The state is divided into five physiographic landforms:

- (i) Northern Karnataka Plateau,
- (ii) Central Karnataka Plateau,
- (iii) Southern Karnataka Plateau,
- (iv) Coastal Karnataka and
- (v) Malnad Region.

13. The state is divided into 31 districts and 176 taluks, spanning 29,340 villages, and 347 cities and towns. According to the Census of India 2011, Karnataka had a population of 61,095,297 individuals, comprising 5.05% of the country's total population. The population of Karnataka constitutes 61.4% of rural and 38.6% of urban population.

C. Project Objectives

14. The objective of the Project is to upgrade 1335 rural roads (total length of 5,178 km) in all 31 districts of Karnataka to all-weather standards. The rural roads will improve connectivity between habitations, post-harvest centres, medical facilities, educational institutions, and administrative centres. This will improve access to essential services, enhance employment opportunities, and help reduce poverty, particularly in rural areas where over 55% of the state's population resides.

15. All design and construction activities will adhere to the Environmental Code of Practice (ECoP) and Indian Road Congress (IRC) standards. The construction works include upgrading of existing rural roads, within the available Right of Way (RoW) for each road.

D. Objective of the Environmental Impact Assessment Study

16. The Project has been classified as category 'A' for environmental safeguards in accordance with ADB's Safeguard Policy Statement (SPS), 2009 which necessitates the preparation of an Environmental Impact Assessment (EIA) study. The EIA identifies and evaluates the environmental issues to be considered at project planning, construction and operation stage. The EIA report covers the general environmental profile of the state and includes an overview of the potential environmental impacts and their magnitude on physical, ecological, economic, social and cultural resources within the project road's influence area. Based on environmental screening of all 1,335 rural roads proposed under the Project. The screening considered the ecological sensitivity of each road, including its location in relation to reserved forests, protected areas, eco-sensitive zones, critical habitat areas, and other ecologically sensitive or biodiversity-important locations. Based on this assessment, 269 roads have been categorised as Category A, as these roads are located within, adjacent to, or in close proximity to environmentally and ecologically sensitive areas, including forest areas, protected areas, eco-sensitive zones, and/or critical habitat areas, where project activities may result in potentially significant adverse environmental and biodiversity impacts if not properly assessed and managed. List of 269 roads is provided in Appendix 2B. The remaining 1,066 roads have been categorised as Category B, as these roads are not located within highly sensitive ecological settings and are expected to have site-specific, limited, and largely reversible environmental impacts that can be effectively addressed through standard mitigation measures, and road-specific Environmental Management Plans. Although the Project primarily involves improvement of existing rural roads within the available Right of Way, the presence of Category A roads within ecologically sensitive areas triggers the requirement for a comprehensive Environmental Impact Assessment, including biodiversity assessment, Critical Habitat Assessment, Biodiversity Action Plan, and detailed mitigation and monitoring measures in line with ADB SPS 2009. Therefore, considering the overall safeguard risk profile and the presence of 269 Category A roads, the Project is classified as Category A for environment.

17. An Environmental Management Plan (EMP) has been developed as part of this report which includes mitigation measures for significant environmental impacts during implementation of the Project, environmental monitoring program, and the institutional set-up covering the responsibilities for mitigation and monitoring during implementation and operation stages of the Project. The EIA has four basic major objectives- (i) assess the environmental baseline condition along 1335 roads; (ii) determine the magnitude of potential environmental concerns and to ensure that environmental considerations are given adequate weight at planning, design and operation stages; (iii) suggest mitigation, monitoring, and reporting and grievance redressal mechanism; and (iv) provision of environmental management plan (EMP) including the biodiversity action plan (BAP) and relevant cost on it under the Project.

18. **Categorization.** In accordance with the Asian Development Bank (ADB) Safeguard Policy Statement (SPS), 2009, the Project has been classified as Category A for environment due to the potential for significant adverse environmental and biodiversity impacts associated with a substantial number of project roads located within or adjacent to ecologically sensitive areas. Of the 1,335 rural roads proposed for improvement, 591 roads are situated within Ecologically Appropriate Areas of Analysis (EAAAs) identified as critical habitat. These include 307 roads passing through forests, 14 roads traversing legally protected areas, and 86 roads located within notified eco-sensitive zones, while the remaining 305 roads occur within critical habitats outside the legally protected areas. In addition, several road sections are located in or near internationally recognized biodiversity areas, including parts of the Western Ghats UNESCO World Heritage landscape. Given the potential risks to natural habitats, biodiversity values, and ecosystem functions, the Project is likely to generate biodiversity impacts that require detailed assessment and management. Accordingly, a comprehensive EIA supported by baseline biodiversity assessments and CHA has been undertaken to identify, evaluate, and mitigate potential environmental and biodiversity risks in compliance with ADB SPS (2009) requirements and implement a BAP to achieve biodiversity no-net loss followed by net gains in critical and/or natural habitats.

E. Scope of the Study

19. This draft EIA covers the existing alignment of the roads including the improvement of bridges and ancillary facilities such as camp, borrow areas, quarry, material storage, and construction plant operations under the Project.

20. The study has established a core zone of impact for the Right of Way (RoW) for each road as direct area of influence and 500 m aerial distance on either side of the road, as the indirect area of influence or buffer zone. The indirect influence area also includes location of Project utilities where project activities take place and from which direct impact on the surrounding environment is expected.

21. The EIA process involved the following activities:

- (i) Screening, and Scoping
- (ii) Baseline data collection of ambient air quality, ambient noise, water, biodiversity, soil, climate etc.
- (iii) Impact Identification and Assessment of life-cycle impacts, magnitude, duration, reversibility, and cumulative effects.
- (iv) Evaluate alternatives and propose avoidance/minimization options; determine significance.

- (v) Mitigation and design options of concrete mitigation measures; adjust design and construction sequencing to reduce impacts.
- (vi) Stakeholder engagement
- (vii) Develop and implement a consultation plan; document feedback and incorporate it; ensure accessible information.
- (viii) Legal, compliance, and risks
- (ix) Align with national laws and SPS 2009; identify transboundary issues if relevant; maintain risk registers.
- (x) Economic alignment and budget
- (xi) Public disclosure and grievance redressal mechanism
- (xii) Monitoring, reporting, and capacity development
- (xiii) Integrate measures into contracts; adapt as needed during construction.

F. Data Requirement and Study Methodology

22. The data collection for physical environment, biological environment, socioeconomic conditions and cultural heritage is based on the screening and scooping of the project roads. The data collection started with transect walk by the DPR consultants followed by primary data collection through representative sampling of ambient air quality, ambient noise level water quality and soil quality.

1. Physical Environment

23. Baseline data on topography, geology, soils, land use pattern, air and noise, temperature and rainfall, hydrological data, water resources, natural hazards were collected.

24. Primary data for ambient air quality and ambient noise levels were collected and analysed in line with guidelines issued by the Central Pollution Control Board (CPCB). Following parameters were analysed for ambient air- Particulate Matter PM₁₀, PM_{2.5}, nitrogen dioxide, sulphur dioxide (SO₂), ozone, carbon monoxide, ammonia, lead, benzene, benzopyrene, arsenic, nickel. Ambient noise quality data was collected as equivalent noise levels for day and night.

25. Ambient air quality and ambient noise levels were compared with the standards covered in schedule of the Environment (Protection) Rules, 1986 and the Noise Pollution (Regulation and Control) Rules, 2000, respectively and guidance value of Ambient Air Quality and Noise provided in General EHS Guidelines of World Bank.

26. Surface and ground water samples from different districts across Karnataka were collected and analysed for following parameters- pH, color, odour, turbidity, Total Dissolved Solids (TDS), total hardness, calcium, magnesium, alkalinity, chloride, sulphate, nitrate, fluoride, iron, manganese, copper, zinc, aluminium, arsenic, lead, cadmium, chromium, mercury, nickel, selenium, cyanide, faecal coliform, and E. Coli. (Escherichia coli). The results obtained were compared with national drinking water standards (Bureau of Indian Standards IS 10500:2012), and CPCB water quality criteria.¹⁰

27. Soil samples were collected and analysed for pH, electrical conductivity, potassium, calcium, magnesium, cation exchange capacity, moisture, Sodium Absorption Ratio (SAR), sand,

¹⁰ <https://tgpcb.cgg.gov.in/Uploads/PcbDocumentAllUploads/CPCBWaterQualityCriteria.pdf> (accessed on 26 May 2026)

silt and clay. The results have been compared with the standards stipulated in Environment Protection (Management of Contaminated Sites) Rules, 2025.

2. Biological Environment

28. Baseline information on habitat and forest types, legal status, flora and fauna, endemic species, their protection status per Wild Life (Protection) Act, 1972 and threat status per international conventions, critical habitats for threatened, range-restricted, migratory/congregatory species, areas supporting key evolutionary processes or unique or highly threatened ecosystems, or supporting key ecosystem services in Karnataka was collected through literature review and field surveys clubbed with first-person interviews, representatives of Karnataka Forest Department. Number of trees data within the RoW and trees necessary to be cut down for the Project was enumerated, based on the data collected during the transect walk.

3. Socio-economic Data

29. Baseline information on the socio-economic profile of the project area was collected through a review of literature and publicly available data sources. The information on demographic characteristics, district-wise households, workforce participation, occupational structure, economic profile, number and types of industries, infrastructure facilities, transport network including road and railway infrastructure, power sources and transmission network, agricultural development, mineral resources and development, tourism facilities, healthcare and educational infrastructure, and presence of indigenous peoples is collected.

4. Cultural Heritage

30. Data on cultural, archaeological and historical resources of Karnataka was collated by digitising the data available in public domain, public consultations and primary data collected during transect walk.

31. Karnataka has a highly diverse range of physical (tangible) and cultural (intangible) heritage resources, shaped by successive dynasties such as the Chalukyas, Hoysalas, Vijayanagara Empire, and Deccan Sultanates. Karnataka has four officially designated United Nations Educational, Scientific and Cultural Organization (UNESCO) World heritage sites, of which three are cultural heritage sites (i.e. group of monuments at Hampi, Group of monuments at Pattadakal, Sacred Ensembles of Hoysalas) and one is natural heritage site (i.e. Western Ghats).

32. According to the Archaeological Survey of India (ASI), the state has over 500 Monuments of National Importance, administered under different ASI circles (Bengaluru, Dharwad, and Hampi), along with 1,753 state-protected monuments notified by the Department of Archaeology, Museums and Heritage, Government of Karnataka. These have been assessed in detail in the subsequent sections.

G. Limitations of the Study

33. The draft EIA has been prepared based on the information available at the current stage of project preparation, including preliminary project details, environmental screening, secondary data review, stakeholder consultations, and selected primary baseline surveys. The environmental categorisation of the project roads has been undertaken based on screening of all

1,335 rural roads, considering their ecological sensitivity and proximity to forests, protected areas, eco-sensitive zones, critical habitat areas, and other biodiversity-sensitive locations.

34. The baseline biodiversity assessment and CHA are preliminary at this stage, as only the summer season biodiversity survey has been completed. The remaining seasonal biodiversity surveys, including monsoon, post-monsoon, and winter surveys, are yet to be completed. Therefore, the findings related to species presence, habitat use, seasonal movement, breeding behaviour, migratory/congregatory species, and critical habitat triggers may be further refined. However, efforts have been made to ensure that the BAP is robust enough to cover species whose status as critical habitat triggers has not been established yet. For example, although threatened and range-restricted amphibians endemic to Western Ghats have not been assessed as critical habitat triggers yet, the action items in the EMP and BAP will inherently ensure that the impacts to such taxa are minimized and assist in achieving no-net loss with sufficient time.

35. The current impact assessment is based on the existing road alignments and the assumption that improvement works will be carried out largely within the available Right of Way (RoW).

36. Any future changes in road design, alignment, construction methodology, widening requirements, drainage structures, bridge improvements, or site-specific interventions may require revision of the impact assessment and mitigation measures.

37. The assessment of ancillary facilities such as construction camps, borrow areas, quarries, material storage yards, batching plants, hot-mix plants, and access routes is indicative, as their final locations will be selected by the contractor during project implementation.

38. Site-specific impacts associated with contractor-selected ancillary facilities will need to be assessed separately before construction, and appropriate mitigation measures will be incorporated into the Contractor's Environmental Management Plan.

39. Some spatial information, including forest boundaries, eco-sensitive zone limits, protected area interfaces, land use details, and biodiversity-sensitive locations, may require further validation through joint verification with relevant government departments. The exercise is already underway at the Office of the Karnataka Forest Department, Aranya Bhavan (Bengaluru, Karnataka).

40. Tree enumeration and assessment of trees likely to be affected are based on data available at this stage and may need to be updated during detailed design and pre-construction verification.

41. The socio-economic and cultural heritage baseline is based on available secondary information, consultations, and field observations, and may require further verification during detailed design and implementation.

42. The EIA report will be updated after completion of the pending seasonal biodiversity surveys and final Critical Habitat Assessment, so that the final EIA, EMP, and BAP reflect the complete baseline and confirmed project-specific impacts.

H. Structure of the Report

43. This draft EIA Report has been prepared based on the requirements of the ADB SPS 2009. The report structured into ten chapters, including the introduction chapter as outlined below:

- **Executive Summary of the EIA Report:** Provide a concise overview of the key findings, impacts, and recommendations of the EIA study.
- **Chapter I-Introduction:** This chapter describes the background information about the Project and scope of the EIA Study, and brief approach and methodology followed for the Project.
- **Chapter II-Policy, legal and Administrative Frameworks:** This chapter summarizes the national and local legal and institutional frameworks that guided the environmental assessment process.
- **Chapter III- Project Description:** This chapter presents the key features and components of the proposed Project.
- **Chapter IV: Description of the Environment:** This chapter describes the relevant physical, biological and socio-economic features covering primary and secondary data, that may be affected by the proposed project.
- **Chapter V-Analysis of Alternatives:** This chapter evaluated various project alternatives considered to minimize the overall impacts of proposed analysis of impact and risk associated risk.
- **Chapter VI: Anticipated Environment Impacts and Mitigation Measures:** This chapter assess the positive and adverse environmental impacts and outlines corresponding mitigation strategies.
- **Chapter VII: Information Disclosure, Consultation and Participation:** Describes the stakeholder engagement process, including public consultations and how feedback was incorporated into the Project design, in compliance with ADB's disclosure policy and national regulations.
- **Chapter VIII – Grievance Redressal Mechanism:** This chapter describes the grievance redressal mechanism put in place for the Project.
- **Chapter IX- Environmental Management Plan:** This chapter describes the proposed EMP including bio-diversity action plan (BAP) for the Project including the institution arrangements for implementing the environment safeguard and BAP measures under the Project. This section discussing the lessons from the impact assessment and translated into action plans to avoid, reduce, mitigate and compensate adverse impacts and reinforce beneficial impacts.
- **Chapter X-Conclusion and Recommendation:** Summarizes the findings and provides recommendations, including whether further detailed environmental studies are required and highlights key findings and recommendations to be implemented by KRRDA.

II. POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

A. ADB Policy

44. ADB requires the consideration of environmental issues in all aspects of ADB's operations, and the requirements for environmental assessment are described in ADB Safeguards Policy Statement, 2009. This states that ADB requires environmental assessment of all project loans, program loans, sector loans, sector development program loans, loans involving financial intermediaries, and private sector loans.

45. Screening and categorization. The nature of the environmental assessment required for a project depends on the significance of its environmental impacts, which are related to the type and location of the project; the sensitivity, scale, nature, and magnitude of its potential impacts; and the availability of cost-effective mitigation measures. Projects are screened for their expected environmental impacts, and are assigned to one of the following four categories:

- (i) Category A. Projects could have significant adverse environmental impacts. An EIA is required to address significant impacts.
- (ii) Category B. Projects could have some adverse environmental impacts, but of lesser degree or significance than those in category A. An IEE is required to determine whether significant environmental impacts warranting an EIA are likely. If an EIA is not needed, the IEE is regarded as the final environmental assessment report.
- (iii) Category C. Projects are unlikely to have adverse environmental impacts. No EIA or IEE is required, although environmental implications are reviewed.
- (iv) Category FI. Projects involve a credit line through a financial intermediary or an equity investment in a financial intermediary. The financial intermediary must apply an environmental management system, unless all projects will result in insignificant impacts.

46. An environmental assessment using ADB's REA checklist for 1335 rural road (Appendix 1) confirms that the project is likely to cause significant and potentially irreversible impacts associated with construction and operational activities along roads situated within a connected ecosystem traversing reserve forests, protected areas, coastal regulation zone (CRZ) areas, and eco-sensitive zone (ESZ) areas. The improvement works will be confined to the existing carriageway, and limited diversion of forest land is anticipated under the project. All construction-related impacts will accordingly be limited to the existing right of way (ROW).

47. Applicable Acts and Policies relevant in the context of the project are discussed below. The Project Authority (KRRDA) will ensure that project activities implemented are consistent with the following regulatory/legal framework.

B. Legal Framework

48. The Government of India has laid out various policy guidelines, acts and regulations pertaining to environment. The Environment (Protection) Act, 1986 provides umbrella legislation for the protection of environment. As per this Act, the responsibility to administer, the legislation has been jointly entrusted to the Ministry of Environment, Forests and Climate Change (MoEF&CC) at national level, and to the State Pollution Control Board (SPCB), Karnataka at state-level.

1. Applicable National and State Regulations

49. The key environmental and other regulations relevant to Improvement and up gradation of roads under KRRIP in the State of Karnataka are presented in Table II-1 below.

Table II-1 Applicable Acts and Rules

S N	Applicable act and rules	Objective	Type of activity involved in project	Applicability (Yes/No)	Competent Authority	Responsible Agency for Obtaining clearance
1	Environment (Protection) Act, 1986	The Umbrella Act for protection and improvement of the environment and for issuing rules, standards and notifications on pollution control, waste management, hazardous substances, and other environmental matters.	Applicable to all construction and operation activities that may affect the environment; specific permission/consents are governed through the relevant rules and notifications issued under this Act.	Yes, but no additional clearance or permits or license is required under the stated Act.	MoEF&CC, SPCB, Central Pollution Control Board (CPCB)	PMU/PIU (KRRDA) for project-level compliance; Contractor for construction-stage permits and implementation, as applicable.
2	EIA Notification dated 14 September 2006 and amendments thereafter	To regulate projects and activities listed in the Schedule of the EIA Notification through prior environmental clearance, where applicable.	Rural road improvement/upgradation is not listed as a standalone activity in the Schedule to the EIA Notification, 2006. However, material sourcing such as quarries, crushers, borrow areas/ordinary earth and associated facilities shall comply with applicable EC/CTE/CTO and state requirements.	No prior EC is expected for the rural road works themselves; Yes/conditional for associated facilities and material sources, where triggered by applicable thresholds and notifications.	MoEF&CC, State-level Environmental Impact Assessment Authority (SEIAA), GOI	PMU/PIU (KRRDA) to ensure compliance is reflected in contracts; Contractor to obtain permits/approvals for associated facilities and material sources, as applicable.
3	The Air (Prevention and Control of Pollution) Act, 1981	To control air Pollution by controlling emission of air pollutants as per	CTE/CTO is required from KSPCB before establishment/operation of crushers, hot-mix plants, batching/RMC plants, DG sets and	Yes, subject to conditions of the State Pollution Control board.	State Pollution Control Board, Karnataka (KSPCB)	Contractor

S N	Applicable act and rules	Objective	Type of activity involved in project	Applicability (Yes/No)	Competent Authority	Responsible Agency for Obtaining clearance
		the prescribed standards.	other air-emitting associated facilities, as applicable.			
4	The Water (Prevention and Control of Pollution) Act, 1974	To control water Pollution by controlling discharge of pollutants as per the prescribed standards.	CTE/CTO is required from KSPCB before establishment/operation of crushers, hot-mix plants, batching/RMC plants, labour camps and other facilities generating wastewater/discharge. Works near water bodies shall include runoff, silt and spill-control measures.	Yes, subject to conditions of the State Pollution Control board.	KSPCB	Contractor
5	The Noise Pollution (Regulation and Control) Rules, 2000 & amendments.	The standards for noise for day and night have been promulgated by the MoEF&CC for various activities	Applicable to construction equipment, DG sets, crushers, hot-mix plants, batching plants, work zones and sensitive receptors. Noise limits and timing restrictions shall be followed, especially near schools, hospitals, settlements and other sensitive locations.	Yes, subject to conditions of the State Pollution Control board.	KSPCB	Contractor
6	Environment (Protection) Act, 1986 and Environment Protection (Management of Contaminated	To provide a regulatory framework for identification, assessment, remediation and management of contaminated sites to protect	Applicable only if contaminated soil, hazardous-substance contamination or a suspected contaminated site is identified within a project road, camp, plant, stockyard, borrow	Conditional. Include chance-identification/reporting and management requirements in the EMP/SEMP; statutory actions will be required only if a contaminated site is identified.	Central Pollution Control Board (CPCB); State Pollution Control Board (SPCB)	PMU/PIU (KRRDA) and Contractor, in coordination with KSPCB/CPCB and any notified responsible person/reference organisation, if triggered.

S N	Applicable act and rules	Objective	Type of activity involved in project	Applicability (Yes/No)	Competent Authority	Responsible Agency for Obtaining clearance
	Sites) Rules, 2025	human health and the environment.	area or disposal location. Not generally triggered for routine rural road improvement works.			
7	Coastal Regulation Zone (CRZ) Notification, 2019 (issued under the Environment (Protection) Act, 1986)	To regulate developmental activities in coastal stretches, conserve coastal ecosystems, and ensure environmentally sustainable development within notified CRZ areas.	Improvement/upgradation of proposed Project road (Road ID 1392) falling within a notified CRZ area in Dakshina Kannada district.	Yes, for any road or associated activity falling within notified CRZ areas, subject to KCZMA/MoEF&CC appraisal and conditions.	Karnataka Coastal Zone Management Authority (KCZMA) and Ministry of Environment, Forest and Climate Change (MoEF&CC), Government of India, as applicable under the CRZ Notification, 2019	PMU/PIU (KRRDA), with support from DPR/PISC consultants; Contractor to comply with clearance/NOC conditions during works.
8	Ancient Monuments and Archaeological Sites and Remains Act, 1958	Conservation of cultural and historical remains of India	Applicable where project corridors or associated activities fall within the prohibited/regulated area of protected monuments or where chance finds are encountered during excavation/construction.	Applicable for following Project Road- 4446	Archaeological Survey of India (ASI) / National Monuments Authority (NMA), Government of India; State Department of Archaeology, Museums and Heritage, where applicable.	PMU/PIU (KRRDA), with support from DPR/PISC consultants; Contractor to implement NOC conditions and chance-find procedure.
9	The Code on Wages, 2019 and applicable Central /	To ensure wage protection for all workers, including minimum wages,	Applicable during engagement of skilled, semi-skilled and unskilled workers for site clearance,	Yes. Applicable to workers engaged by contractors and sub-contractors, subject to provisions/rules	Labour Department, Government of Karnataka / Office of the Labour	Construction Contractor and Sub-contractor for wage registers, minimum wage compliance,

S N	Applicable act and rules	Objective	Type of activity involved in project	Applicability (Yes/No)	Competent Authority	Responsible Agency for Obtaining clearance
	Karnataka Rules	timely wage payment, equal remuneration, wage periods, overtime wages and lawful deductions.	earthwork, embankment construction, sub-base / base-course works, bituminous works, culvert and drain construction, material loading / unloading, road furniture installation, equipment operation and daily-wage labour deployment along rural road corridors.	notified and applicable in Karnataka; contracts should also require compliance with prevailing labour laws until full code implementation.	Commissioner; Inspector-cum-Facilitator or other notified authority under the Code and Rules.	overtime payments and wage disbursement records. PIU / Executing Agency and PISC to verify compliance through contract conditions, monthly reports and site inspections.
10	The Occupational Safety, Health and Working Conditions Code, 2020 and applicable Central / Karnataka Rules	To regulate occupational safety, health, welfare, working conditions, working hours, leave, accident reporting, welfare facilities, contract labour, inter-state migrant workers and worker accommodation.	Applicable to rural road construction risks such as excavation and embankment works, work near live traffic, operation of rollers / graders / pavers / excavators, hot bitumen handling, culvert works, working near drains / water bodies, material stacking, borrow-area haulage, temporary diversions, night work where permitted, labour camps, site offices and storage yards etc.	Yes. Applicable to construction sites, camps and associated facilities, subject to notified provisions/rules and applicable Karnataka requirements.	Labour Department, Government of Karnataka; Directorate of Factories, Boilers, Industrial Safety and Health where applicable; Inspector-cum-Facilitator / Designated Authority under the Code and Rules.	Construction Contractor for registration / licence requirements, OHS plan implementation, PPE, toolbox talks, welfare facilities, accident reporting, labour camp compliance, emergency response and statutory records. PIU / Employer and PISC to monitor through EHS internal audits and corrective action tracking.
11	The Code on Social Security, 2020 and applicable Central /	To provide social security coverage including EPF, ESIC, gratuity, maternity benefit, employee	Applicable where the contractor engages construction workers, drivers, equipment operators, helpers, camp support staff,	Yes. Applicable to the contractor workforce, subject to scheme-specific thresholds and notified provisions/rules;	EPFO; ESIC; Labour Department, Government of Karnataka; Karnataka	Construction Contractor and Sub-contractor for worker enrolment, social security contributions, compensation /

S N	Applicable act and rules	Objective	Type of activity involved in project	Applicability (Yes/No)	Competent Authority	Responsible Agency for Obtaining clearance
	Karnataka Rules	compensation, welfare provisions and worker-registration / contribution requirements, as applicable.	migrant workers and other labour for road works, drainage structures, culverts, haulage, camp operation and project support services. Also relevant for worker insurance, compensation for accidents and construction-worker welfare obligations.	contracts should require evidence of applicable registrations, contributions and insurance/compensation coverage.	Building and Other Construction Workers Welfare Board / other notified welfare authority, as applicable.	insurance compliance, maternity benefit obligations where applicable and statutory records. PIU / Executing Agency to include requirements in bidding documents and monitor through PISC.
1 2	The Industrial Relations Code, 2020 and applicable Central / Karnataka Rules	To regulate industrial relations, trade unions, dispute resolution, standing orders where applicable, strikes / lockouts, termination, retrenchment, lay-off and closure provisions, subject to thresholds and nature of establishment.	Applicable to workforce management during mobilisation, deployment, demobilisation, grievance handling, termination, retrenchment, contractor / sub-contractor labour relations, labour disputes, work stoppage risks and resolution of worker complaints arising during rural road construction.	Yes, for labour relations, worker grievance handling and dispute-management aspects, subject to applicable thresholds and notified provisions/rules.	Labour Commissioner / Conciliation Officer / Industrial Tribunal or other notified authorities under the Labour Department, Government of Karnataka.	Construction Contractor / Principal Employer for labour relations, employment documentation, worker grievance handling and dispute reporting. PIU / Executing Agency and PISC to ensure project-level GRM and contractor labour GRM remain functional and documented.
1 3	Public Liability Insurance Act, 1991	To provide public insurance liability for the purpose or providing immediate relief to the persons affected by	Applicable where hazardous substances such as diesel, bitumen, emulsions, lubricants, fuel oils or chemicals are stored, handled or transported	Conditional. Insurance/relief requirements apply where handling of notified hazardous substances triggers the Act; otherwise manage	MoEF&CC / District Collector and other authorities designated under the Act; insurer for policy	Contractor for insurance, spill prevention and emergency response where triggered; PMU/PIU/PISC to verify compliance

S N	Applicable act and rules	Objective	Type of activity involved in project	Applicability (Yes/No)	Competent Authority	Responsible Agency for Obtaining clearance
		accident occurring while handling any hazardous substances	in quantities/conditions covered under the Act and Rules.	through EMP/SEMP, spill prevention and emergency-response measures.	coverage; KSPCB may be involved for related consents/oversight.	through contract monitoring.
14	The Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 [formerly known as the Forest (Conservation) Act, 1980] and Van (Sanrakshan Evam Samvardhan) Rules, 2023, as amended	To regulate diversion/use of forest land for non-forest purposes and support conservation, protection and sustainable management of forests.	One project road (ID 4817) will require the acquisition of additional right-of-way (RoW) within forest land, involving the diversion of approximately 0.748 hectares of forest area. In addition, the required working permissions/ No Objection Certificates (NOCs) for 307 project roads located within or adjoining forest stretches, as listed in Appendix 2D, shall be obtained prior to the commencement of any civil works under the Project. Furthermore, all necessary approvals for tree felling, where applicable, shall be secured from the competent authorities before any tree-cutting activities are undertaken. The Project shall ensure full	Yes, wherever forest land diversion/use or work within forest stretches is involved. Works shall not commence in such stretches until applicable forest clearance/NOC/working permission are obtained and related conditions are fulfilled.	MoEF&CC / Regional Office; Government of Karnataka; Karnataka Forest Department / Nodal Officer (Forest Conservation), as applicable.	PMU/PIU (KRRDA), supported by DPR/PISC consultants; Contractor to comply with clearance/NOC conditions and forest-stretch work protocols.

S N	Applicable act and rules	Objective	Type of activity involved in project	Applicability (Yes/No)	Competent Authority	Responsible Agency for Obtaining clearance
			compliance with applicable forest clearance, permit, and tree-felling requirements prior to the start of construction works.			
1 5	The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006	To recognize and vest forest rights and occupation in forest land in favour of forest-dwelling Scheduled Tribes and other traditional forest dwellers whose rights were not recorded, and to provide a framework for recording such rights. The Act also recognises responsibilities for sustainable use, conservation of biodiversity and maintenance of ecological balance.	Applicable where the rural road improvement / construction requires use or diversion of forest land for non-forest purposes, including road construction, widening, curve improvement, drainage works, culverts, bridges, embankment works, construction access, or any activity within Reserved Forest, Protected Forest, deemed forest, community forest resource area, or other forest land. Section 3(2) of the Act specifically includes roads among facilities managed by the Government for which diversion of forest land may be permitted, subject to conditions.	Yes/conditional, where forest land diversion/use is involved or where individual/community forest rights may be affected. FRA screening/documentation and district-level certification/clearance requirements should be completed before forest diversion works.	Gram Sabha, Forest Rights Committee, Sub-Divisional Level Committee, District Level Committee, District Collector / District Magistrate of the concerned district, and the designated State / district authorities under FRA. The Gram Sabha initiates determination of individual / community forest rights and also recommends developmental projects involving diversion of forest land under Section 3(2)	PIU / KRRDA / Executing Agency, in coordination with the District Administration, Forest Department and Tribal Welfare / Social Welfare Department, as applicable. The civil works contractor should not commence works in forest stretches until applicable FRA compliance, forest clearance / NOC, and related conditions are completed. Internal project documents also identify the District Collector / District Magistrate as competent authority and PIU as the agency responsible for this Act.

S N	Applicable act and rules	Objective	Type of activity involved in project	Applicability (Yes/No)	Competent Authority	Responsible Agency for Obtaining clearance
16	Karnataka Preservation of Trees Act, 1976	To regulate felling, preservation and protection of trees in non-forest/private/local-authority areas in Karnataka.	A total of 80 trees within the RoW, which cannot be avoided has been proposed for felling	Yes, for felling of 80 trees.	Tree Officer, Karnataka Forest Department	PIU
17	Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation & Resettlement Act, 2013 (RFCTLARR Act, 2013) – Karnataka Amendment Act, 2019; Karnataka Land Acquisition Rules 2015 & 2020	Sets out rules for acquisition of private land by the Karnataka Government for public purpose and governs compensation, R&R, and acquisition procedures.	200 square meter land will be acquired through voluntary land donation. Any strip land required through voluntary land donation shall follow the project Voluntary Land Donation Guidelines, with documentation, verification and grievance provisions.	Not applicable for compulsory land acquisition, based on current project approach; conditional due diligence applies for voluntary land donation and any unanticipated land requirement.	Revenue Department, Government of Karnataka	PMU/PIU (KRRDA), Revenue Department/local administration where required; PISC/social safeguards team to verify documentation and compliance.
18	Wildlife (Protection) Act, 1972, as amended by the Wildlife (Protection) Amendment Act, 2022	To protect wildlife, provide for establishment of protected areas, describe the roles of forest officials, and provisions for	Applicable where project roads or associated activities fall within/near national parks, wildlife sanctuaries, conservation/community reserves, eco-sensitive zones, wildlife	Yes/conditional. wildlife clearance/NBWL recommendation, Chief Wildlife Warden permission, working permission or NOC may be required depending on final alignment, activity type,	Chief Wildlife Warden/Karnataka Forest Department; State Board for Wildlife; Standing Committee of NBWL/MoEF&CC, as applicable.	PMU/PIU (KRRDA), with support from biodiversity/environment specialists; contractor to implement clearance conditions, BAP/EMP controls and wildlife protocols.

S N	Applicable act and rules	Objective	Type of activity involved in project	Applicability (Yes/No)	Competent Authority	Responsible Agency for Obtaining clearance
		penalty to the offenders	corridors, or habitats of protected species. Wildlife-related permissions/NOCs and BAP/EMP measures will be required as applicable. Working permission/NoC will be required for 86 roads in ESZ and 14 roads in protected area provided in Appendix 2D where RoW is with KRRDA.	location and statutory requirement. KRRDA should confirm applicable roads with the Karnataka Forest Department.		
19	Solid Waste Management Rules, 2016	To manage segregation, collection, storage, transportation, processing and disposal of municipal/solid waste generated from construction camps, offices and work sites.	Applicable to domestic/municipal solid waste from labour camps, site offices, maintenance yards and work fronts; waste shall be segregated and disposed through authorized/local-approved systems.	Yes	KSPCB, CPCB	Contractor
20	Construction and Demolition Waste Management Rules, 2016	To manage collection, transportation, segregation, treatment, and disposal of waste arising of construction and demolition activities	Applicable to debris, excavated material, bituminous scarified material, dismantled culverts/drains and other C&D waste generated during road improvement works.	Yes	KSPCB, CPCB	Contractor, with PIU/PISC approval of reuse/disposal locations and records.
21	Hazardous and other	To manage, store, transport	Applicable for used oil, waste oil, oil-	Yes	KSPCB, CPCB	Contractor, through authorized

S N	Applicable act and rules	Objective	Type of activity involved in project	Applicability (Yes/No)	Competent Authority	Responsible Agency for Obtaining clearance
	Wastes (Management and Transboundary Movement) Rules, 2016	hazardous and other waste	contaminated rags/filters, bitumen drums, chemical containers and any other hazardous/other waste generated from plants, workshops, camps or work sites.			recyclers/disposal facilities; PIU/PISC to verify records/manifests.
2 2	Plastic Waste Management Rules, 2016	To regulate generation, segregation, collection, storage, transport, recycling and disposal of plastic waste, including single- use plastic restrictions and extended producer responsibility requirements, as applicable.	Applicable to plastic packaging, plastic sheets, bags, bottles and other plastic waste generated at construction camps, offices and work sites; plastic waste shall be segregated and handed over to authorized recyclers/vendors/local body systems.	Yes	KSPCB, CPCB	Contractor
2 3	Central Motor Vehicles Act, 1988; Central Motor Vehicles Rules, 1989; and Motor Vehicles (Amendment) Act, 2019, as amended	To regulate registration, fitness, emission compliance, safety and operation of vehicles and construction equipment using public roads.	All vehicles and construction equipment used for road works shall have valid registration/fitness, insurance, permits and Pollution Under Control (PUC) certificates, as applicable.	Yes	Transport Department / Regional Transport Office (RTO), Government of Karnataka	Contractor

S N	Applicable act and rules	Objective	Type of activity involved in project	Applicability (Yes/No)	Competent Authority	Responsible Agency for Obtaining clearance
2 4	Mines and Minerals (Development and Regulation) Act, 1957; Karnataka Minor Mineral Concession Rules, 1994 and amendments; Karnataka Regulation of Stone Crushers Act, 2011	Regulation of extraction, quarrying, crushing, procurement and transportation of minor minerals and stone aggregates.	Borrow earth, soil, gravel, moorum, laterite, sand, aggregates and stone materials shall be sourced only from approved/licensed borrow areas, quarries and crushers. No new quarry/crusher shall be established without required approvals, consents and environmental clearance, where applicable.	Yes. Applicable for sourcing/procurement, transport and royalty/DMF compliance for minor minerals and stone aggregates; contractor shall maintain permits, challans, royalty receipts and source approvals.	Department of Mines and Geology, Government of Karnataka	Contractor
2 5	Guidelines to Regulate and Control Ground Water Extraction in India, 2020, as amended	To regulate groundwater extraction and prevent over-exploitation of groundwater resources.	Construction water should preferably be sourced from approved surface/public/local sources with prior consent. If groundwater extraction through borewell/tube well is proposed, prior NOC/permission shall be obtained from CGWA/State Ground Water Authority, as applicable.	No, if no direct groundwater extraction is undertaken. Conditional/Yes only if the contractor proposes groundwater abstraction during construction.	CGWA / State Ground Water Authority; Gram Panchayat/local authority for local water sources, as applicable.	Contractor, with PMU/PIU (KRRDA) support and PISC verification.

2. Other Applicable National Laws and Regulations

50. Other key laws, including amendments thereof, pertaining to environment, health and safety aspects that are applicable to proposed interventions include:

- Easement Act, 1882, as amended
- Wetland (Conservation and Management) Rules, 2017
- Public Liability Insurance Act, 1991, as amended
- The Public Liability Insurance Rules, 1991, as amended
- Plastic Waste Management Rules, 2016, as amended
- Batteries (Management and Handling) Rules, 2001, as amended
- Petroleum Rules, 2002, as amended
- Gas Cylinder Rules, 2004, as amended
- The Insecticides Act, 1968 and Insecticides Rules, 1971 and as amended.

51. Environmental issues during road construction stage generally involve equity, safety and public health issues. The following laws will also apply:

- Workmen's Compensation Act, 1923: The Act provides for compensation in case of injury by accident arising out of and during employment.
- Payment of Wages Act, 1936: It lays down as to by what date the wages are to be paid, when it will be paid and what deductions can be made from the wages of the workers.
- Child Labour (Prohibition and Regulation) Act, 1986: The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of child labour is prohibited in Building and Construction Industry.
- The Building and Other Construction Workers' (Regulation of Employment and Conditions of Service) Act, 1996: The Act regulates the employment and conditions of service of building and other construction workers and to provide for their safety, health and welfare measures and for other matters connected therewith or incidental thereto.
- Inter-state Migrant Workmen (Regulation of Employment and Condition of Service) Act, 1979: The Inter-State Migrant Workmen Act, 1979 was an Act of the Parliament of India enacted to regulate the condition of service of inter-state labourers in Indian labour law. The Act's purpose was to protect workers whose services are requisitioned outside their native states in India
- Employees Provident Funds and Miscellaneous Act, 1952: The Act provides the institution of provident funds pension fund and deposit-linked insurance fund for employees in factories and other establishments.
- Employees State Insurance Act, 1948: The Act provides certain benefits to employees in case of sickness, maternity and employment injury and to make provision for certain other matters in relation thereto
- The Bonded Labour System (Abolition) Act, 1976: The Act provides for the abolition of bonded labour system with a view to preventing the economic and physical exploitation of the weaker sections of the people and for matters connected therewith or incidental thereto.

3. Key Statutory Clearances/Permissions Requirements during Construction Stage

52. During the construction stage, some of the key statutory requirements that need to be obtained by the Contractor as part of mobilization (pre-construction) have been listed in Table II-2 below.

Table II-2 Key Statutory Clearances

SN	Clearance/ Consents Requirement	Statute under which clearance/permission is required	Statutory Authority	Responsible Agency for Obtaining clearance
Pre-construction-stage clearance/permission required				
1	Tree felling	Applicable 80 trees are identified for felling. The permission for the felling will be obtained before construction.	Karnataka Preservation of Trees Act, 1976 and Forest (Conservation) Act 1980 Karnataka Forest Department	PMU/ PIU, KRRDA
2	Forest Clearance	Applicable 0.748 ha of forest land diversion in Project Road ID 4817. In other areas in forest land where additional forest land is not required, a working permission/NOC from the Karnataka Forest Department should be taken.	Forest (Conservation) Act, 1980 Karnataka Forest Department	PMU/ PIU KRRDA
3	Wildlife Clearance	Not applicable However, in legally protected areas, working permission or NOC from the Karnataka Forest Department should be taken. No civil work should proceed until this requirement has been fulfilled.	Wildlife (Protection) Act, 1972 National Board for Wildlife MOEF&CC Karnataka Forest Department	PMU/ PIU KRRDA
Construction-stage clearance/permission required				
3	Borrow area for sand and earth	Environment clearance is not required	DEIAA/SEIAA	Contractor with support of KRRDA
4	Stone quarry	EIA Notification, 2006, Mines and Minerals (Development and Regulation) Amendment Act, 2015	DEIAA/SEIAA and Department of Mines	Contractor
5	Hot-mix plant, crusher and batch mix plant	Air (Prevention and Control of Pollution) Act, 1981	Karnataka Pollution Control Board	Contractor

SN	Clearance/ Consents Requirement	Statute under which clearance/permission is required	Statutory Authority	Responsible Agency for Obtaining clearance
6	Storage, handling and transport of hazardous wastes	Hazardous and Other Waste (Management and Transboundary Movement) Rules, 2016	Karnataka Pollution Control Board	Contractor
7	Storage and handling fuel/oil (such as diesel)	Manufacture, Storage and Import of Hazardous Chemicals (Amendment) Rules, 2000	Chief Controller of Explosives	Contractor
8	Location, emissions, sewage/wastewater discharge from plants, labour camps and construction camp sites	Water (Prevention and Control of Pollution) Act, 1974 + Air (Prevention and Control of Pollution) Act, 1981	Karnataka Pollution Control Board	Contractor
9	Permission for withdrawal of groundwater for construction (may not be required as contractor will procure water from government approved water vendor)	Guidelines to Regulate and Control Ground Water Extraction in India, 2019	Central Ground Water Board	Contractor
10	Disposal of bituminous wastes	Construction and Demolition (C&D) Waste Management Rules, 2016	Local civic body	Contractor
11	Traffic Management and Regulation during construction and maintenance	National Road Safety Policy and Guidelines of Indian Roads Congress	Traffic Police Department and District Administration.	Contractor with support of KRRDA
12	Construction over waterways/canals	Guidelines to Regulate and Control Road Construction over Waterways, as applicable at the State Level	Irrigation Department and Inland Waterways Association	Contractor with support of KRRDA

4. Indian Road Congress (IRC) Code of Practices applicable for the Project

53. Key Indian Road Congress (IRC) Code of Practices applicable for the project road with respect to environment are given below in Table II-3:

Table II-3 Key Indian Road Congress (IRC) Code of Practices

SN	IRC Code Theme	Year	Purpose
1	Recommendations for Road Construction in Areas Affected by Water Logging, Flooding and/or Salts Infestation	IRC:34-2011	Construction in waterlogged areas
2	Recommended Practice for Construction of Earth Embankments and Sub-Grade for Road Works (First Revision)	IRC:36-2010	Issues relating to borrow pits

SN	IRC Code Theme	Year	Purpose
3	Guidelines for Pedestrian facilities	IRC: 103 - 1988	Safety of pedestrians
4	Recommended Practice for Recycling of Bituminous Pavements	IRC:120-2015	For recycling of bituminous pavements
5	Guidelines for Use of Construction and Demolition Waste in Road Sector	IRC:121-2017	Use of construction and demolition waste in road sector
6	Guidelines on Landscaping and Tree Plantation	IRC: SP:21-2009	Landscaping and tree plantation along the road.
7	Guidelines for Road Drainage	IRC: SP: 42-1994	Drainage
8	Highway safety code	IRC: SP: 44-1994	Highway safety
9	Guidelines for Traffic Management in work zones	IRC: SP-55-2014	Worksite safety management
10	Guidelines for use of fly ash in Road Embankments	IRC: SP:58-2001	Use of fly ash in road embankments
11	Guidelines for Use of Geotextiles in Road Pavements and Associated Works	IRC: SP:59-2002	Use of geotextiles in road pavements and associated works
12	Guidelines for Soil and Granular Material Stabilization Using Cement Lime and Fly Ash	IRC: SP-89-2010	Soil and granular material stabilization using cement lime and fly ash
13	Guidelines on Requirements for Environmental Clearance for Road Projects	IRC: SP-93-2017	Requirements for Environmental Clearance for road projects
14	Guidelines for the use of Waste Plastic in Hot Bituminous Mixes (Dry Process) in Wearing Courses	IRC: SP-98-2013	Use of waste plastic in hot bituminous mixes (dry process) in wearing courses
15	Use of Cold Mix Technology in Construction and Maintenance of Roads Using Bitumen Emulsion	IRC: SP-100-2014	Use of cold mix technology in construction and maintenance of roads using bitumen emulsion
16	Interim Guidelines for Warm Mix Asphalt	IRC: SP-101-2014	Warm mix asphalt
17	Guidelines on Preparation and Implementation of Environment Management Plan	IRC: SP-108-2015	Preparation and implementation of Environment Management Plan

5. Environmental Standards and IS Codes

54. National environmental standards applicable to the project are given below.

- National Ambient Air Quality Standards, 2009
- Measurement of Air Pollution - IS: 5182-1977
- Ambient Noise Standards
- Measurement of Noise from Moving Road Vehicles - IS: 3028-1980
- Measurement of Noise from Stationary Road Vehicles - IS: 10399-1982
- Measurement of Noise Pollution from Machines - IS: 4758-1968
- Stack Emissions of CPCB for Hot Mix Plants
- Discharge Standards of CPCB for Disposal of Treated Sewage
- Drinking Water Quality Standards - IS:10500:2012
- CPCB Standards for Surface Water Use

55. For ambient air and ambient noise emissions, World Bank EHS General Guideline standards¹¹ are noted to be more stringent and will be applicable to the project. World Bank EHS general standards for ambient air and noise are used to compare baseline environmental data (Chapter 4) and impact assessment (Chapter 6) in this EIA report.

6. Environmental Code of Practice (ECoP)

56. **Key Environmental Management Provisions.** The ECOP prescribes a structured set of mitigation and management measures covering all major environmental aspects, including:

SN	Aspect	Description
1.	Environmental Screening and Design Integration	Environmental screening is conducted at the planning stage to identify sensitive receptors such as forests, water bodies, habitats, and cultural properties. Project alignment and design are optimized to avoid or minimize impacts, incorporating mitigation measures directly into Detailed Project Reports (DPRs).
2.	Soil Conservation and Erosion Control	Measures such as slope stabilization, bio-engineering techniques, controlled excavation, and appropriate drainage design are implemented to prevent soil erosion, slope failure, and land degradation, particularly in hilly and high rainfall areas.
3.	Water Resource Protection	Natural drainage patterns are maintained through adequate cross-drainage and longitudinal drainage provisions. Protection measures are applied to prevent sedimentation, contamination, and alteration of water bodies, while ensuring sustainable use of water resources during construction.
4.	Material Sourcing and Resource Management	Environmentally sound practices are adopted for identification, operation, and rehabilitation of borrow areas and quarries. Use of alternative materials, where feasible, is encouraged to minimize resource extraction and environmental footprint.
5.	Waste Management	Construction and domestic wastes are managed through segregation, reuse, recycling, and safe disposal at designated sites. Direct disposal into water bodies, agricultural land, and environmentally sensitive areas is strictly avoided.
6.	Pollution Prevention and Control	Emissions of dust, noise, and pollutants from construction activities are controlled through adherence to regulatory standards, proper equipment maintenance, and site-specific mitigation measures.
7.	Biodiversity and Natural Habitat Protection	Impacts on ecologically sensitive areas are minimized through avoidance, design modifications, and implementation of site-specific management measures, including additional safeguards where roads pass through or near natural habitats.
8.	Protection of Cultural Properties	Impacts on physical cultural resources are avoided through alignment planning; where unavoidable, appropriate mitigation measures such as relocation and protection are undertaken in consultation with stakeholders.
9.	Occupational Health, Safety, and Community Protection	Provisions are made to ensure safe working environments, including use of personal protective equipment, traffic management measures, and emergency preparedness. Community safety is addressed through awareness, signage, and controlled construction practices.

57. ECoP provisions are integrated into the Environment Management Plan (EMP) (Chapter 9) of this EIA as Embedded Mitigation Measures (EDM) and are detailed in Chapter 3 (Description

¹¹ World Bank EHS General Guidelines: <https://documents1.worldbank.org/curated/en/157871484635724258/pdf/112110-WP-Final-General-EHS-Guidelines.pdf> (accessed on 21 July 2026)

of the Project). EMP developed as part of this report will be built into the bid documents and contracts.

7. Institutional Arrangements and Monitoring Requirements

58. The ECOP framework defines clear institutional mechanisms for implementation, supervision, and compliance monitoring.

59. **Institutional Responsibilities.** Environmental management responsibilities are assigned across national, state, and district-level implementing agencies. Dedicated environmental personnel are designated to oversee compliance, coordinate with regulatory authorities, and ensure implementation of ECOP provisions.

60. **Integration into Project Implementation.** ECOP requirements are incorporated into DPRs, bid documents, and contractual conditions, ensuring that contractors are legally accountable for implementing environmental mitigation measures during construction.

61. **Capacity Building and Supervision.** Training programs are undertaken to enhance the capacity of implementing agencies, contractors, and field staff. Supervision consultants and technical teams are responsible for periodic review of environmental compliance.

62. **Environmental Monitoring.** Monitoring is conducted at all stages of the project, including planning, construction, and post-construction phases. Standardized checklists and indicators are used to track compliance with ECOP provisions and regulatory requirements.

63. **Environmental Audit and Reporting.** Periodic environmental audits are carried out to evaluate the effectiveness of mitigation measures and identify any gaps in implementation. Monitoring results are documented and reported to relevant authorities to support corrective actions and continuous improvement.

64. **Corrective Action Mechanism.** Any non-compliance identified during monitoring or audits is required to be addressed through timely corrective measures, ensuring adherence to environmental standards and safeguard commitments.

C. Asian Development Bank's Safeguard Policy Statement (SPS), 2009

65. The Asian Development Bank's Safeguard Policy Statement (SPS) 2009 requires that environmental considerations be incorporated into ADB's funded project to ensure that the project will have minimal environmental impacts and be environmentally sound. Occupational Health & Safety of the local population should also be addressed as well as the project workers as stated in SPS. A Grievance Redress Mechanism (GRM) to receive application and facilitate resolution of affected peoples' concerns, complaints, and grievances about the project's environmental performance is also established in this assessment report. Projects are classified using Rapid Environment Checklist into one of the following environmental categories:

- (i) Category A: A proposed project is classified as category 'A' if it is likely to have significant adverse environmental impacts that are irreversible, diverse or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An Environmental Impact Assessment (EIA) is required.

- (ii) Category B: A proposed project is classified as category 'B' if its potential adverse environmental impacts are less adverse than those of category A projects. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category 'A' projects. An Initial Environmental Examination (IEE) is required.
- (iii) Category C: A proposed project is classified as category 'C' if it is likely to have minimal or no adverse environmental impacts. No environmental assessment is required although environmental implications need to be reviewed.
- (iv) Category Fi: A proposed project is classified as category Fi if it involves investment of ADB funds to or through a financial intermediary (FI).

D. World Bank Group's Environment, Health, and Safety Guidelines

66. The World Bank Group's Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). EHS Guidelines are applied as required by their respective policies and standards. These industry sector EHS guidelines are designed to be used together with the General EHS Guidelines document, which guides users on common EHS issues potentially applicable to all industry sectors. The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them.

67. The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project based on the results of an environmental assessment in which site-specific variables, such as host country context, the assimilative capacity of the region. Defined as the exercise of professional skill, diligence, prudence, and foresight that would be reasonably expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances globally. The circumstances that skilled and experienced professionals may find when evaluating the range of pollution prevention and control techniques available to a project may include but are not limited to, varying levels of environmental degradation and environmental assimilative capacity as well as varying levels of financial and technical feasibility.

68. Applicability of specific technical recommendations should be based on the professional opinion of qualified and experienced persons. When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in these EHS Guidelines are appropriate, given specific project circumstances, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance level is protective of human health and the environment.

69. The World Bank Group EHS Guidelines for Roads and Infrastructure Projects, Water and Sanitation, and General EHS Guidelines contain information on cross-cutting environmental, health, and safety issues may be used.

70. In addition, the Bank Directive on Disadvantaged and Vulnerable Individuals/Groups (2016)¹² and the Labour Influx Guidance Note (2016)¹³ will also be consulted for addressing various project activities. Applicability of Environmental Clearance (EC), Forest Clearance (FC) and Wildlife Clearance (WC) will be assessed for the roads and bridges under Phase-I.

71. The Van (Sanrakshan evam Samvardhan) Adhiniyam, 1980 states that the use or diversion of forest land for non-forest purposes, such as construction or improvement of roads, requires Forest Clearance from the MoEF&CC. For roads falling within forest lands and requiring additional forest lands for improvement, Forest Clearance shall be required from Karnataka Forest Department, Government of Karnataka. All linear projects and other proposal related with diversion of forest land from 0 ha to 40 ha, are forwarded to regional office MoEF&CC for diversion (Online Submission & Monitoring of Environmental, Forest and Wildlife Clearance Guideline; User manual version 1.0 issued by MoEF&CC, 2015). However, improvements to PMGSY built in forest lands before 1980 are exempted from the process of obtaining Forest Clearance. Based on the available GIS data, 307 project roads pass through forest lands. During reconnaissance site visit, it was observed that sufficient RoW was available along all the project roads. However, widening (road ID 4817), curve treatment at hair bend section would require additional land for which further approval from competent authority shall be required. This should be assessed on a case-by-case basis. The estimated timeline for the obtaining of Forest Clearance/working permission/NOC is anticipated to be of 6 months from the date of application. Where the Project Road falls within forest lands but does not require diversion of additional forest lands, working permission may be required and where additional forest land less than 1 hectare is required, a Forest Clearance from the State Government should be taken. However, according to the information provided by KRRDA, one road will require additional forest land amounting to ~1.02 hectares. The use of forest land for non-forest purposes will require the Stage-II Forest Clearance and the deposition of the money towards the raising of compensatory afforestation over an equivalent area (1.02 ha) of non-forest land. Road-specific requirements are being evaluated on a case-to-case basis jointly with the Karnataka Forest Department.

72. A total of 14 roads proposed for improvement fall within legally protected areas. In addition to Forest Clearance/NOC from the competent authority for developing upon forest lands, Wildlife Clearance from the Standing Committee of the National Board for Wildlife is also required. Furthermore, Wildlife (Protection) Act, 1972 is separate regulation. A letter issued by the Wildlife Division of the MOEF&CC to the Principal Secretary (Forests) of all states and union territories (F. No. 6-62/2013 WL dated 22 December 2014) restricts the creation of new roads inside protected areas, widening of existing roads is regulated; however, resurfacing and strengthening of existing roads within protected areas may be undertaken without reference to the Standing Committee of the NBWL. During the discussions, KRRDA indicated that if roads fell within forest lands or legally protected areas and RoW was not available, or NOC from forest department or permits from the competent authority could not be obtained, sections of roads within forest lands or protected areas would be dropped from the project. As stated in the preceding paragraph, road-specific regulatory requirements are being evaluated jointly by the Karnataka Forest Department and KRRDA and are expected to be completed before the end of August 2026. No works on roads in legally protected areas will be undertaken unless the views of the stakeholders (protected area managers or sponsors) have been established. Improvement of roads in legally protected areas

¹² World Bank. 2016. Bank Directive: Addressing Risks and Impacts on Disadvantaged or Vulnerable Individuals or Groups. Washington, DC: World Bank. The Directive forms part of the World Bank Environmental and Social Framework approved in August 2016.

¹³ World Bank. 2016. Managing the Risks of Adverse Impacts on Communities from Temporary Project-Induced Labor Influx. Guidance Note, Environmental and Social Safeguards Advisory Team, Operations Policy and Country Services, Washington, DC, 1 December 2016.

will thereby be undertaken only after the requisite permissions or clearances from the competent authorities have been obtained. The requirement of a Wildlife Clearance has been ruled out at this stage.

III. DESCRIPTION OF THE PROJECT

73. The Project comprises 1,335 rural roads, of which 591 fall within Ecologically Appropriate Areas of Analysis (EAAAs) identified as critical habitat. Further, 307 roads intersect reserved forests, 14 roads traverse legally protected areas and 86 are in their eco-sensitive zones¹⁴. Considering the potential for significant environmental and biodiversity-related impacts across these road sections, the overall Project in accordance with the ADB Safeguard Policy Statement (SPS), 2009 is considered as “Category A” for environmental safeguards. Accordingly, an Environmental Impact Assessment (EIA) has been prepared to assess the potential environmental and biodiversity-related risks and impacts associated with the proposed project roads under the KRRIP.

74. This chapter presents the project description for the proposed project roads, including the nature and type of rural road improvement works, geographic location and distribution, scope of proposed rehabilitation/upgrading activities, design and construction characteristics, resource requirements, temporary facilities, implementation arrangements, and other key features relevant to environmental assessment and management.

Type of the Project

75. The proposed project is a transport sector rural road improvement programme, primarily involving rehabilitation and upgrading of existing rural roads (pavement strengthening and selective widening within the available right of way, shoulder formation, drainage improvement, slope/embankment protection and road safety furniture), with limited new construction only where required for connectivity such as replacement/rehabilitation of minor bridges and cross drainage structures.

76. Construction type for the Project includes linear civil works within the existing Right of Way (ROW), execute package wise and in a phased manner, comprising site preparation and limited clearing, earthwork (cut/fill and subgrade preparation), granular layers (granular sub-base/ wet mix macadam), bituminous or gravel surfacing as per the respective DPR, construction/rehabilitation of culverts and minor bridges, and installation of signage, markings and safety measures, using standard road construction equipment and temporary work areas/camps under the Project.

77. Operation type will remain that of a low volume rural road network. The Project does not introduce significant new operational facilities and will require routine operation and periodic maintenance (e.g., drainage upkeep, shoulder repairs, pothole patching and periodic resurfacing) during the defect liability period and maintenance for 5 years by respective contractors and thereafter by the responsible agency.

78. Resource requirement type will largely be temporary during construction, with materials such as soil/borrow, aggregates, sand, cement and bitumen sourced from approved suppliers/quarries/borrow areas; water required for compaction, dust suppression and concreting from permitted local sources; and energy mainly in the form of diesel for machinery and Diesel Generators (DG) at camps, with a limited workforce mobilised locally where feasible.

B. Project Categorization

¹⁴ KRRDA is in the process of identifying presence of forests, along the roads, under this improvement project. Final number of roads crossing the forests will be updated after the assessment.

79. Project categorization in line with the ADB SPS 2009, has been done using Rapid Environment Assessment (REA) checklist of ADB for roads and highways (Appendix 1) after survey, screening of environmental and biodiversity sensitivities and initial consultations, considering the Project scope to be limited to improvement and widening of the existing roads.

80. Based on environmental screening undertaken in accordance with ADB's Safeguard Policy Statement, 2009, all 1,335 project roads were reviewed for ecological sensitivity, including their location in relation to reserved forests, protected areas, eco-sensitive zones, critical habitat areas, and other biodiversity-sensitive receptors. The initial road-level screening identified roads with varying levels of environmental sensitivity; however, considering that 269 number of roads are located within, adjacent to, or in close proximity to ecologically sensitive areas, the Project as a whole of 1335 roads has been classified as Category A for environment. This project-level categorisation supersedes any earlier road-level Category A/B distinction used for screening purposes. Accordingly, the Environmental Impact Assessment and Environmental Management Plan cover the entire scope of the Project, comprising all 1,335 rural roads with a total length of approximately 5,178 km, rather than only a subset of environmentally sensitive roads.

81. The Project comprises 1,335 roads (Road details are provided in Appendix 2) with a total approximate length of 5,178 km in the state of Karnataka. Based on environmental and biodiversity sensitivity screening, 591 roads fall within EAAAs (Appendix 2C) identified during the CHA. 307 roads either partially or fully traverse forest, 14 roads traverse legally protected areas and 86 project roads falls within Eco-Sensitive Zones (ESZs).

82. Project roads are located within or in proximity to ecological sensitive areas, including UNESCO World Heritage Sites, Key Biodiversity Areas (KBA) including Important Bird and Biodiversity Areas (IBA), Alliance for Zero Extinction Sites, and legally protected areas including national parks, wildlife sanctuaries, tiger reserves, elephant reserves, other conservation and community reserves, as well as their eco-sensitive zones (ESZ). A few roads also pass through other forest lands including reserved, protected, social, or unclassified state forests. Most of the roads also fall within the Northwestern Ghats montane rainforest and Northwestern Ghats moist deciduous forest. The Western Ghats, a biodiversity hotspot and a UNESCO World Heritage Site, is a mountain chain parallel to the west coast of India characterized by exceptionally high levels of biodiversity and endemism and is recognized as one of the eight 'hottest hotspots'. At least 325 globally threatened (International Union for Conservation of Nature's Red Data List) species occur in the Western Ghats.

83. Implementation of projects within forest lands and involving additional forest land require Forest Clearance from the Ministry of Environment, Forest and Climate Change (MoEFCC), whereas those within legally protected areas require Wildlife Clearance from the Standing Committee of the National Board for Wildlife (NBWL) in addition to Forest Clearance. However, PMGSY roads inside forest lands constructed before 1980 are exempted from Forest Clearance, although there are restrictions on the improvement of roads in legally protected areas. Implementation of projects involving road widening/strengthening inside the ESZ is legally permitted, however, widening and/or strengthening of existing roads requires recommendation from the district-level Eco-sensitive Zone Monitoring Committee. At the time of drafting of this report, KRRDA was in discussion with the Karnataka Forest Department to determine the applicability of a working permission or No Objection Certification (NOC) for the roads located inside the forest lands, including legally protected areas. The exercise is likely to be concluded in August 2026 after every road, its available and proposed ROW, proposed improvements, requirement of additional land and other details have been evaluated jointly with the Karnataka Forest Department. In addition to legal requirements, road projects within or in proximity to

ecologically sensitive areas may have potentially detrimental impacts, if not managed systematically.

84. Owing to the siting of the roads within ecologically sensitive areas which harbour threatened and endemic or range-restricted floral and faunal species, a critical habitat assessment (CHA) for the Project has been commissioned and is ongoing. Initial data processing from baseline biodiversity surveys as well as consultations with stakeholders confirms the presence of the roads within critical habitats for threatened and range-restricted species; however, this will be commented upon after the CHA has been concluded (in May 2027). Aside from species, the Western Ghats also host some unique and threatened ecosystems such as the Myristica swamps.

85. In view of the location of several project roads within and/or in proximity to legally protected areas, ESZs, forest lands, KBAs/IBAs, Western Ghats ecosystems and EAAAs identified for critical habitat assessment, the Project has been classified as Category A for environment in accordance with ADB SPS, 2009. The classification is based on the environmental sensitivity of the project locations and the potential for significant, adverse and irreversible impacts if not properly assessed and managed. Accordingly, the EIA, EMP and associated biodiversity assessment processes cover the entire Project, including all 1,335 roads, with enhanced assessment and mitigation measures for roads located in ecologically sensitive and critical habitat areas.

C. Need of the Project

86. The Karnataka Rural Road Improvement Project (KRRIP) is required to address the existing deficits in the rural road network of Karnataka, where many links exhibit poor riding quality, inadequate width, missing road safety features, and insufficient/blocked drainage that leads to waterlogging, erosion, and periodic loss of access during the monsoon. These constraints increase travel time and vehicle operating costs, reduce safe access to markets, schools, health facilities and administrative centres, and limit rural economic opportunities and social inclusion.

87. In line with the ADB SPS, 2009, the Project is designed to deliver essential all-weather connectivity while integrating environmental considerations into planning and design—emphasising improvement of drainage and cross-drainage structures, slope/embankment protection, and climate/disaster resilience measures to reduce flood-related failures and service interruptions. The Project also responds to KRRIP expectations for safer and more efficient rural mobility by incorporating safety-by-design measures (signage, markings, speed management and related road safety engineering) and by strengthening linkages of village roads to Other District Roads (ODR), State Highways (SH) and National Highways (NH).

88. The Project is expected to deliver measurable socio-economic benefits by improving reliable year-round access from villages to key social and public services, including schools/colleges, primary health centres and hospitals, anganwadis¹⁵, markets, bus stops, and administrative offices. Improved road surface condition and better drainage will enhance serviceability during monsoon periods, reduce travel time and transport costs for people and goods, and improve the efficiency and safety of passenger and freight movement.

¹⁵ The Anganwadi system is a component of India's Integrated Child Development Services (ICDS) program, a government initiative, focused on improving the health and development of children, pregnant women, and nursing mothers. Key services include supplementary nutrition, pre-school education, health education, immunization, health check-ups, and referral services

89. For the rural economy, the upgraded roads will facilitate timely transport of agricultural inputs and outputs (crops, milk and other farm/forest produce) to local and regional markets, reduce post-harvest losses and vehicle operating costs, and strengthen supply chains for essential commodities. Overall, the improved connectivity and safety are expected to support inclusive rural development by enhancing access to employment opportunities and services, while the Project's safeguard approach under ADB SPS 2009 ensures that these benefits are achieved with appropriate mitigation of site-specific environmental risks through implementation of the Environment Management Plan (EMP).

D. Location of the Project

90. Karnataka has a total geographical area of 191,791 km² accounting for 5.83% of the total geographical area of India. It is situated on the western edge of the Deccan Peninsula and is located approximately between 11.5° N and 18.5° N latitudes and between 74° E and 78.5° E longitudes. The state is bounded by Goa to the northwest, Maharashtra to the north, Telangana and Andhra Pradesh to the east, Tamil Nadu to the southeast and Kerala to the southwest. The western part is flanked by the Arabian Sea. The southern corner of the state is seated at an angle where the Western Ghats and the Eastern Ghats converge into the Nilgiri hills (Figure I-1). The state extends to about 760 km from north to south and about 420 km from east to west.

Size and Magnitude of Operation

91. The size and magnitude of operation under KRRIP are substantial in overall programme terms but distributed across many small and geographically dispersed road sections. The Project comprises improvement of 1335 rural roads with an aggregate length of approximately 5178 km to be implemented package wise and in phases. The magnitude of construction will therefore involve simultaneous or sequential work fronts across districts, with typical activities limited to rehabilitation/upgrading within the available right of way, including earthwork for formation and shoulders, pavement strengthening and resurfacing, drainage and cross drainage improvements, and localized bridge/culvert rehabilitation or replacement. Construction will require standard road construction equipment, temporary camps/material storage areas, and short-term use of resources such as aggregates, bitumen, water and diesel, generating manageable construction phase emissions, noise, wastes and traffic/community safety risks. In line with ADB SPS (2009) requirements for Category A projects, the Project's environmental sensitivity is primarily linked to the siting of roads within and/or in proximity to ecologically sensitive areas, including LPAs, ESZs, forest lands, KBAs/IBAs, and Western Ghats ecosystems. Although the Project scope is limited to improvement and widening of existing rural roads, the potential environmental risks may be significant due to likely impacts on sensitive habitats and threatened, endemic, or range-restricted species. These risks are being assessed and addressed through the EIA and EMP implementation across all packages.

F. Selection criteria of roads

92. The proposed rural roads improvement Project are selected based on the following factors- habitat count along the roads, connectivity the road can provide to educational institutes, markets and other economic centres and medical support. Total of 1,335 roads were selected as the first round of consideration.

93. Selected roads were then screened based on the availability of Right of Way (RoW). Roads with sufficient available RoW for the improvement and widening works, where applicable,

are selected for the Project. Roads inside forest lands, legally protected areas, and other ecologically sensitive areas where sufficient ROW was not available and required additional land were not selected in this Project, except road ID 4817, where 1.02 hectares of forest land will be required. Also, roads located within forest lands¹⁶ having significant importance for connectivity have been retained and the roads not having significant importance for connectivity point of view has been avoided, to prevent any impacts during construction and operation on the ecology of the area. Hence total 1335 roads were selected for the improvement works under the Project.

G. Proposed Schedule for Implementation

94. The construction of the proposed rural road project shall be undertaken in a phased manner in accordance with the approved Detailed Project Report (DPR), contract conditions, and the construction methodology prescribed in IRC:SP:20-2002. Following approval of the DPR and award of contract, pre-construction activities such as land availability confirmation, utility shifting (if any), setting out of alignment, establishment of construction camp, and mobilisation of machinery and manpower shall be completed prior to commencement of physical works.

95. The main construction works shall include site preparation, earthwork, subgrade preparation, sub-base and base layers, pavement works (gravel/Water Bound Macadam (WBM)/bituminous surfacing as applicable), drainage structures, cross-drainage works, and road furniture. Construction activities shall be planned keeping in view the local climatic conditions, particularly the monsoon season in Karnataka, and critical works such as earthwork and pavement layers shall be scheduled during dry months to ensure quality and durability.

96. The overall construction period for the rural road is expected to be 12 to 18 months, depending on the length of the road, terrain, and availability of resources. Upon completion of construction, the road shall be opened to traffic after inspection and certification by the PIU - Engineer and competent authority, followed by the Defect Liability and Maintenance Period.

97. A summary construction schedule indicating major activities and timelines shall be included in the DPR to facilitate monitoring and timely completion of the Project. Project schedule is presented in Table III-1.

Table III-1 Project Schedule

Activities	Schedule
DPR Preparation	3 months
Tendering	3 months
Updating of EIA and Completion of CHA	Before start of the construction
Forest Clearance/Wildlife Clearance/ NoC	Before start of the construction
Construction Work	12 to 18 months

H. Proposed Roads for Improvement

98. KRRDA has considered 1,335 roads for improvement. The selection of roads under the Project development considered avoidance of sensitive ecologies and roads that are already under consideration. The Project consists of 1,335 roads with the total approximate length of 5178 km. Out of the these, 307 roads located within forest of which 14 roads either partially or fully traverses the protected areas and 86 roads fall within their Eco-Sensitive Zones (ESZs). In addition, roads are located outside protected areas or their ESZs but fall within Ecologically

¹⁶ Forest land: Reserved Forest/ Protected Forest/ Ecological Sensitive Zone/Wildlife Sanctuary etc.

Appropriate Areas of Analysis (EAAAs) designated as critical habitats. A comprehensive list of 1,335 roads is provided in Appendix 2.

99. This section describes the key characteristics of the proposed Project roads for improvement under the Project. The description covers proposed design parameters, right of way, design speed, pavement composition, drainage provisions, cross-drainage structures, road safety features, and other associated components. Proposed typical cross section of asphalt and cement concrete road is presented in Figure 3-III-1 and Figure 3-III-2 respectively.

Figure 3-III-1 Proposed typical cross section of asphalt road

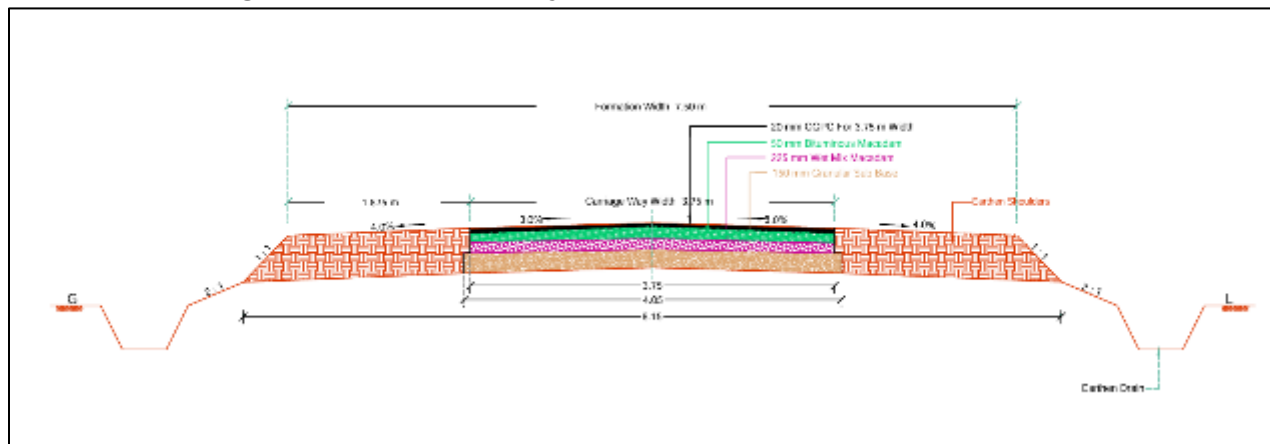
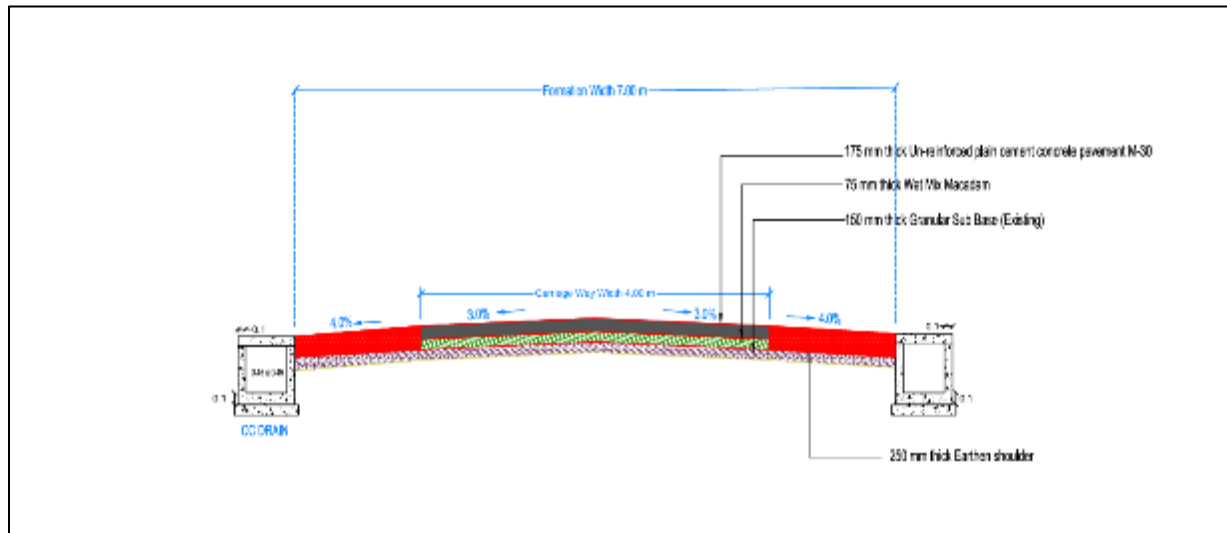


Figure 3-III-2 Proposed typical cross section of cement concrete road



1. Design of Road

100. The geometric design standards for this Project conforms to Pradhan Mantri Gram Sadak Yojana (PMGSY) guidelines and the guidelines as stated in IRC-SP20:2002. Recommended design standards vis-à-vis the standards followed for this road are described in Table 3-III below.

Table 3-III Cross Slope of Terrain Classification

Terrain classification	Cross slope	
Plain	0-10%	Less than 1 in 10

Terrain classification	Cross slope	
Rolling	10-25%	1 in 10 to 1 in 4
Mountainous	25-60%	1 in 4 to 1 in 1.67
Steep	Greater than 60%	More than 1 in 1.67

2. Design Speed

101. The proposed design speed based on the terrain has been selected based on following standards of IRC SP 20:2002 (Table III-2).

Table III-2 Speed classification as per the Terrain

Road classification	Plain terrain		Rolling terrain		Mountainous		Steep terrain	
	Ruling	Min.	Ruling	Min.	Ruling	Min.	Ruling	Min.
Rural Roads (Village Road)	50	40	40	35	25	20	25	20

3. Right of Way (RoW)

102. The Project roads are largely existing rural links, and, in most stretches, the improvement works are proposed within the available Right of Way (RoW). The available RoW, however, varies along the alignment—being generally wider in open/rural sections and constrained in built-up locations due to abutting properties, boundary walls, utility corridors and roadside structures. The RoW varies from 5 meters to 13 meters; the distribution of RoW is provided in Table III-3. Accordingly, the design has been prepared to utilise the existing RoW to the maximum extent practicable through options such as symmetric/asymmetric widening, shoulder optimisation and localized geometric improvements, with avoidance measures adopted as per ADB SPS (2009) to minimise land take and associated social impacts.

Table III-3 Distribution of road with respect to RoW

Right of Way in meters	Existing RoW		Proposed RoW	
	No. of Roads	Percentage distribution	No. of Roads	Percentage distribution
less than 5 meters	0	0%	0	0%
5-8 meters	348	26.07%	611	45.63%
Up to 10 meters	574	43%	339	25.32%
Up to 13 meters	413	30.94%	485	28.75%
Total	1335	100%	1335	100%

Source: KRRDA Spreadsheet of RoW data.

103. All the improvements of roads are limited to available rights of way except for one road (4817) which requires ~0.748 ha of forest land. The forest land will be diverted with due process of the forest clearance before start of the construction work in the particular stretch where forest land diversion is involved. Any additional private land is required, it will be taken on voluntary land donation process and in compliant with SPS 2009.

104. The requirement of ROW for these roads is as follows (as specified in IRC-SP 20:2002) (Table III-4):

Table III-4 Right of Way Requirements

Road classification	Plain and Rolling Terrain		Mountainous and Steep Terrain	
	Open Area	Built-up Area	Open Area	Built-up Area

	Normal	Range	Normal	Range	Normal	Range	Normal	Range
Rural roads (VR)	15	15-25	15	15-25	12	12	12	9

105. The right of way has been considered as per the land use whether it is open area or built-up area.

4. Road width

106. As per IRC:SP:20-2002 (Rural Roads Manual), proposed village roads are planned as single-lane rural roads and the adopted road width is selected to match the expected traffic, terrain and safety requirements, while also considering availability of right of way and physical constraints in built-up sections. The Manual provides guidance for adopting standard single-lane cross-sections for normal rural conditions, with enhanced widths where higher traffic volumes, frequent meeting of vehicles, or specific safety/operational needs justify it. In constrained locations and for very low traffic sections where traffic growth is unlikely (e.g., dead-end roads, low habitation or difficult terrain conditions), the Manual allows reduced carriageway provision subject to incorporation of appropriate passing places and other safety measures, so that accessibility is achieved without unnecessary widening and land take. Roadway width proposed carriage way is given below (Table III-5).

Table III-5 Road width and Carriageway

Carriageway	Road width in meters		
	Plain and Rolling	Mountainous and steep	
		Desired	Minimum
3.75 meter	7.5m	6.0m	4.8m
5.5 meter	9.0m	7.5m	7.0m

5. Cross-drainage Structures and Shoulder

107. As per the requirements of ECoP, a DPR has been prepared and cross-drainage structures, side drains have been provided where streams cross the road and area with flood prone and high rainfall. The existing drainages, natural water course roadside drains has been identified and accordingly cross drainage structures have been proposed in the DPR.

108. The type of cross drainage are box culverts, piped culverts, major and minor bridges. The quantity of cross drainage structures is provided in Table III-6 below.

Table III-6 Detail of Cross Drainage Structure

SN	Type of cross drainage structure	Number of structure proposed
1	Box Culverts	3494
2	Piped Culverts	7175
3	Minor Bridges	323

109. Cross drainage structures covered in the table above will be for improvement works on the existing structures. However, the above list also includes 51 new minor bridges construction, after demolishing the existing structures, due to condition of these bridges.

110. Borrower has defined bridges of less than 15 meters of length span as minor bridges.¹⁷

¹⁷ Consolidated classification of bridges, based on the length span is under process by KRRDA.

111. At culvert locations, the roadway width will be set at 7.5 meters in plain terrain and 9 meters in rolling terrain. The culverts will be constructed on-site. To ensure continuous water flow during the construction of structures at watercourses, a temporary diversion channel will be created. Once the construction is completed, the original watercourse will be restored to its initial state.

112. The proposed shoulder width will vary between 1.0 meters and 1.875 meters based on land availability. These shoulders will be constructed as earthen shoulders.

6. Bridges Construction

113. Bridge works proposed along the rural road alignment will be carried out in accordance with the PMGSY guidelines and the provisions of IRC:SP:20-2002. Wherever existing bridges or culverts are found to be structurally inadequate, hydraulically insufficient, or beyond economic repair, they will be dismantled and reconstructed as per approved designs.

114. All bridges will be designed to safely accommodate the design flood corresponding to a minimum return period of 1 in 30 years, considering local hydrological conditions, catchment characteristics, and drainage requirements as stipulated under PMGSY. The proposed structures will generally comprise single-lane RCC bridges, suitable for rural traffic conditions.

115. Construction of new bridges will commence with setting out, followed by excavation up to the required foundation level. The excavated surfaces will be properly dressed and compacted before laying Precast Concrete (PCC) as levelling course. Reinforcement steel conforming to relevant IRC and IS standards shall be placed in position as per approved drawings. Concreting of substructure and superstructure elements shall be carried out using controlled mix concrete, compacted with mechanical vibrators to achieve a dense, homogeneous, and void-free mass with the required surface finish.

116. Curing of all RCC components will be carried out adequately to ensure strength development and durability. The bridge deck, approaches, parapets, wearing coat, and drainage arrangements will be completed as per PMGSY specifications. All bridges will be integrated with the road approaches to ensure smooth riding quality and safe movement of rural traffic.

117. Details regarding the location, span arrangement, width, and structural configuration of the proposed bridges will be provided in the DPR drawings and schedules.

7. Culverts Construction

118. Culverts will be provided at locations as indicated in the approved drawings and DPR to ensure uninterrupted cross-drainage of natural streams, irrigation channels, and surface runoff, in accordance with IRC:SP:20-2002 and MoRD Specifications for Rural Roads.

119. Culverts will be constructed in-situ. All materials, workmanship, and dimensions will conform to the approved drawings and specifications.

120. During construction of culverts at watercourses, temporary diversion arrangements such as earthen bunds, bypass channels, or pipes will be provided to maintain uninterrupted flow of water. After completion of the culvert works, the original watercourse will be restored to its natural alignment and condition.

8. Box Culverts Construction

121. Reinforced Concrete Cement (RCC) box culverts will be constructed in-situ. The excavation will be carried out to the required lines, levels, and dimensions as per approved drawings. The foundation bed will be properly prepared, dressed, and compacted, followed by laying of a Plain Cement Concrete (PCC) levelling course of specified thickness.

122. Reinforcement for the base slab will be placed in position as per drawings, followed by concreting of the base slab. After the base slab has attained sufficient strength, reinforcement for side walls and top slab will be fixed. Side walls and top slab will be cast using proper formwork and staging, ensuring correct alignment, dimensions, and structural stability. Concrete will be placed, compacted using mechanical vibrators, and cured as per specifications. Formwork will be removed only after the concrete has achieved the specified strength.

9. Pipe Culverts Construction

123. For pipe culverts, trenches will be excavated to the required depth and width as per approved drawings using suitable mechanical or manual methods. The trench bottom will be prepared and a PCC bedding of specified thickness will be laid throughout the length of the culvert.

124. Precast concrete pipes of approved diameter and class will be laid on the prepared bedding from the downstream (outlet) end towards the upstream (inlet), ensuring correct line, level, and slope. Pipes will be joined using cement sand mortar (1:4) to obtain smooth and watertight joints. The inside surface of joints will be finished smooth to ensure uniform flow. Joints will be kept moist and cured for a minimum period as specified.

125. Head walls, wing walls, and aprons will be constructed in PCC or masonry as specified, up to the required levels.

10. Drainage Works

126. Drainage arrangements as per DPR will be provided along the rural road to ensure efficient disposal of surface water and to protect the pavement and embankment, in accordance with IRC:SP:20-2002 Rural Roads. The type, size, and location of drains will be as indicated in the approved drawings and DPR.

127. Lined drains are proposed in village limits, whereas earthen drains are proposed in open areas. The length of lined drains and unlined drains are provided in Table III-7 below.

Table III-7 Estimated Length of Drains

Item	Length (in km)*
Length of Road	5178
Length of Lined Drain	359.046
Length of Unlined Drain	7,268.774
Total length of Drain	7,627.820

Note: These figures are based on data received from the DPR consultants. As the available information contains certain data gaps, the figures are provisional and may be revised as additional or updated data become available.

128. After completion of site clearance, the alignment and levels of drains will be set out on the ground by the survey team. Excavation for side drains will be carried out to the required lines, levels, and slopes, where not already available, generally using mechanical means such as excavators or backhoe loaders. Dressing and trimming of the excavated surfaces will be carried out manually wherever required to obtain neat and uniform sections.

129. Where lined drains are proposed, suitable formwork will be provided for the required length and cross-section prior to concreting. Side formwork will be used for casting of side walls to ensure proper shape and finish. Reinforcement, where specified, will be placed as per drawings using approved thermo-mechanically treated (TMT) bars with proper cover blocks.

130. Concrete of specified grade will be placed in position, compacted properly, and finished to the required profile. All exposed concrete surfaces will be cured immediately after removal of formwork, and curing will be continued by sprinkling water for a minimum period of seven days or as specified.

131. Backfilling along the sides of drains will be carried out using approved soil free from organic matter, stones, and debris. Backfill will be placed in layers of 200 mm to 300 mm thickness and compacted properly using suitable compaction equipment.

132. In case of precast drain elements, joints will be properly aligned and filled with cement sand mortar (1:4) to ensure continuity and prevent leakage. Precast units will be laid on a prepared and compacted bed as specified.

133. The construction of drainage channels will follow a procedure similar to that adopted for culverts. After excavation and preparation of the bed, the drain lining or structure will be constructed as per design, ensuring adequate longitudinal slope for free flow of water. Upon completion, disturbed areas will be restored, and the drainage system will be made functional to ensure unobstructed flow.

I. Construction

134. Construction of roads will be undertaken in a phased manner and will commence following the tendering and award for the construction. Approximately 50% of the roads will be prioritised in the construction schedule.

1. Equipment

135. The key equipment used in the construction of rural roads involves:

- Excavator - Used for excavation of earth, trenches, foundations, and culverts.

- Backhoe Loader (JCB)- Multi-purpose machine for digging loading, trenching, and material handling.
- Jackhammer- To break up concrete and asphalt.
- Bulldozer - Used for site clearing, pushing soil, and rough levelling of land.
- Motor Grader - Used for levelling, shaping, and maintaining road subgrade and camber.
- Dump Truck / Tipper - Used for transporting soil, sand, aggregates, and debris.
- Wheel Loader - Used for loading aggregates, sand, and earth into trucks or hoppers.
- Road Roller / Compactor - Used for compaction of soil, gravel, WMM, and asphalt layers.
- Water Tanker - Used for dust suppression and moisture conditioning during compaction.
- Concrete Mixer (Drum / Mobile) - Used for mixing concrete for culverts, drains, and small structures.
- Asphalt Paver / Concrete Paver - Used for laying bituminous or concrete road surfaces (where applicable).
- Wet Mix Macadam (WMM) / Drum Mix Plant - Used for producing base layers for rural roads.
- Trenching Machine - Used for digging narrow trenches for pipelines, drainage, or cables.
- Crane / Hydra - Used for lifting pipes, precast slabs, and structural elements.
- Tar plant
- Bitumen sprayer
- Tractor cum truck- for movement of labour and material
- Vibrator (Needle / Plate) - Used for compaction of concrete in foundations and RCC works.
- Survey Instruments (Auto Level, Total Station) - Used for alignment, levelling, and setting out of roads and structures.

2. Site Preparation

136. Site preparation will consist of clearing and grubbing of the carriage way and associated areas within the approved Right of Way (RoW) to prepare the site for earthwork and pavement construction. After finalisation of the road alignment and centre line, the limits of clearing will be marked on the ground using lime powder and wooden pegs.

137. All bushes, shrubs, grass, weeds, small trees, and other obstructions within the formation width and additional working space will be removed. Roots and stumps of trees will be grubbed out to the required depth. Cutting of trees is not expected, however, wherever involved, will be carried out only after obtaining permission from the competent authority, as per applicable rules.

138. Depressions, pits, or cavities formed due to clearing and grubbing operations will be filled with suitable soil and compacted properly to achieve uniform ground levels before commencement of earthwork.

139. Topsoil will be stripped from areas where embankment or pavement construction is proposed, generally to a depth of about 150 mm. Stripping of topsoil will be carried out using appropriate machinery such as dozers or backhoe loaders. The stripped topsoil will be stacked

separately at designated locations within the RoW or other approved areas. Topsoil stacks will be formed in a manner that ensures stability and prevents erosion. The height of stockpiles will generally not exceed 2.0 m, with side slopes of about 1:1. Where topsoil is required to be stored for longer periods, suitable measures such as turving or other protective arrangements will be provided to prevent erosion and loss of fertility. Topsoil will be stacked separately and preserved for subsequent reuse. The stored topsoil will be spread back on exposed or disturbed areas, such as road embankment slopes and other construction-affected land, to support site restoration and vegetation growth.

140. Site clearance will be carried out in advance of earthwork operations, generally in a progressive manner along the road length, to ensure smooth and uninterrupted construction. Clearing will extend beyond the start and end of the Project stretch as required for proper construction operations.

141. Adequate measures will be taken during site preparation to prevent soil erosion and obstruction to natural drainage. Temporary drains and channels will be provided, wherever necessary, to ensure proper disposal of surface water and to keep the construction area free from waterlogging.

142. Scarification of the existing roads will be undertaken, where applicable, to remove the worn-out asphalt. Scarified material will be reused where applicable, while waste generated during the activity will be disposed through authorised vendor by the respective contractor.

3. Earthwork

143. **Source of Construction Material.** Construction materials required for the road improvement works will include aggregates, sand, bitumen, and soil for embankment construction.

144. Stone aggregates will be procured from licensed quarries in compliant with environmental regulations of the country, while locally available sand will be used where suitable. The quarry locations and distances to the project roads will be finalized in consultation with the Project Implementation Unit (PIU). Bitumen required for pavement works will be sourced through approved suppliers. Aggregates and sand will be used for bituminous works, concrete works, and other pavement layers. Aggregates will be procured only from quarries possessing valid environmental clearances, and extraction from unauthorized or environmentally sensitive areas will be avoided. Soil required for embankment and fill sections will be sourced from designated borrow areas.

145. Excavated material from roadway cutting, drainage excavation, and foundation works will be reused in embankment construction to the extent feasible. Additional material required for fill, including the top 30 cm subgrade layer, will be obtained from borrow pits where the available soil is suitable for road construction. Borrow pits will generally be excavated to a depth not exceeding 450 mm (including about 150 mm of topsoil). The stripped topsoil will be stored separately and spread back on the land after excavation to restore soil productivity. Borrow areas will be located away from road embankments as far as practicable and rehabilitated after extraction so that the land can be reused, including for agricultural purposes. The information on the locations of the borrow area and quarries is not available at the time of writing this report.

146. An estimated quantity of earth work is provided below (Table III-8).

Table III-8 Estimated quantity of earthwork

Item	Quantity in Cubic meter
Total length of 1335 number of roads	5136
Average earth work cubic meter per km	815
Total earth work cubic meter	41,85,048

4. Excavation

147. Excavation will commence only after proper setting out of the alignment and levels as per approved drawings. Excavation of soil and other materials will be carried out using suitable equipment such as hydraulic excavators, backhoe loaders, tippers, and other approved machinery. Rock excavation, if encountered, will be carried out as per IRC SP 20:2002, using mechanical means. No blasting is envisaged in this Project.

148. The formation width will be as per design and ground condition, generally 7.0 m minimum, with a camber of 3% on either side for earthen shoulders, unless otherwise specified in the DPR. The excavation limits will be marked at regular intervals, normally at 50 m intervals and at closer spacing of 20 m in curves, to ensure proper control of width and depth.

149. Excavation will be carried out to the lines, levels, and slopes shown in the approved drawings. The sides of excavated areas will be neatly trimmed and dressed. Where required, slopes will be protected by turfing, stone pitching, or other approved slope protection measures depending on site conditions.

150. Soils encountered will be classified based on visual inspection and laboratory testing as per IRC and IS standards. Suitable excavated material will be reused in embankment construction or filling in low-lying areas. Unsuitable materials such as black cotton soil, highly plastic clay, organic soil, or other deleterious materials will be removed to the depth specified in the design and disposed of at approved locations.

151. Necessary precautions will be taken to prevent soil erosion, water pollution, and siltation of nearby water bodies. Temporary drainage arrangements will be provided by trimming the sides of excavations and forming channels to allow free flow of natural drainage.

5. Borrow Pits

152. For construction of the rural road, earth and other materials required for embankment, subgrade, and shoulder construction will, as far as practicable, be obtained from approved sources such as government quarries or authorised suppliers. Where adequate material is not available from such sources, borrow pits may be opened with the prior approval of site Engineer of PIU and in accordance with PMGSY guidelines and IRC:SP:20-2002.

153. The borrow areas will be restricted to within 200 m as specified in the bid documents to avoid and minimize requirement of regulatory permission/clearance for the designated wildlife sanctuaries, national parks, reserved forest and Eco sensitive zones of the of the Wildlife sanctuaries and National parks keeping the vital connectivity to the hospitals, school and administrative offices. Borrow material should not be collected from ecologically sensitive locations, forest areas, socially important sites including areas near cultural heritage properties under the project. and away from habitations, water bodies, agricultural fields, and environmentally sensitive areas. The exact location, size, and depth of borrow pits will be finalised

during detailed design and prior to commencement of earthwork, based on material requirements and site conditions.

154. The identification and selection of borrow pit locations will consider environmental and social baseline conditions and potential environmental and social impacts associated with borrow areas are assessed in Impact Assessment Chapter of this report.

155. Material excavated from borrow pits will be tested to ensure suitability as per IRC SP 20:2002. Unsuitable material will not be used in embankment or subgrade construction.

156. The operation of borrow pits will be carried out in a controlled manner to minimise environmental impacts. Proper drainage arrangements will be provided to prevent water stagnation. Excavation will be limited to approved depths and side slopes will be formed to ensure stability.

157. After completion of material extraction, borrow pits will be rehabilitated by dressing the slopes, providing proper drainage, and restoring the area by spreading topsoil and turfing, or by converting the pits into water storage areas, where feasible and acceptable to local authorities.

158. All borrow pit activities will comply with applicable local regulations and PMGSY environmental management requirements.

159. A borrow pit assessment framework is provided in Table III-9 below and borrow pit management plan is provided in Appendix 13 of this report.

Table III-9 Borrow Pit Assessment Framework

Borrow Pit Phase	Activities	Measures
Site definition	Baseline data collection Site boundaries Material quality testing	- Baseline data collection will be undertaken for the proposed borrow pit areas. This will include, as a minimum: biodiversity surveys, ambient air quality, noise baseline and current landownership and land use. Baseline data will include any areas required for new access roads for the borrow pits. - Boundaries for the proposed borrow pits will be reviewed and refined to reflect areas from which contractor to obtain borrow material prior to baseline data collection and permitting processes. This will be undertaken following results of material quality testing.
Site Clearance	Vegetation clearance Soil and overburden removal Access roads and paths	- Borrow pit impact assessment will consider all phases of borrow pit usage, from site definition through to closure. - Assessment will include any new access roads required to access the borrow pit location. - Impact assessment will consider all relevant impacts associated with the construction, use and closure of borrow pits including but not limited to: dust generation, noise generation, dewatering impact, impacts to surface waters from discharge, community health and safety impacts, impacts to biodiversity and impact that may arise from waste generation and disposal. Mitigation measures will be identified following the waste hierarchy and in line with local government requirements, World Bank EHS Guidelines on Construction Material Extraction.
Operation	Material exploration Access roads maintenance Stockpiling	
Closure	Degraded area Management	

Borrow Phase	Pit	Activities	Measures
			model to ensure extraction activities maintain the required buffer above the aquifer. Any mitigation measures identified as a result of this assessment will be incorporated into the Borrow Pit Management Plan.

6. Backfilling and Protection Works

160. After the joints and concrete have attained sufficient strength, the culvert structure will be backfilled using approved material free from stones, boulders, and organic matter. Backfilling will be carried out in layers not exceeding 200 mm up to the top of the pipe and 300 mm above the pipe, each layer being properly compacted using suitable equipment such as plate compactors or light vibratory rollers.

161. In cases of reconstruction or widening of existing culverts, the existing structure or part thereof will be carefully dismantled, and debris will be disposed of at approved locations.

162. After construction of end walls and aprons, the culvert will be protected against erosion by providing appropriate bank protection measures such as stone pitching, rip-rap, or turfing, as specified in the drawings.

163. Upon completion of the works, all temporary diversion arrangements will be removed, and the watercourse will be reinstated to ensure free and unobstructed flow.

7. Bituminous (Asphalt) Works

164. Bituminous works for the rural road will be carried out only where specified in the approved DPR and drawings, in accordance with IRC:SP:20-2002 for Rural Roads. The type of bituminous surfacing, thickness, and construction method will be as per the approved pavement composition.

165. In general, for low-volume rural roads, bituminous surfacing will be provided, as specified in the DPR. Bitumen will be procured from authorized suppliers.

166. Temporary access for movement of construction machinery and materials will, wherever required, be provided using earthen or gravel tracks along the road alignment. These temporary tracks will be formed using locally available material and will not involve bituminous surfacing.

167. To avoid the need for construction of new access roads construction camps, material storage areas, and plant locations will be planned adjacent to or accessible from the existing road network.

168. Where short connecting stretches are required to link Project facilities such as maintenance units or utility areas to existing roads, such stretches will normally be constructed using cement concrete paving blocks or cement concrete pavement, and not with bituminous surfacing, otherwise specified in the DPR.

169. All temporary access arrangements will be removed after completion of construction, and the areas will be restored to their original condition.

8. Temporary Facilities

170. **Construction Camp and Worker Camps.** For execution of the rural road works, temporary construction camp will be established by the contractors, prior to commencement of construction activities at an approved location, preferably close to the project Road and accessible from the existing road network, to minimise movement through village roads.

171. Construction will be undertaken package-wise, with each package typically comprising of number of roads with cumulative length of about 15 km. On average, about 140-150 workers per package may be engaged during construction. Most workers will be locally sourced; however, a small number of migrant skilled workers may be employed. The camps will be temporary facilities used only during the construction period and will be dismantled after completion of the works. The location of the construction camp will be on approved land, avoiding agricultural land, water bodies, and habitations as far as practicable, in accordance with PMGSY guidelines.

172. The layout and facilities of the construction camp will be commensurate with the scale of the rural road Project and will comply with the provisions of IRC:SP:20-2002. An indicative layout will be prepared and approved prior to establishment of the camp.

173. **Facilities at the Construction Camp.** The construction camp will typically comprise the following facilities:

- Site office for Project management and supervision
- Field laboratory for quality control and testing of soil, aggregates, concrete, and bituminous materials
- Material storage yard for aggregates, sand, and moorum¹⁸
- Cement store with proper weather protection and raised platform
- Bitumen storage area (where bituminous works are involved), with safety arrangements as per specifications
- Parking for construction machinery
- Small workshop for routine repair and maintenance of equipment
- Fuel storage area (diesel), with approved above-ground tank and safety measures
- Water storage tank for construction and domestic use
- Security post at camp entrance
- First-aid facility and safety notice board

174. **Worker Facilities.** Temporary accommodation for supervisory staff, where required. The accommodation facility will include basic amenities such as adequate sleeping space, potable water supply, sanitation facilities, electricity, and waste collection arrangements. It will also include separate toilets and bathing facilities, proper drainage, and arrangements for solid waste management to maintain hygienic conditions. These facilities will be established and managed in accordance with the requirements of the Asian Development Bank under the ADB Safeguard Policy Statement and the Workers' Accommodation: Processes and Standards, as well as national regulations including the Building and Other Construction Workers (BoCW) Central Rules (Rules 33–36 related to drinking water, sanitation, washing facilities, and worker accommodation).

- Rest shelters for workers

¹⁸ Moorum is a locally available reddish gravelly soil used as a filling and sub-base material in road construction due to its good compaction and drainage properties.

- Drinking water facility
- Rest area / cooking space with safe storage of fuel
- Sanitary facilities (toilets and bathing areas) with proper drainage
- Waste collection and disposal arrangement
- First-aid box with basic medicines and emergency contact information

175. **Environmental and Safety Measures.** The construction camp will be provided with proper drainage arrangements to avoid water stagnation. Wastewater from washing areas will be disposed of through sedimentation pits. Solid waste will be collected and disposed of at approved locations. Adequate fire-fighting equipment will be provided at fuel and bitumen storage areas.

176. Awareness will be created among workers on health, hygiene, and safety practices.

177. In case of any medical emergency, workers will be taken to the nearest Primary Health Centre (PHC).

178. **Camp Closure and Restoration.** Upon completion of construction activities, the labour camp will be dismantled completely. All temporary structures, waste, and debris will be removed, and the site will be restored to its original condition or as directed by the site Engineer of PIU.

J. Resource Requirements¹⁹

1. Energy Use

179. Energy requirements during construction of the rural road will be limited and temporary in nature. Power supply for construction activities will primarily be met through diesel generator (DG) sets and fuel used for construction machinery.

180. A small-capacity diesel generator, typically in the range of 20–40 kVA, will be provided at the construction camp for site office lighting, laboratory equipment, and minor electrical needs. One standby generator of similar capacity may be provided, if required. No permanent electricity infrastructure such as transformers or overhead transmission lines is proposed for the Project.

181. Fuel consumption during construction will mainly be for operation of earthmoving machinery, compactors, tippers, and DG sets. Diesel will be the primary fuel used for construction equipment, while petrol may be used for light vehicles. Fuel will be stored in approved containers or tanks with necessary safety precautions as per specifications.

182. An estimated diesel consumption of approximately 4,000 litres per km is anticipated during construction, primarily for the operation of construction machinery, equipment, and DG sets.

183. Efforts will be made to optimise fuel usage by proper maintenance of machinery and efficient planning of construction activities. Upon completion of construction, all temporary power arrangements will be dismantled and the site restored.

2. Materials

¹⁹ The quantitative estimation of resources has been provided by quantity surveyors of DPR consultants of KRRDA

184. Materials required for construction of the rural road will conform to the provisions of IRC:SP:20-2002 for Rural Roads. As far as practicable, materials will be sourced locally to reduce haulage distance and construction cost.

185. Borrow materials such as soil, gravel, moorum, or laterite required for embankment, subgrade, and shoulders will be procured from approved borrow areas generally located within 2 km to 10 km of the Project alignment. All borrow areas will be finalised with the approval of the PIU Engineer and relevant local authorities.

186. On average, approximately 6,269 m³ of borrow material per road is estimated to be required for embankment, granular sub-base (GSB), shoulder, and subgrade works. Of this requirement, approximately 979 m³ per road is expected to be met through material generated from roadway cutting and drain excavation, thereby reducing the requirement for borrow material from external sources. Quarry materials, including aggregates for concrete works, granular sub-base (GSB), wet mix macadam (WMM), blanket layer (0–40 mm), and stone pitching, will be procured from existing and licensed quarries located near the proposed Project Road. No new quarry or crushing operation will be opened exclusively for the Project.

187. The average resource requirement for the proposed road improvement works is estimated to include approximately 2,843 m³ of aggregate, about 209 m³ of sand, and around 157 m³ of cement per road. The bitumen requirement is anticipated to be approximately 85.5 tonnes per road for prime coat, tack coat and seal coat, and about 42.2 tonnes per road for OGPC/MSS, resulting in an estimated combined bitumen requirement of around 127.6 tonnes per road. In addition, the average water requirement for construction activities, including curing, dust suppression and concreting, is estimated at approximately 2124 kL/km. All materials procured from borrow areas or quarries will be tested and approved for compliance with the specified quality requirements before use. Unsuitable materials will not be used in construction.

188. The quantities and sources of materials required for the rural road works will be indicated in the DPR, and procurement will be carried out through authorised suppliers only.

K. Workforce

189. The construction workforce for the rural road Project will comprise about 140-150 labourers per package of skilled, semi-skilled, and unskilled labour, including engineers, supervisors, equipment operators, mechanics, drivers, helpers, and general labourers, as required for various construction activities such as earthwork, pavement works, drainage structures, and ancillary works. As construction will be undertaken package-wise (typically cumulative length of 15 km per package), the total workforce engaged in a district at any given time is expected to be approximately 140-150 workers (Table III-10).

Table III-10 Assessment of Workforce Requirement in a Standard Condition

Item	Numbers
Total Number of labours per package	140-150 ²⁰
Composition of skilled labours	10-15%
Semi-skilled labours	25-35%
Composition of unskilled	50-60%

²⁰ The number of works will vary with the number of structures like culverts, minor and major bridges

190. In accordance with PMGSY guidelines, preference will be given to local labour from villages located along and near the Project corridor, to the extent feasible. Employment of local workforce will help minimise labour movement, reduce pressure on local infrastructure, and provide livelihood opportunities to the rural population.

191. Daily mobilisation of workers to different work fronts will be arranged by the Contractor using suitable vehicles, ensuring safe transportation and adherence to applicable labour and road safety regulations. Pick-up and drop-off points will be identified in consultation with local authorities and village representatives.

192. Where temporary accommodation is required for supervisory staff or non-local skilled workers, small labour camps will be established in compliance with PMGSY provisions, IRC:SP:20-2002, and applicable labour laws. Such facilities will be provided with potable water, sanitation, waste disposal arrangements, and basic medical facilities.

L. Utilities

1. Water Supply

193. Water required during construction of the rural road will be sourced from locally available approved sources, such as nearby streams, village ponds, or public water supply systems, subject to availability and community consent. Use of local water supply systems will be permitted only after prior consent and confirmation that community access, drinking-water needs, livestock use, irrigation requirements and ecological flows will not be affected. In water-scarce areas, reliance on local systems will be avoided unless adequate availability is demonstrated. Contractors will be required to identify dedicated and approved construction water sources through the site-specific EMP, including authorized suppliers, tanker supply or permitted sources, where necessary.

194. Water will be used primarily for construction activities, including earthwork, compaction, dust suppression, and concrete works.

195. Water will be stored in portable PVC or steel storage tanks at the construction camp to ensure uninterrupted supply. Potable water for labour and staff will be arranged through safe drinking water sources approved by the local Panchayat or Public Health Engineering Department. Installation of permanent facilities such as borewells or RO plants is not proposed, in line with PMGSY norms.

196. No separate statutory permits are generally required for temporary water use for PMGSY works; however, necessary permissions and consent from the Gram Panchayat and local community will be obtained prior to extraction. Care will be taken to avoid over-extraction and any adverse impact on local water sources. In case of ground water abstraction, a requisite permission from the Karnataka Ground Water Board will be obtained by the contractor.

197. Upon completion of construction, all temporary water arrangements will be dismantled and the site restored to its original condition.

2. Communication Facilities

198. Communication during construction will be maintained through mobile phones and basic internet connectivity, as required. No permanent telecommunication infrastructure is proposed

under the Project. These facilities will be temporary and restricted to construction and supervision purposes only.

M. Waste

199. Approximately 35 m³ of scarified bituminous waste is estimated to be generated per kilometre of road during the rehabilitation works. The total estimated quantity of bituminous waste is 144984 cubic meter. This quantity represents the material removed from the existing pavement surface. An assessment of waste generation from the construction of the rural road is provided in Table III-11.

Table III-11 Construction Waste Management

Waste type	Quantity	Source	Destination	Waste Management/ Disposal
Scarified Bituminous Material from road surface	144,984 cubic meter	Scarification of Bituminous Road	disposal at designated landfill	Resycling and disposal
Excavated materials	1449840 cubic meter of earth (after 50% used for filling)	Excavation	disposal to inert construction landfill or, if contaminated, disposal	Filling and grading of the low-lying areas within RoW. material will be used for grassing and turfing.
Vegetation waste	2589 ha of vegetation clearance	RoW clearance	Nearby low-lying areas, within RoW, nearby community use	Decomposition, disposal at nearby low-lying areas
Topsoil	Top soil will be reused so waste is not expected.	RoW clearance	Nearby low-lying areas, within RoW	Graded within RoW, with used for turfing, filling of nearby low-lying area.
Concrete and gypsum	Concrete/gypsum is dependent on the number of structures to be demolished.	Demolition of structures	Disposed of to government approved Landfill or Panchayat approved locations	Landfill/ identified disposal site
Waste lubricating oil (from machinery)	Quantity as per the local condition	Construction equipment maintenance	Recycling facility	Will be sold to agencies for recycling purpose
Waste paints and solvents	Quantity as per the local condition	Site office construction		
Domestic refuse from the workforce	Quantity as per the local condition	Accommodation camp	Municipal/Panchayat waste facility	Paid to disposal agency on payment

200. **Waste Management.** Waste management during construction of the rural road will be carried out in accordance with the provisions of IRC:SP:20-2002 and applicable Central and Karnataka State environmental regulations. The Contractor will follow the waste management hierarchy of avoidance, minimization, reuse, recycling, and safe disposal.

201. Waste generation will be minimised through restricted clearing within the Right of Way (RoW) and limiting excavation only to areas required for construction. Excavated materials found suitable will be reused for embankment construction, backfilling, shoulder formation, grading, and site restoration. Reusable excavated soil will be stored separately from topsoil stockpiles in designated areas.

202. Waste will be segregated at source and stored in designated containers at construction camps and work sites. Waste streams will broadly include:

- Biodegradable waste (food waste, vegetation);
- Recyclable waste (metal, plastic, paper);
- Construction debris (surplus concrete, masonry);
- Hazardous waste (used oil, grease, oil-contaminated cotton waste, empty paint containers).

203. Adequate numbers of colour-coded bins will be provided by the Contractor. Waste will be periodically collected and disposed of through authorised agencies or local bodies at approved disposal or recycling facilities.

204. Hazardous waste will be stored in sealed containers on an impervious surface with bunding, away from water bodies and habitation. Storage will be temporary and handled only by trained personnel. Disposal will comply with the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, as amended.

205. If demolition of existing structures is involved, materials will be screened for hazardous components. Any hazardous material encountered will be handled and disposed of as per statutory requirements through authorised handlers.

206. Approximately 6750 litres per day of wastewater will be generated for 150 labourers engaged. Wastewater generated from labour camps and construction facilities will be managed through septic tanks with soak pits or other approved on-site sanitation systems. No untreated wastewater will be discharged into nearby drains, water bodies, or agricultural land.

207. A Waste Management Plan (WMP) will be prepared by the Contractor and approved by the PIU Engineer prior to commencement of works, and its implementation will be monitored throughout the construction period. Sample waste management plan is provided in Appendix 3 of this report.

N. Associated Facilities

208. Associated Facilities are facilities that are not funded as part of the Project and that would not have been constructed or expanded if the Project did not exist and without which the Project would not be viable. It is expected that all the necessary facilities and services such as water supply, energy and facilities for works will be created under the funded Project with no associated facilities being developed or utilised that are not part of the Project.

O. Embedded Mitigation Measures

209. An Environment Management Plan (EMP) has been developed as part of the bid document for the Project, as conditions for the contractors and PIU to comply with for the Project

construction and operation phases. These action items embedded in the existing bid documents and regulatory requirements are considered as embedded mitigation measures (EDMs) for the Project, as presented in the Table III-12 below.

210. EMP has been developed, consolidating all the embedded mitigation measures and additional mitigation measures, if any, in section 9 of this report.

Table III-12 Embedded Mitigation Measures

SN	Environmental / safeguard purpose	Embedded mitigation measure in DPR/design	Reference code / ECOP / design standard
EDM-1	Reduces land acquisition, physical disturbance, and footprint-related environmental impacts.	The DPR keeps the road largely on the existing alignment and avoids unnecessary deviation. This reduces the need for fresh land, limits disturbance to adjacent land uses, and avoids avoidable cutting, filling, and impact on roadside properties.	PMGSY ECOP 1: Project Planning and Design; IRC:SP:20-2002
EDM-2	Avoids resettlement, minimizes footprint, and reduces impact on private assets and agricultural land.	The DPR includes improvement within the available right of way as far as possible and avoids additional land acquisition where the existing corridor is adequate.	PMGSY ECOP 1; ADB SPS 2009; IRC:SP:20-2002
EDM-3	Prevents waterlogging, flooding, embankment damage, and erosion caused by blocked drainage.	DPR includes hydrology-based cross-drainage design and provides for replacement of damaged culverts and addition of new culverts where drainage crossings require intervention. This allows runoff to pass along natural drainage paths instead of getting obstructed by the road. The culvert outlets will be designed to minimize the soil erosion risk of water flow through the culverts and outfall to the solid erosion potential. The culvert outlets will be designed to minimize the soil erosion risk of water flow through the culverts and outfall to the soil erosion potential.	IRC:SP:13-2004; IRC:5-2015; IRC:SP:20-2002; PMGSY ECOP 7: Drainage
EDM-4	Controls surface runoff, prevents water stagnation, reduces shoulder erosion, and protects pavement life.	The DPR provides roadside drainage, side drains, and drainage chambers at relevant locations so that storm water is collected and safely conveyed to low points and discharge points.	IRC:SP:20-2002; PMGSY ECOP 7: Drainage; MoRTH Section 300/309
EDM-5	Reduces the risk of inundation, flood damage, and service interruption during heavy rainfall events.	In low-lying sections, the DPR proposes raising the embankment and maintaining freeboard above the recorded flood level. This is a climate-resilient design measure embedded in the engineering profile of the road.	IRC:75-2015; IRC:SP:13-2004; climate-resilient road design practice
EDM-6	Improves durability in sensitive stretches, reduces pothole formation,	The DPR adopts different pavement types for different stretches, including rigid pavement / cement concrete pavement in selected sections such as habitation or problem stretches and	IRC:SP:62-2014; IRC:SP:72-2015; IRC:37-2018

SN	Environmental / safeguard purpose	Embedded mitigation measure in DPR/design	Reference code / ECOP / design standard
	reduces mud and poor hygiene in built-up areas, and lowers maintenance needs.	flexible pavement in others. This indicates that pavement selection has been matched to local conditions rather than applied uniformly.	
EDM-7	Prevention of rain cuts, slope erosion, and shoulder degradation.	The DPR includes turfing and stabilization of embankment slopes and earthen shoulders after road formation. This is an embedded bioengineering measure intended to stabilize bare soil surfaces that would otherwise erode during rainfall.	PMGSY ECOP 6: Slope Stability and Erosion Control; MoRTH slope protection practice
EDM-8	Conserves fertile soil and supports rehabilitation of temporarily disturbed areas.	The DPR requires topsoil from borrow areas and disturbed surfaces to be stripped, stored separately, and reused during site restoration. This is an important embedded mitigation measure because the design documentation recognizes topsoil as a resource to be conserved and reused.	PMGSY ECOP 3: Borrow Areas; MoRTH 301/305; IRC:36-2010
EDM-9	Reduces land degradation, prevents drainage interference, and restores the productive use of excavated land.	The DPR places controls on borrow area development by limiting excavation depth, maintaining distance from the embankment, and requiring rehabilitation/redevelopment of borrow areas after material extraction. This means the source area is considered part of the environmental footprint and not ignored.	PMGSY ECOP 3: Borrow Areas; IRC:36-2010; MoRTH 305.2.2.2
EDM-10	Avoids illegal quarrying and reduces off-site environmental and regulatory risk.	The DPR provides that construction aggregates, sand, and other materials should be sourced from approved quarries and licensed sources. This is an embedded mitigation measure because it shifts the project away from informal or unregulated extraction.	MoRTH 111.3; relevant mining permissions / SPCB consents; PMGSY good practice for material sources
EDM-11	Prevents service disruption, accidental damage, and road safety risks from utility conflicts.	The DPR identifies utilities that fall within the improvement corridor and provides for shifting or relocation before construction. This is an embedded design-stage mitigation because it reduces the need for ad hoc site decisions and avoids unsafe obstruction within the roadway.	IRC:SP:20-2002; good rural road design practice
EDM-12	Improves safety for vulnerable road users and reduces shoulder edge damage.	The DPR provides shoulders on both sides of the carriageway, including hard shoulder in some stretches, so that pedestrians, cyclists, and other vulnerable users can move more safely outside the traffic stream. This is a built-in safety and environmental design response for rural roads passing through inhabited areas.	IRC:103-2012; IRC:SP:20-2002
EDM-13	Reduces accident risk and improves safe movement of vehicles and pedestrians through	The DPR incorporates traffic signs, retro-reflective signs, pavement markings, stop lines, and zebra crossings at relevant locations. These measures are embedded because they are included as part of the road safety design and not left only to later operation-stage action.	IRC:67-2012; IRC:35-2015

SN	Environmental / safeguard purpose	Embedded mitigation measure in DPR/design	Reference code / ECOP / design standard
	settlements and junctions.		
EDM-14	Protects residents and sensitive receptors by reducing speed-related road safety risk.	The DPR provides for speed management at village entries, curves, junctions, schools, and other sensitive points through measures such as speed humps, warning signs, or other traffic calming arrangements. This is an embedded mitigation because it directly responds to community safety risks created by improved road speed.	IRC:99-2018; IRC:SP:55
EDM-15	Reduces risk of vehicular run-off, collision at structures, and poor night visibility.	The DPR includes crash barriers, hazard markers, delineators, guide posts, and object markers at embankments, culverts, bridge approaches, sharp bends, and other hazardous locations. These are embedded engineering safety measures incorporated into the road design.	IRC:119-2015; IRC:79-2019; IRC:SP:82-2008
EDM-16	Improves drainage, roadside hygiene, and safety in built-up stretches.	In habitation or village stretches, the DPR proposes covered concrete drains and other settlement-specific treatment measures. This integrates drainage management and community safety into the village road design instead of treating the road simply as a traffic corridor.	IRC:99-2018; IRC:SP:63-2004; PMGSY ECOP 7
EDM-17	Controls dust nuisance and protects roadside receptors from secondary construction impacts.	The DPR/EMP provisions require construction materials to be transported with tarpaulin cover and haul roads to be maintained and dust-controlled. Contractor shall sprinkle water to suppress dust as per site condition. Contractor shall maintain existing road and haul road so that vehicles can pass easily and ensure that generation of dust is minimized. The excavated earth /construction materials shall be stored properly so that it does not generate fugitive emissions. Storage area should be located downwind of the habitation area. Contractor shall install wet scrubber or any other suitable pollution control mechanism for hot mix plant and ensure that flue gas passes through the wet scrubber before releasing into ambient air. Contractor shall also ensure that wet scrubber or other filter is always operational when hot mix plant is in operation. Although implemented during construction, these are embedded in the project	MoRTH 111.9; PMGSY ECOP 10: Air Quality; Environment (Protection) Second Amendment Rules, 2023

SN	Environmental / safeguard purpose	Embedded mitigation measure in DPR/design	Reference code / ECOP / design standard
		documentation and therefore form part of the planned mitigation package. The setback conditions for sensitive receptor as prevailing CPCB guidelines is 500 m from human habitation, 200 m from highways, and 500 m from sensitive ecological/institutional zones. Where the setback distances specified above cannot be achieved and no alternative location is available, and subject to prior approval of the PIU/PISC, barricading with 6-meter-high GI sheets will be provided as a supplementary control. Barricading shall not be treated as a substitute for the prescribed separation distances, and avoidance of siting within the setback shall remain the first order of preference.	
EDM-18	Improves consultation, disclosure, and grievance access during implementation.	The project documentation includes provisions for information boards and public communication mechanisms, including the display of project-related information and grievance redress contact details. These measures are integrated into the project's management framework and serve to enhance transparency, stakeholder engagement, and effective communication with affected communities.	ADB SPS 2009 (information disclosure / consultation principle); PMGSY consultation provisions
EDM-19	Controls air pollution	LPG should be used as a fuel source in construction camps instead of wood. Ambient air quality shall be monitored by the Contractor as per the environmental monitoring plan of the EIA to ensure parameters are within permissible limits. Contractor shall follow Generic Guidelines for Environment Friendly Construction Methodology appended in EMP. DG set shall be provided with chimney of adequate height as per CPCB guidelines (Height of stack in meter = Height of the building + $0.2 \sqrt{\text{KVA}}$).	PMGSY ECoP; IRC:SP:108-2015; CPCB guidelines on DG stack height
EDM-20	Controls air pollution	Road (main carriage way) damage to be promptly rectified with proper road repair and maintenance work to avoid dust emission.	IRC:SP:108-2015
EDM-21	Controls noise pollution	The plants and equipment used for construction will strictly conform to Central Pollution Control Board (CPCB) noise standards.	PMGSY EcoP 13 and 14; IRC:SP:108-2015

SN	Environmental / safeguard purpose	Embedded mitigation measure in DPR/design	Reference code / ECOP / design standard
		Vehicles, equipment and construction machinery shall be monitored regularly with particular attention to silencers and mufflers to maintain noise levels to minimum. Use of noise shields to construction machinery and provision of earplugs to the heavy machine operators are some of the mitigation measures.	
EDM-22	Protects water quality	Contractor shall ensure that no spillage of spoil material in surface water bodies directly or indirectly. Contractor shall ensure that no untreated discharge should enter into surface water bodies. Any discharges into environment should follow environmental standard. Install temporary silt traps or sedimentation basins along the drainage leading to the water bodies. Soak pit and septic tank will be provided to be constructed by the Contractor. Contractor shall prepare impervious surface at fuel refilling station, workshop area and material storage area. The fuel refilling station and workshop area should be provided with shed for sun and rain. Precaution should be taken to ensure that the impervious surface is not located on natural and critical habitats	Water (Prevention and Control of Pollution) Act, 1974; PMGSY EcoP 3, 9, 11, 12, 13; MoRTH Section 111 & Environmental Protection Provisions
EDM-23	Protects water and resource ecology	Contractor shall obtain permission for withdrawal of surface or ground water and consult with the community and ensure that villager's user right is protected. Contractors shall provide for dedicated sources or supplementary supply where reliance on local systems is not feasible. Surface flow shall be diverted, or construction activities shall be isolated from the surface flow in a manner acceptable to PIU. Any diversion / bund/isolation constructed for bridge/culvert work shall be removed by Contractor as soon as utility of those are over. Installation of slit fencing with planting vegetated swales at the mouth of the nearest water body to prevent any residual sediments from entering the water body.	PMGSY EcoP 8

SN	Environmental / safeguard purpose	Embedded mitigation measure in DPR/design	Reference code / ECOP / design standard
EDM-24	Protects Drainage system	To prevent runoff and surface waters from entering agricultural fields or infiltrating the ground, the drainage system shall be kept in good condition as part of pre-monsoon maintenance. Rejuvenation of the drainage system by removing encroachments/ congestions will be regularly conducted.	PMGSY EcoP 9, 12
EDM-25	Protects Cultural Heritage	Conduct a heritage/archaeological field surveys before start of the construction work. If surveys find resources, map them and define buffers/avoidance. Implementation of Chance Find Procedure (Appendix 4) including standard “stop-work — secure — notify — assess — conserve or salvage” sequence: stop work if finds occur, cordon off, notify competent authorities and project authorities, assess significance, implement approved conservation/salvage or reburial, document finds, then resume works only after clearance. Any shifting of cultural assets like idols of local importance will be done in consultation with the local community. Educate workers about heritage sensitivity. Install speed breakers or rumble strips before approaching heritage, cultural or archaeological structures. Define low speed limit where road is around the heritage, cultural or archaeological structures. Install crash barriers or stone masonry buffers between road and heritage, cultural or archaeological structures. Provide warning signs for ‘heritage, cultural or archaeological structure ahead’, ‘slow down’. Provide reflective road marking for nighttime around heritage, cultural or archaeological structures.	Ancient Monuments and Archaeological Sites and Remains (AMASR) Act, 1958, AMASR Rules, 1959, PMGSY EcoP 15, IRC:SP:20:2002, IRC:35:2015, IRC:SP:67:2001, IRC:99:2018, IRC:119:2015
EDM-26	Community socio-economy	Contractors to keep community members apprised of construction schedules in readily accessible public locations.	PMGSY ECoP-14, 20; IRC:SP:20:2002; IRC:SP:55 and IRC:SP:67

SN	Environmental / safeguard purpose	Embedded mitigation measure in DPR/design	Reference code / ECOP / design standard
		Construction schedule to be aligned with agricultural cycle to avoid harvest period and consulted with community and farmers. A traffic management plan to be prepared for construction phase as part of the EMP. The contractors shall ensure that no inconvenience is caused to the commuters and local communities.	
EDM-27	Compensatory Plantation	Afforestation on land on twice area of impacted and plantation of tree in 1:2 ratio or condition provided by the Forest Department.	PMGSY EcoP 1, 16; IRC:SP:20:2002; IRC:SP:21:2009
EDM-28	Utility management	All efforts shall be made to reduce the duration of utility shifting impact and restore the disturbed facilities and access. All utilities should be shifted before start of construction. Necessary permission and payments should be made to relevant utility service agencies and individuals to allow quick shifting and restoration of utility services. Visual barriers are to be provided, as necessary, on active construction zones. Consultation with affected people prior to the start of utility shifting, presenting construction timelines and guidelines should be conducted. Local people must be informed through appropriate means about the time of shifting of utility structures and potential disruption of services, if any.	PMGSY EcoP 2, 14, 20
EDM 29	Community health and safety	Safety provisions in accordance with IRC guidelines to be implemented under the Project. These include (i) speed breakers in habitat areas to regulate speed, (ii) retro-reflective warning signboards near schools, hospitals, and religious places, (iii) proper sidewalks/pedestrian zones along roads in habitat areas and near schools, hospitals, and religious places.	IRC:35; IRC:67; IRC:79; IRC:119 And other applicable IRC guidelines
EDM 30	Occupational health and safety	Develop and implement occupational health and safety plan (Appendix 6). Appropriate Personal Protective Equipment (PPE) to be provided to workers engaged in construction. Daily Toolbox Talks (TBTs) to be conducted at work sites before start of construction activities. Undertake regular health and safety trainings for the workers.	Occupational Safety, Health and Working Conditions Code, 2020; PMGSY EcoP 14; IRC:SP:20:2002

SN	Environmental / safeguard purpose	Embedded mitigation measure in DPR/design	Reference code / ECOP / design standard
		Develop Emergency Preparedness and Response Plan (Appendix 7) with regular on-site mock drills; emergency contacts displayed at camps and worksites. A grievance mechanism shall be developed for workers. Ensure compliance with labour laws; shift scheduling; overtime monitoring with mandatory rest periods Implement permit-to-work system for high-risk activities. Develop designated worker movement corridors with trained flagmen. Provide drinking water stations, shaded rest areas, work-rest schedules, heat stress awareness and first aid facilities. Maintain transparent wage records, compliance with labour laws, periodic audits; Establish worker grievance mechanism consistent with ADB SPS, maintain grievance register, periodic consultations with workers and evacuation procedures.	

IV. DESCRIPTION OF THE ENVIRONMENT

211. This chapter presents the baseline environmental and socio-economic conditions of the Project area. The proposed 1,335 Project roads for improvement are distributed all over 31 districts in the state of Karnataka.

A. Physical Environment

1. Physiography

212. Karnataka is situated on the western edge of the Deccan Peninsular region of India. It is located approximately between 11.5° North and 18.5° North latitudes and 74° East and 78.5° East longitudes.

213. Karnataka is divided into following five physiographic regions—the Northern, Central and Southern Karnataka Plateaus, the Malnad (Western Ghats) belt, and the Coastal Karnataka strip.

214. The state's inland Deccan plateau is split into three plateau zones: the Northern Karnataka Plateau is a low, basaltic plain of about 300–600 meter above mean sea level (mamsl), largely formed on Deccan Trap flows and marked by extensive flat or gently undulating terrain with occasional residual hills; the Central Karnataka Plateau is a transitional belt at roughly 500–700 m amsl, featuring undulating plains, scattered inselbergs and moderate relief underlain by crystalline rocks and lateritic mantles; and the Southern Karnataka Plateau rises to about 600–900 m amsl, with more pronounced uplands, isolated hill ranges and deeper river basins (Cauvery and its tributaries) reflecting greater relief and more dissected topography.

215. The Malnad or Western Ghats zone forms the steep, forested western escarpment and mid-elevation mountain belt (commonly ~600–1,500 m amsl with peaks above 1,000 m), characterized by sharp ridgelines, deep valleys, perennial streams and very high monsoon rainfall that make it the principal catchment for rivers such as the Tunga, Bhadra, Sharavathi and Netravathi. This ghats belt runs parallel to the coast and strongly modulates climate and vegetation.

216. Coastal Karnataka is a narrow, low-lying littoral plain between the Arabian Sea and the Western Ghats (extending roughly ~225–320 km north–south and varying in width from ~12–64 km), featuring sandy beaches, dunes, estuaries and short west-flowing rivers that form mangrove-fringed estuaries and alluvial plains near their mouths.

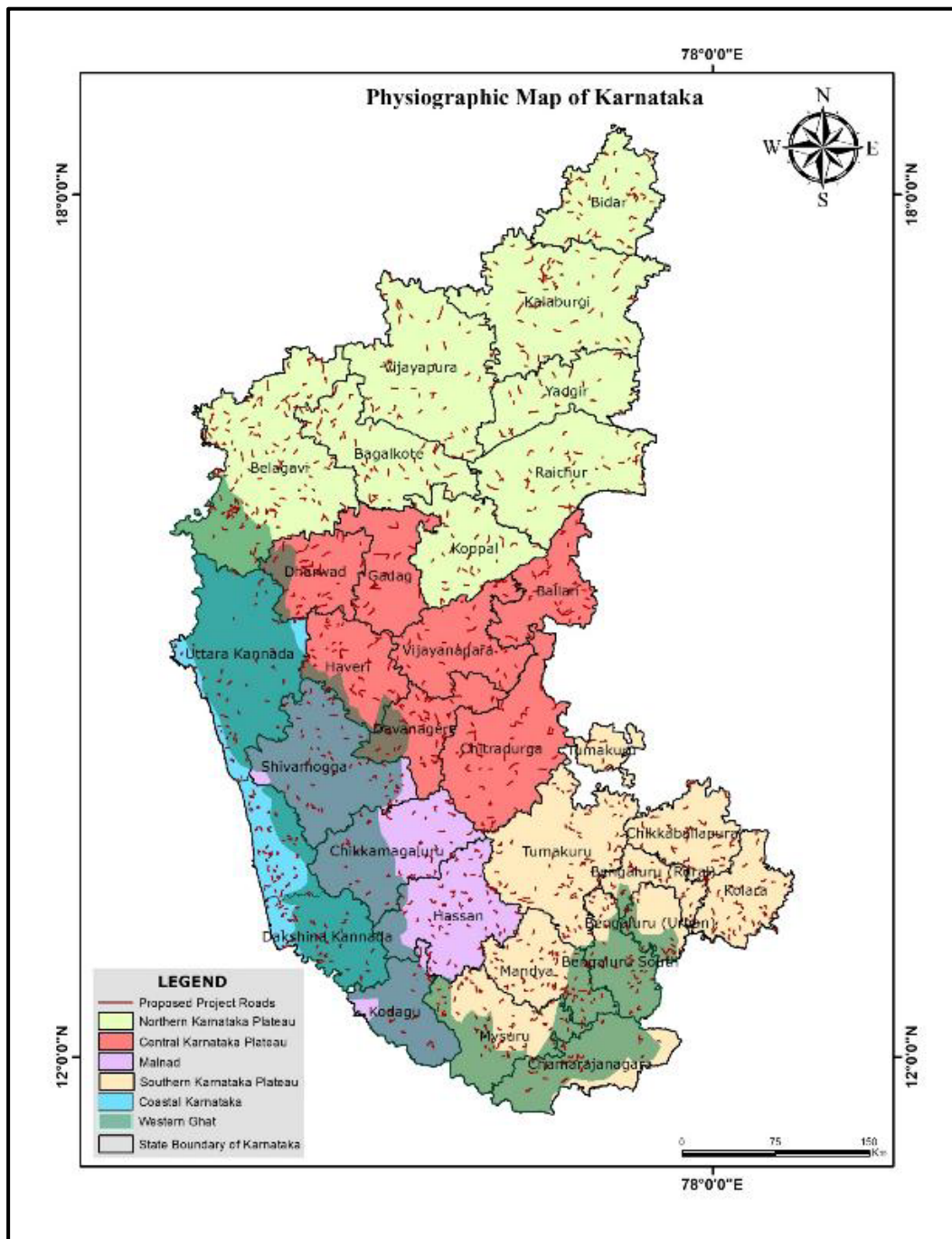
217. Coastal Regulation Zone (CRZ) Notification, 2019, (issued under the Environment (Protection) Act, 1986), provides the regulatory framework for protection and management of coastal areas, conservation of coastal ecosystems, safeguarding the livelihood security of coastal communities, and promoting sustainable development. The CRZ notification is applicable to coastline of Karnataka covering Dakshina Kannada, Udupi, and Uttara Kannada districts. The Karnataka Coastal Zone Management Plan (CZMP) identifies and maps CRZ areas and serves as the basis for regulating permissible activities and processing project clearances.

218. Out of 1335 total roads, one of the Project Road (ID 1392) in Dakshina Kannada falls within a notified CRZ area. Accordingly, the CRZ clearance for the proposed rural road improvement works is required from the Karnataka Coastal Zone Management Authority (KCZMA), with approval by the competent authority under the applicable CRZ Notification, 2019.

The clearance process is under process, and the approval is expected to be obtained prior to commencement of civil works on the road section (road ID 1392). The status of the CRZ clearance will continue to be monitored and reported during project implementation.

219. The proposed Project roads are distributed over all physiographic regions. The physiography of Karnataka is presented in Figure IV-1 below.

Figure IV-1: Physiographic Map of Karnataka



2. Climate

220. For meteorological purposes, the state of Karnataka can be divided into following three meteorological sub-divisions: Coastal Karnataka (consisting of Dakshin Kannada, Udupi and Uttara Kannada districts), North Interior Karnataka (consists of Bagalkot, Belgaum, Bidar, Dharwad, Gadag, Haveri, Kalaburagi, Koppal, Raichur, Vijayapura and Yadgir), South Interior Karnataka (consisting of the districts viz. Bengaluru (Rural), Bengaluru (Urban), Bellary, Chamarajanagar, Chikkaballapura, Chikkamagaluru, Chitradurga, Davanagere, Hassan, Kodagu, Kolar, Mandya, Mysuru, Ramanagara Shivamogga, Tumakuru and Vijayanagara)²¹.

221. As per Köppen's classification, Karnataka experiences arid, semi-arid, and humid tropical climates, influenced by altitude, topography, and proximity to the sea. The coastal belt has a tropical monsoon climate with high rainfall, while the Western Ghats and southern regions experience a tropical savanna climate. The northern parts are predominantly semi-arid (tropical steppe). A small portion of Chamarajanagar exhibits a temperate dry-winter climate. Overall, more than 75% of the state falls under arid or semi-arid conditions.

222. Karnataka experiences following four seasons in a year:

- Summers: Starting from March, extending till mid-May, with April and May as the hottest months.
- Monsoon: The monsoon season in Karnataka extends from June to September. In June, both temperature and humidity rise sharply as the southwest monsoon brings rainfall to the southern regions of the state. Between July and September, rainfall moderates the heat, though humidity remains persistently high. Rainfall distribution is uneven, with coastal districts such as Udupi recording the highest averages, while interior districts including Bagalkot, Ballari, Chitradurga, and Vijayanagara experience the lowest.
- Post-Monsoon: The post-monsoon season in Karnataka spans from October to December and is marked by a distinct improvement in weather conditions. During this period, the state experiences occasional rainfall linked to the northeast monsoon, primarily affecting the southeastern districts. Humidity levels decline significantly.
- Winters: The winter season extends from January to February. These are the coldest months in most parts of Karnataka and the temperature dips low. The weather remains pleasant as the humidity reduces considerably.

3. Temperature

223. The spatial distribution of temperature across Karnataka is represented through seasonal maps of mean maximum temperatures (Figure IV-2, Figure IV-3, Figure IV-4 and Figure IV-5). Temperature in Karnataka varies across its physiographic divisions as follows²⁵:

224. The Northern Karnataka Plateau experiences the highest temperature conditions in the state. Mean maximum temperatures during May range between about 35°C and 41°C, with mean minimum temperatures between about 18°C and 26°C. The maps further indicate that this region experiences significant seasonal variation and higher diurnal temperature range (11°C–16°C).

²¹ Climate of Karnataka, Issued by Office of Climate Research and Services, India Meteorological Department, Pune, Ministry of earth Sciences, Government of India. Available at: [Climate of Karnataka.pdf](#)

Figure IV-2 to Figure IV-5 shows that the temperatures as high as 47.3°C have been recorded in Kalaburagi district, highlighting the occurrence of extreme heat conditions in the northern interior region.

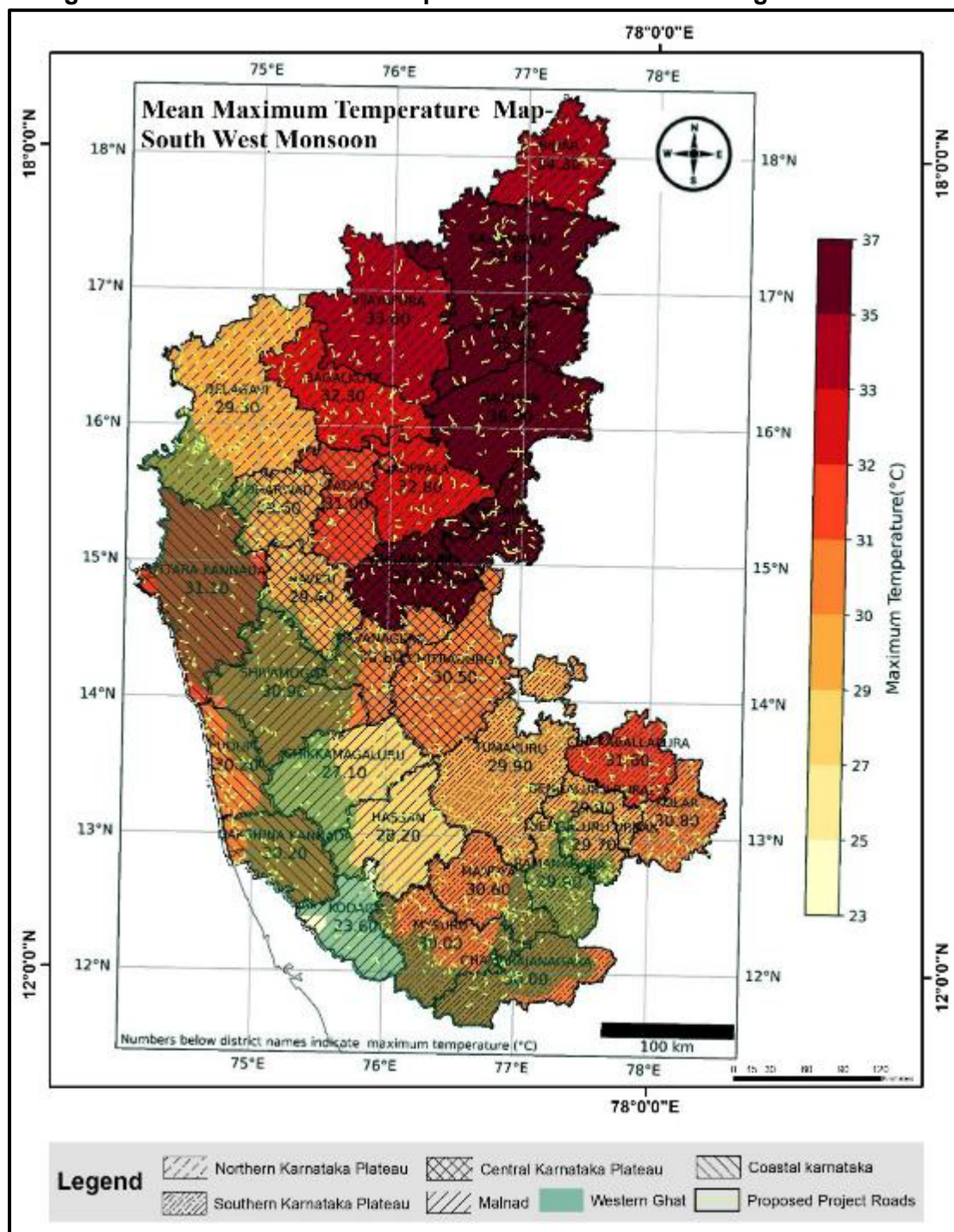
225. The Southern Karnataka Plateau shows a moderate temperature regime, influenced by elevation (generally 600–900 m above mean sea level). Figure IV-2 to Figure IV-5 indicate relatively lower mean maximum temperatures compared to northern regions, with seasonal variations but no extreme temperature conditions.

226. The Malnad region, associated with the Western Ghats, exhibits comparatively lower temperatures due to higher elevation and dense vegetation.

227. The Central Karnataka Plateau experiences moderate to relatively higher temperatures, representing a transitional climatic zone between the southern and northern regions.

228. In the Coastal Karnataka region, the climate is characterized as tropical monsoon with annual mean temperatures exceeding 26°C. During the pre-monsoon season (March–June), mean temperatures range between about 27.4°C and 29.9°C, while mean maximum temperatures during peak summer (April–May) range from about 33.2°C to 34.9°C. The seasonal temperature maps Figure IV-2 to Figure IV-5 show relatively uniform temperature distribution across this region, reflecting strong maritime influence.

Figure IV-3 Mean Maximum Temperature in Karnataka during Southwest Monsoon



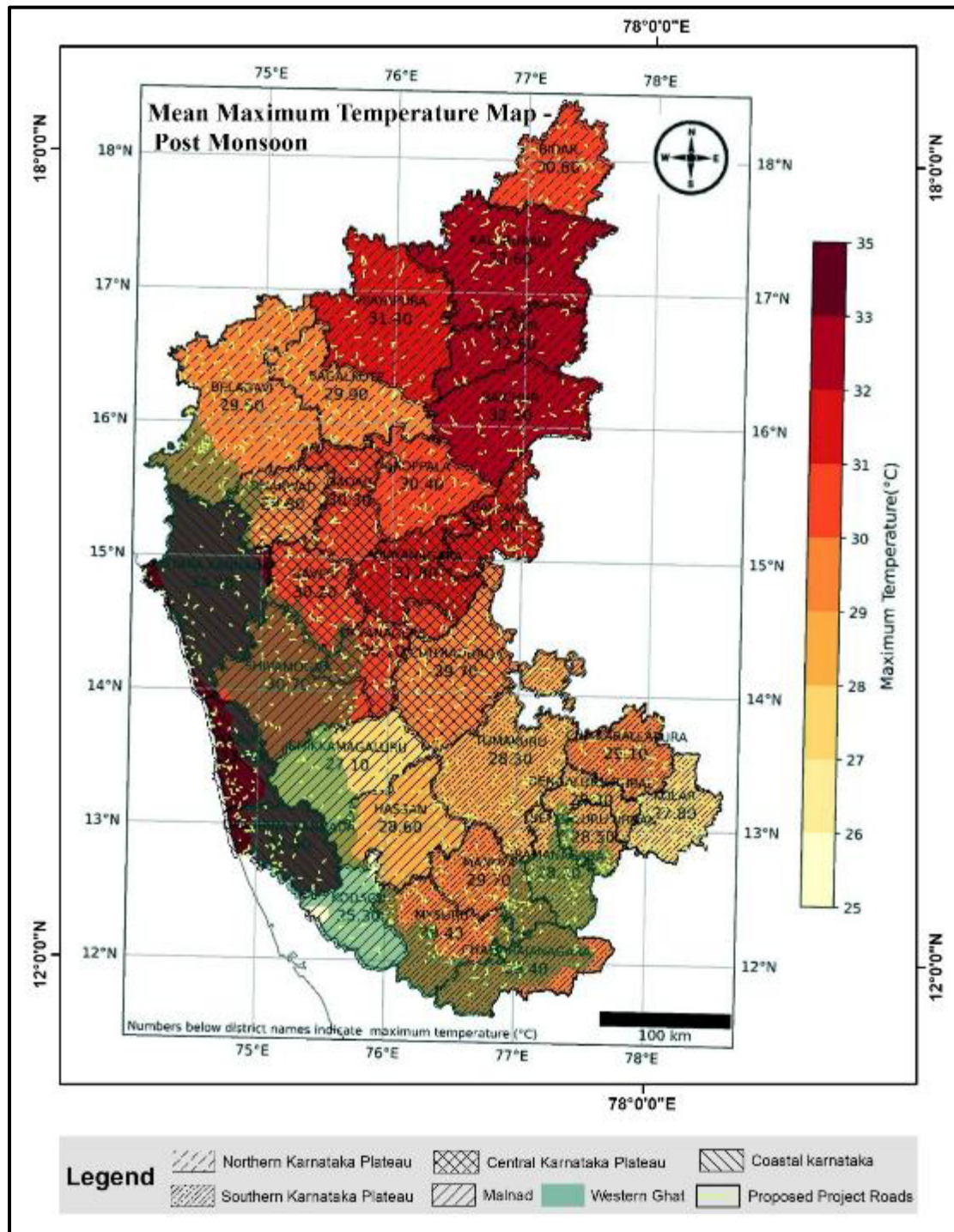
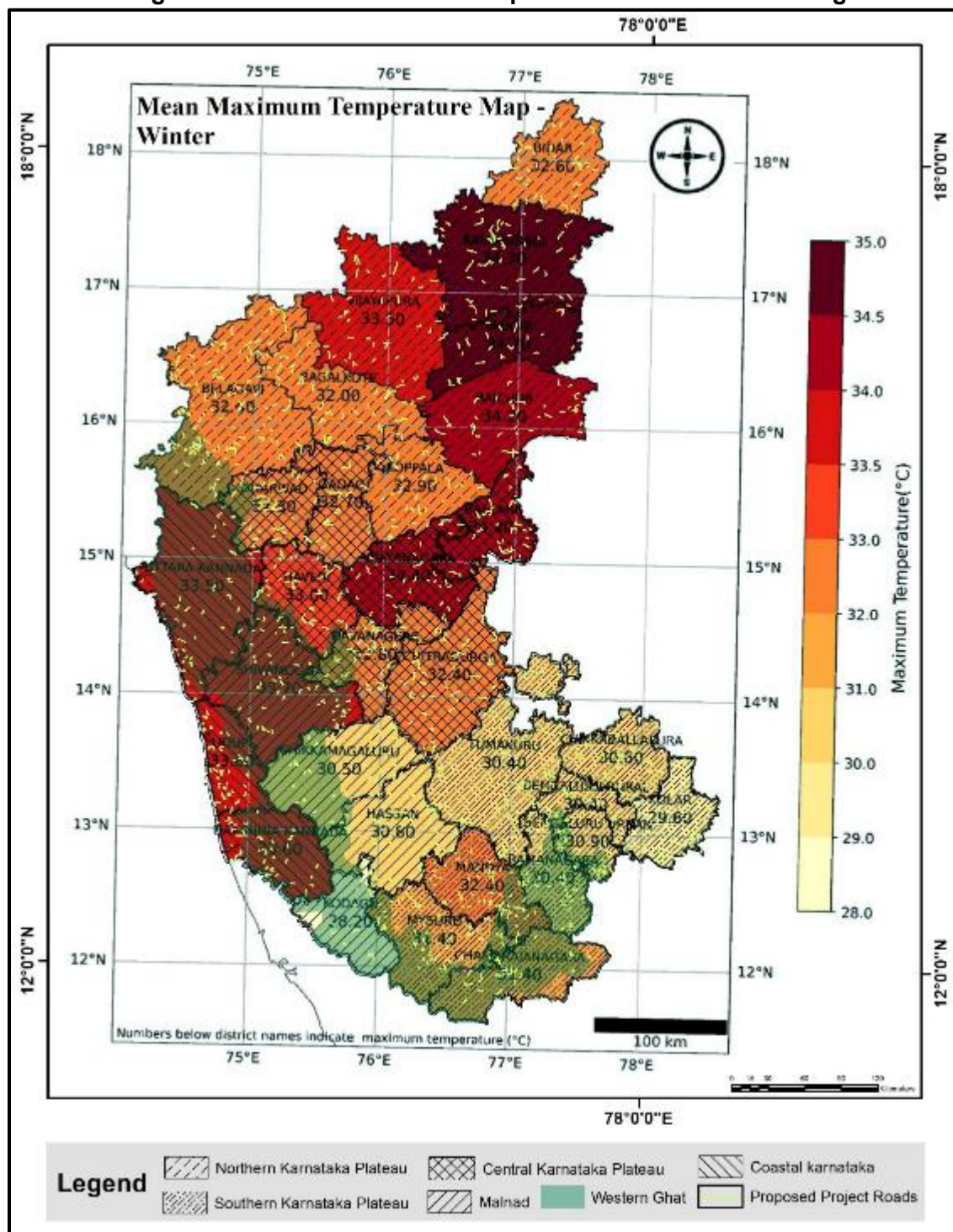


Figure IV-5: Mean Maximum Temperature in Karnataka during Winter

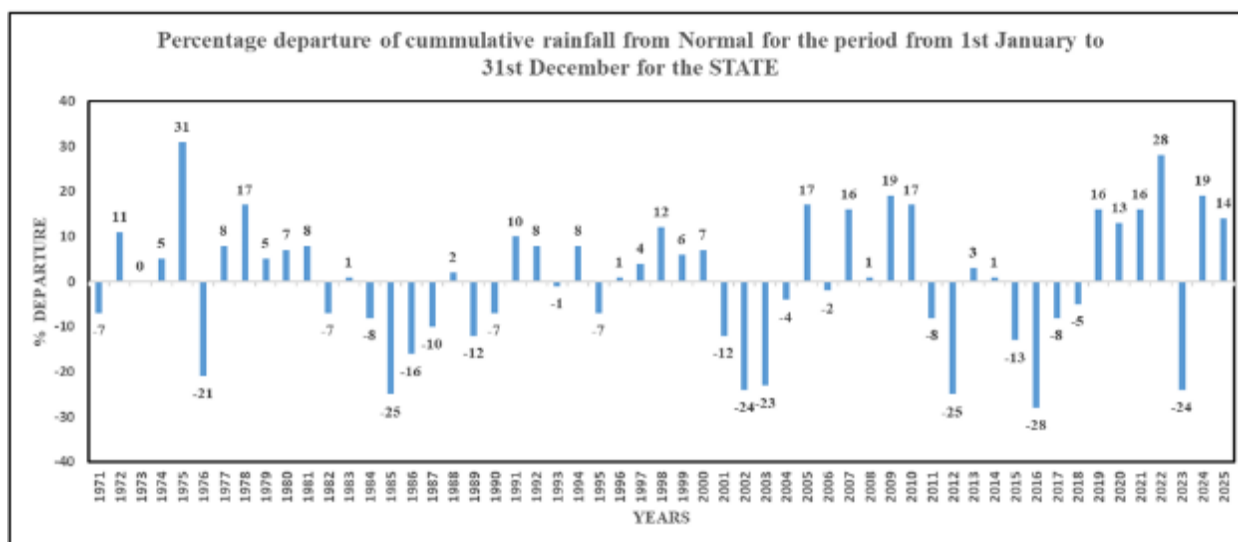


4. Rainfall²²

229. Karnataka receives an annual normal rainfall²³ of 1,153 mm, with pronounced spatial and seasonal variability. The rainfall regime is dominated by the southwest monsoon (June–September), which contributes about 74% of the total, followed by the northeast monsoon (October–December) at 16%, and the pre-monsoon season (March–May) at 10%.

230. In the year 2025, the state recorded 1,319 mm rainfall, representing a 14% positive departure from the long-term normal. The percentage departure of annual rainfall from normal for the State since 1971 is given in the following Figure IV-6.

Figure IV-6: Percentage Departure of Cumulative rainfall from Normal for Karnataka State



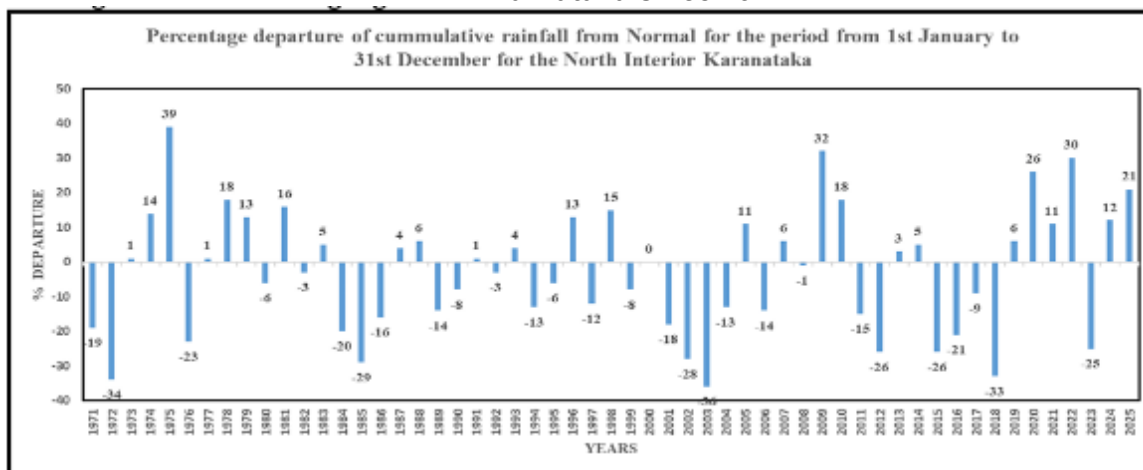
231. Rainfall in different meteorological subdivisions is as follows:

- North Interior Karnataka: During 2025, the Annual rainfall was recorded Normal in Bagalkote, Ballari, Belagavi, Bidar, Dharwad, Gadag, Kalaburagi, Koppala, Haveri, Raichur, Vijayanagara, Vijayapura and Yadgir Districts. During the preceding year (2024), the Annual rainfall was Excess in 1 District and Normal in 12 Districts. Figure IV-7 indicates that, during 2025, the North-Interior Karnataka recorded rainfall (+)21% which is more than the corresponding period from last year. Percentage departure of the Annual rainfall from Normal in North Interior Karnataka since 1971 is given in the Figure IV-7.

²² <https://data.opencity.in/dataset/karnataka-annual-rainfall-districts-taluks-and-hoblis>

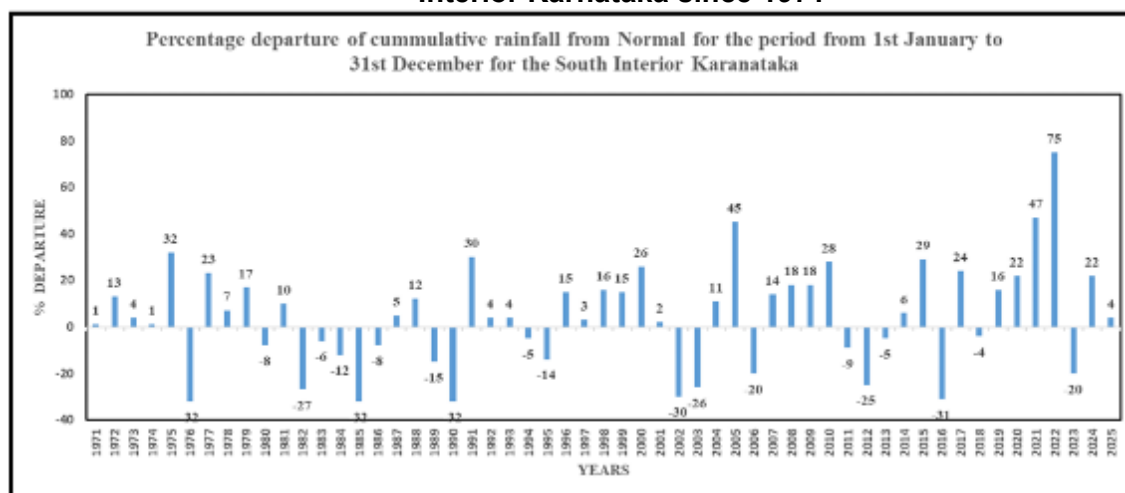
²³ Normal Rainfall: Rainfall within $\pm 19\%$ of the long-term average for the season or year.

Figure IV-7: Percentage departure of Annual rainfall from Normal in North Interior Karnataka since 1971



- South Interior Karnataka: During 2025, the Annual rainfall was Normal in Bengaluru Rural, Bengaluru Urban, Chikkaballapura, Chitradurga, Davanagere, Kolar, Mandya, Mysuru, Ramanagara and Tumakuru Districts and Deficit in Chamarajanagara District. During the preceding year (2024), the Annual rainfall was Excess²⁴ in 8 Districts and Normal in 3 Districts. Figure IV-8 shows that, during 2025, the South-Interior Karnataka recorded rainfall more the Normal, which is less than the corresponding period from the last year (2024).

Figure IV-8 Percentage departure of the Annual rainfall from Normal in South Interior Karnataka since 1971

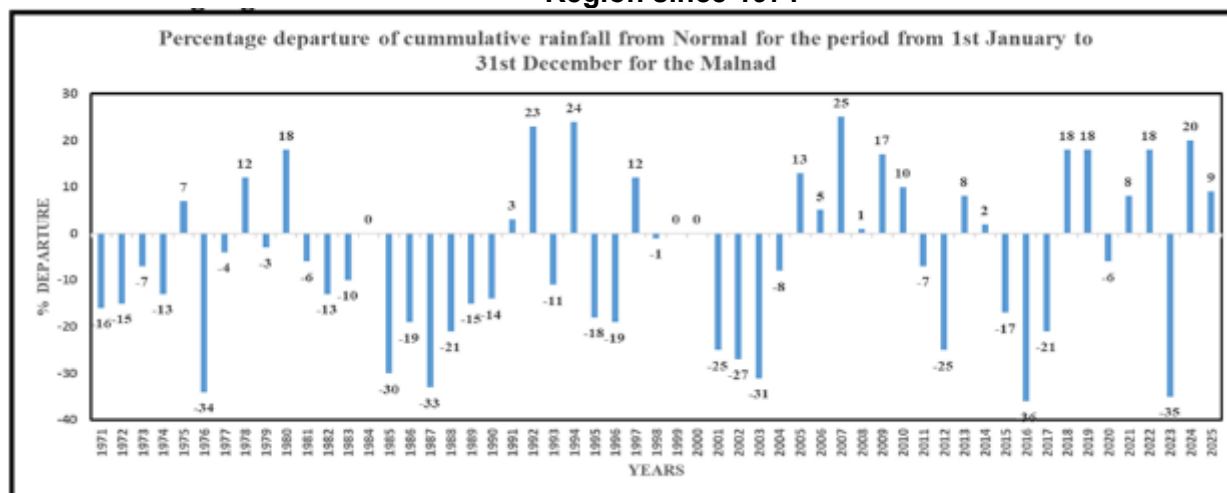


- Malnad Region: During 2025, the Annual rainfall was Normal in Chikkamagaluru, Hassan, Kodagu and Shivamogga Districts. During the preceding year (2024), the Annual rainfall was Excess in 2 Districts Excess in 2 Districts. Percentage departure of the Annual rainfall from Normal in Malnad Region since 1971 is given in the following Figure IV-9. Further during 2025, the Malnad Region recorded a

²⁴ Excess: Rainfall +20% to +59% above normal, Deficit: Rainfall -20 to -59% below normal

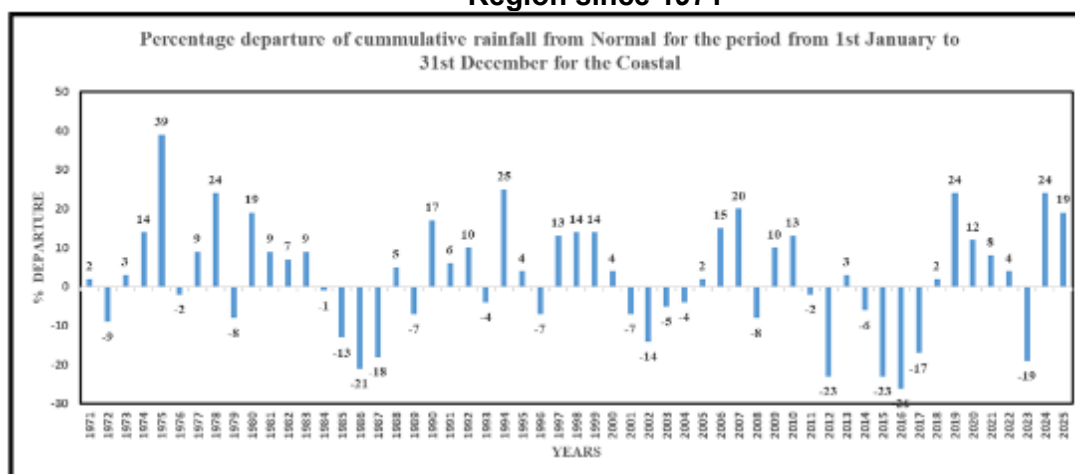
rainfall (+)9% more the Normal, which is less than the corresponding period from the last year.

Figure IV-9: Percentage departure of the Annual rainfall from Normal in Malnad Region since 1971



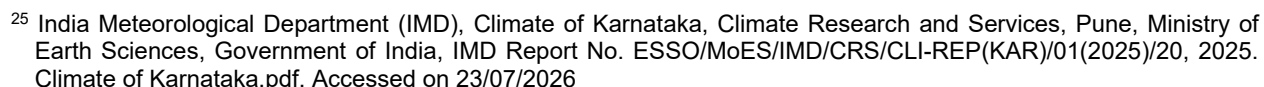
- Coastal Region: During 2025, the Annual rainfall was Excess in Dakshina Kannada District and Normal in Uttara Kannada and Udupi Districts. During the preceding year (2024), the Annual rainfall was Excess in 1 District and Normal in 2 Districts.
- Figure IV-10 shows that, during 2025, the Coastal Region recorded a rainfall (+)19% more the Normal and which is less than the corresponding period of the last year.

Figure IV-10: Percentage departure of the Annual rainfall from Normal in Coastal Region since 1971



232. District wise Annual rainfall pattern during 2025 in Karnataka state is presented in Figure IV-11 indicates that during 2025, the rainfall was Excess in 11 Districts, Normal in 19 districts while Deficit in Chamarajanagara.

233. Karnataka exhibits distinct seasonal variations in sea level pressure and wind regimes, largely governed by the southwest monsoon circulation and associated regional weather systems. The sea level pressure generally ranges around 1013.25 mb, which is the standard pressure at



sea level, with variations influenced by weather systems and seasons. During summer (March to May), a heat-induced low-pressure system develops over northwestern India and adjoining Pakistan, establishing a pressure gradient that gradually strengthens with the approach of the southwest monsoon. During the southwest monsoon season (June to September), this pressure gradient supports the influx of moisture-laden winds over Karnataka, resulting in increased wind speeds and widespread rainfall, particularly over the coastal districts.

234. With the withdrawal of the southwest monsoon, the pressure gradient weakens and gradually reverses during the post-monsoon season (October to December). During this period, low-pressure systems develop over the Bay of Bengal and progressively shift southwards, influencing the weather conditions over southern India. By January and February, the pressure gradient generally becomes weak and relatively stable. Sea level pressure over the region typically remains close to the standard mean sea level pressure, with seasonal fluctuations associated with these regional circulation patterns.

235. Table IV-1, Table IV-2 and Table IV-3²⁵ gives the monthly mean wind speed in kilometre per hour and predominant wind direction in the morning and evening for observatory stations in the state. Karnataka experiences strong surface winds (40-50 kmph) during the southwest monsoon season, particularly along the coast. The coastal regions of Karnataka are prone to rough sea conditions and strong winds associated with the monsoon and offshore troughs.

236. In Coastal Karnataka, wind speeds are moderate to strong from March to August, peaking in July (6.3 kmph) Lowest speeds are seen in November (3.9 kmph) and October (3.5 kmph). Karwar experiences the strongest winds (up to 9.7 kmph in July). Shirali has the lowest annual average wind speed (3.8 kmph), especially low from September to November. During morning, winds generally blow from the east in pre-monsoon, monsoon and post-monsoon months while south-westerly winds dominate during monsoon months. In the evening winds are mostly westerly in all stations during March to September. Winds shift to Westerly or North-westerly in evenings during post-monsoon and winter months.

237. In North Interior Karnataka, Gadag, Bidar, Dharwad, Vijayapura and Haveri experience the strongest winds, especially during the monsoon. Koppal show much lower wind speeds, indicating relatively calmer conditions. Wind direction patterns align well with seasonal monsoon influences, transitioning from eastern winds in early months to south-westerly during monsoon, and then returning northeasterly post-monsoon. Wind speeds increase steadily from January, peaking during June to August. Average annual wind speed for the region is 7.5 kmph.

238. In South Interior Karnataka, winds during the winter season are generally light and predominantly easterly to northeasterly. Wind speeds increase during the summer months, accompanied by a gradual shift in direction towards south-westerly and north-westerly sectors. Stronger and more persistent south-westerly winds prevail during the southwest monsoon, while wind speeds decrease again during the post-monsoon season, with winds shifting back towards easterly and northeasterly directions or becoming calm. Annual average wind speeds across the region range from approximately 3.7 km/h to 9.2 km/h, with a regional average of about 5.6 km/h. Bengaluru Rural, Ballari, Chitradurga and Kolar exhibit a comparatively pronounced seasonal pattern, with higher wind speeds during the monsoon and lower speeds during winter. In contrast, Mandya, Mysuru, Chikkamagaluru and Chikkaballapura generally experience relatively low wind speeds throughout the year. Evening wind directions are also observed to be comparatively more consistent than morning wind patterns.

Table IV-1: Mean Wind Speed (kmph) and Predominant Wind Direction of Coastal Karnataka

DISTRICT MEAN		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Dakshina Kannada	a	4.1	4.2	4.2	4.4	4.6	4.9	4.7	4.3	3.9	3.7	3.3	3.9	4.2
	m	E	E	E/C	E/C	E/C	C/E/SE	C/W	C/W	C/E	C/E	E	E	
	e	W	W	W	W	W/NW	W	W	W	W/NW	W	W	W	
Karwar (Uttar Kannada)	a	4.2	5.1	6.1	7.4	8.6	9.5	9.7	7.8	4.8	3.9	3.7	4.0	6.2
	m	C	C	C	C	C	C/SW	SW/C	C/SW	C	C	C/NE	C/NE	
	e	W/NW	W	W	W	W	SW	SW	W/SW	W	C/W	C	C	
Honavar (Uttar Kannada)	a	4.8	4.9	4.9	5.5	5.4	6.3	6.0	4.7	4.4	4.3	4.8	5.5	5.1
	m	E	E	E	E	C/E	C	C/W	C	C	E/C	E	E	
	e	W	W	W	W	W	W/SW	W	W	W	W	W/C	W	
Shirali (Uttar Kannada)	a	4.2	3.9	3.8	3.8	4.2	4.0	4.7	3.5	3.0	2.3	3.7	4.9	3.8
	m	NE	NE	NE	NE	NE/NW	SW	SW	SW	NE	NE	NE	NE	
	e	SW	NW	NW/SW	SW/NW	NW/SW	SW	SW	SW	SW/NW	SW	SW/NW	NW/SW	
Udupi	a	4.1	4.2	4.2	4.4	4.6	4.9	4.7	4.3	3.9	3.7	3.3	3.9	4.2
	m	E	E	E/C	E/C	E/C	C/E/SE	C/W	C/W	C/E	C/E	E	E	
	e	W	W	W	W	W/NW	W	W	W	W/NW	W	W	W	
Sub- Division Coastal Karnataka	a	4.3	4.5	4.7	5.3	5.7	6.2	6.3	5.1	4.0	3.5	3.9	4.6	4.8

a: Mean Wind Speed in Km. per hour, m: Predominant Wind Direction in the Morning, e: Predominant Wind Direction in the Evening, C: Calm.

Source: India Meteorological Department (2025), Climate of Karnataka, IMD Climate Report, Tables I(A)-I(C), pp. 68-72.

Table IV-2: Mean Wind Speed (kmph) and Predominant Wind Direction of North Interior Karnataka

OBSERVAT ORY		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNU AL
Bagalkot	a	3.3	3.6	4.2	4.6	7.0	9.7	10.2	8.3	5.7	4.3	4.1	3.3	5.7
	m	E	E/C	E/C	W	W	W	W	W	W	E/W	E	E	
	e	E	E	E	E/C/W	W	W	W	W	W	E/C/W	E	E	
Belagavi (Belgaum)	a	5.0	5.2	5.2	5.7	7.1	8.9	8.5	7.1	5.6	4.6	5.6	5.8	6.2
	m	C/E	C/E	C/E	C/W	W	W	W	W	W	C/E/NE	E	E	
	e	E	W/E	W	W	W	W	W	W	W	W/NE	E	E	
Bidar	a	7.6	8.2	7.9	8.7	10.6	14.6	14.9	12.9	9.1	6.9	7.1	6.8	9.6
	m	SE/S W	SW/SE	SW	SW/NW	NW/SW	SW	SW	SW/ W	NW	NE	NE/S E	SE/E	
	e													
Dharwad	a	4.5	5.6	6.8	8.4	10.5	11.9	12.2	10.4	7.7	5.5	5.7	5.3	7.9

OBSERVATORY		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
	m													
	e													
Gadag	a	8.5	8.1	8.1	9.4	12.0	15.6	16.4	14.5	11.2	8.5	9.0	9.0	10.9
	m	SE/E	SE/C	SW/C	SW	SW/W	SW	SW/W	SW/W	W/SW	E/SW/W	E	E/SE	
	e	E	E	E/NE/SE	NW/E/NE	SW/W/NW	SW	W/SW	W/SW	SW/W	NE/E/SW	E	E	
Haveri	a	6.4	6.5	7.4	9.6	12.0	13.3	13.5	11.4	9.1	6.7	7.2	7.0	9.1
	m	NE	NE	SW	SW	SW	SW	SW	SW	SW	SW/NE	NE	NE	
	e	NE	NE	SW/NE	SW	SW	SW	SW	SW	SW	NE/SW	NE	NE	
Kalaburagi	a													
	m	NE/C/E	C/NE/E	C/NE/E	C/N/W	W	W	W	W	W	NE/C/E	NE/E	NE/E/C	
	e	C/E	C/E	C/E	C/E/W	W	W	W	W	W	NE/C/E	E/NE	E/C/NE	
Koppal	a	1.9	1.9	2.3	3.1	4.3	5.1	5.4	5.1	3.4	2.5	2.0	2.3	3.3
	m	C/NE	C/NW	C/SE	C/SW/NW	SW/NW	SW	SW	SW	SW/NW	C/NE/SW	C/NE	C/NE	
	e	NE	NE	NE	NE/SE/C	NW	SW/NW	SW	SW	SW/NW	NE	NE	NE	
Vijayapura	a	3.8	4.5	5.4	6.4	9.7	11.5	12.8	11.5	8.2	4.5	3.7	3.6	7.2
	m	C/SE	C/SE	NW/N	NW/N	W/NW	W	W	W	W	NE/NW/SE	NE/SE	SE/C	
	e	NE/SE	NE/SE/SW	NE/SE/SW	NE/NW	NW/W	W	W	W	W	NE	NE	NE	
Sub Division North Interior Karnataka	a	5.1	5.5	5.9	7.0	9.2	11.3	11.7	10.2	7.5	5.4	5.6	5.4	7.5

a: Mean Wind Speed in Km. per hour, m: Predominant Wind Direction in the Morning, e: Predominant Wind Direction in the Evening, C: Calm.

Source: India Meteorological Department (2025), Climate of Karnataka, IMD Climate Report, Tables I(A)-I(C), pp. 68-72.

Table IV-3: Mean Wind Speed (kmph) and Predominant Wind Direction of South Interior Karnataka

OBSERVATORY		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Bengaluru (Rural)	a	4.5	4.8	5.2	5.6	7.6	11.5	12.0	10.0	8.0	4.9	3.6	3.9	6.8
	m	E	E	C/SW/E	W/SW	W	W	W	W	W	W/E	E/NE	E	
	e	E	E	E	E	W/NW	W	W	W	W	E/NE	E	E	
Bengaluru (Urban)	a	4.6	4.4	4.0	3.7	5.2	7.6	8.1	7.1	5.5	3.8	4.1	4.7	5.2
	m	E	E	C/E	C/W/SW	W	W	W	W	W	C/E/W	E	E	
	e	E	E	E	E/C	W/C	W	W	W	W	C/E/W	E	E	
Ballari (Bellary)	a	3.9	3.6	3.8	4.6	7.0	10.0	10.7	9.9	6.8	3.7	2.8	4.2	6.0
	m	SE/E	E/SE	C	C	C/NW	W	W	W	W/NW	C	C	C/E/SE	
	e	E/SE	SE/E	E/SE	NW/SE	NW	W	W	W	W	NE/E	NE/E	E/SE	
Chikkaballapura	a	2.4	3.3	3.3	2.0	3.1	6.3	6.5	6.7	4.2	2.2	1.9	2.5	3.7
	m	SE	SE	SE	SW	NW/SW	SW	SW	SW	SW	NE/SW	NE	NE	
	e	SE	SE	SE	SE/NE	NW	SW	SW	SW	SW/NW	NE	NE	NE	
Chikmagalur	a	3.0	3.1	3.4	3.6	4.9	6.4	6.6	5.9	4.6	2.9	3.1	3.1	4.3
	m	C/NE	C/E	C/SW	C/SW	NW/C	NW/SW	NW	NW	NW	C	NE/C	NE	
	e	NE	NE/E	NE/SW	SW/NW	NW	NW/SW	NW	NW	NW	C/NE	NE	NE	
Chitradurga	a	6.3	6.6	7.0	7.5	10.9	13.9	14.4	13.1	10.7	6.4	6.0	6.6	9.2
	m	E	C/E	SW/C	SW	SW	SW	SW	SW	SW	SW	E	E	
	e	NE	NE	NE	NE/SW	SW/W	SW	SW	SW	SW	NE/SW	NE	NE	
Davanagere	a	4.4	4.2	4.0	4.5	5.8	7.1	7.7	6.8	5.2	3.9	4.4	4.6	5.2
	m	SE	SE	SW/SE	SW	SW	SW	SW	SW	SW	SW	NE	NE	
	e	E/SE	SE/E	SW/SE	SE	SW	SW	SW	SW	SW	SW	NE	NE	
Kolar	a	6.1	5.9	5.9	5.7	6.9	10.3	10.0	9.4	6.6	4.6	4.9	5.9	6.9
	m	E	E	W/SW	W	NW/W	W	W	W	NW/W	NW/NE/E	NE/E	E	
	e	E	E	E	E/NW	NW	W	W	W	NW	E/NW	E	E	
Mandya	a	3.1	3.1	3.0	3.4	4.2	6.5	5.4	4.9	5.3	3.6	3.0	3.0	4.1

OBSERVATORY		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
	m	NE	C/NE	C/SW/NE	C/SW	SW	SW	SW	SW	SW	C/NE/SW	NE	NE	
	e	NE/C/SE	NE/C/SE	C/NE/SE	C/SE/NE	SW	SW	SW/W	SW	SW	C/SW	C/NE/SE	NE/C/E	
Mysuru	a	3.0	3.4	3.6	3.6	4.1	6.1	6.4	5.6	4.7	2.9	2.8	3.5	4.1
	m	C/NE/E	C/E/NE	C/E/SW	C/SW	SW/C/W	SW	SW	SW	SW/C/W	C/SW	C/NE/E	NE/C/E	
	e	C/E/NE	E/NE/C	E/C/NE	C/E/NE	C/SW/W	SW	SW	SW	SW	C/SW	C/NE/E	C/E/NE	
Tumakuru	a													
	m	E/S/SE	S	S	S	S	S	S	S/W/SW	S/W	S	E/S	E	
	e	E	S/SE/E	S/SE/E	S/SW/E	S/SW/E	S/SW/W	S/W/SW	W/SW/S	W/S	S/E/NE	E/NE	E/NE/SE	
Sub Division South interior Karnataka	a	4.1	4.2	4.3	4.4	6.0	8.6	8.8	7.9	6.2	3.9	3.7	4.2	5.6

a: Mean Wind Speed in Km. per hour, m: Predominant Wind Direction in the Morning, e: Predominant Wind Direction in the Evening, C: Calm.
Source: India Meteorological Department (2025), Climate of Karnataka, IMD Climate Report, Tables I(A)-I(C), pp. 68-72.

6. Relative Humidity

239. Relative humidity (RH) varies across the different meteorological subdivisions of Karnataka, reflecting regional variations in climatic and geographical conditions is as follows:

240. In Coastal Karnataka, RH is generally high during the period from March to October. On an average, it varies from 66% to 70% and from 78% to 88% in the afternoon during the period of summer and monsoon season respectively. The values of humidity during the summer season generally remain low than that of the southwest monsoon and winter season. Diurnal variation in the relative humidity is the least during the monsoon season and it is highest in the winter season.

241. In North Interior Karnataka, RH is generally high during the period June to November in the morning and on an average, it varies from 71% to 85 % during the monsoon season and from 51% to 61% in the post monsoon season in the afternoon. Summer season is the driest part of the year with relative humidity varying from 56% to 68% in the morning and 30% to 41% in the afternoon and making the summer very hot. Diurnal variation in the relative humidity is the least during the monsoon season and it is the highest in the winter season.

242. In South Interior Karnataka, RH is generally high during the period of southwest monsoon and post monsoon season. It varies from 80% to 85% in the morning and 64% to 72% in the afternoon. Summer season is the driest part of the year with RH varies from 68% to 76% in the morning and 36% to 52% in the afternoon and making the summer very dry and hot.

7. Geology and Minerals

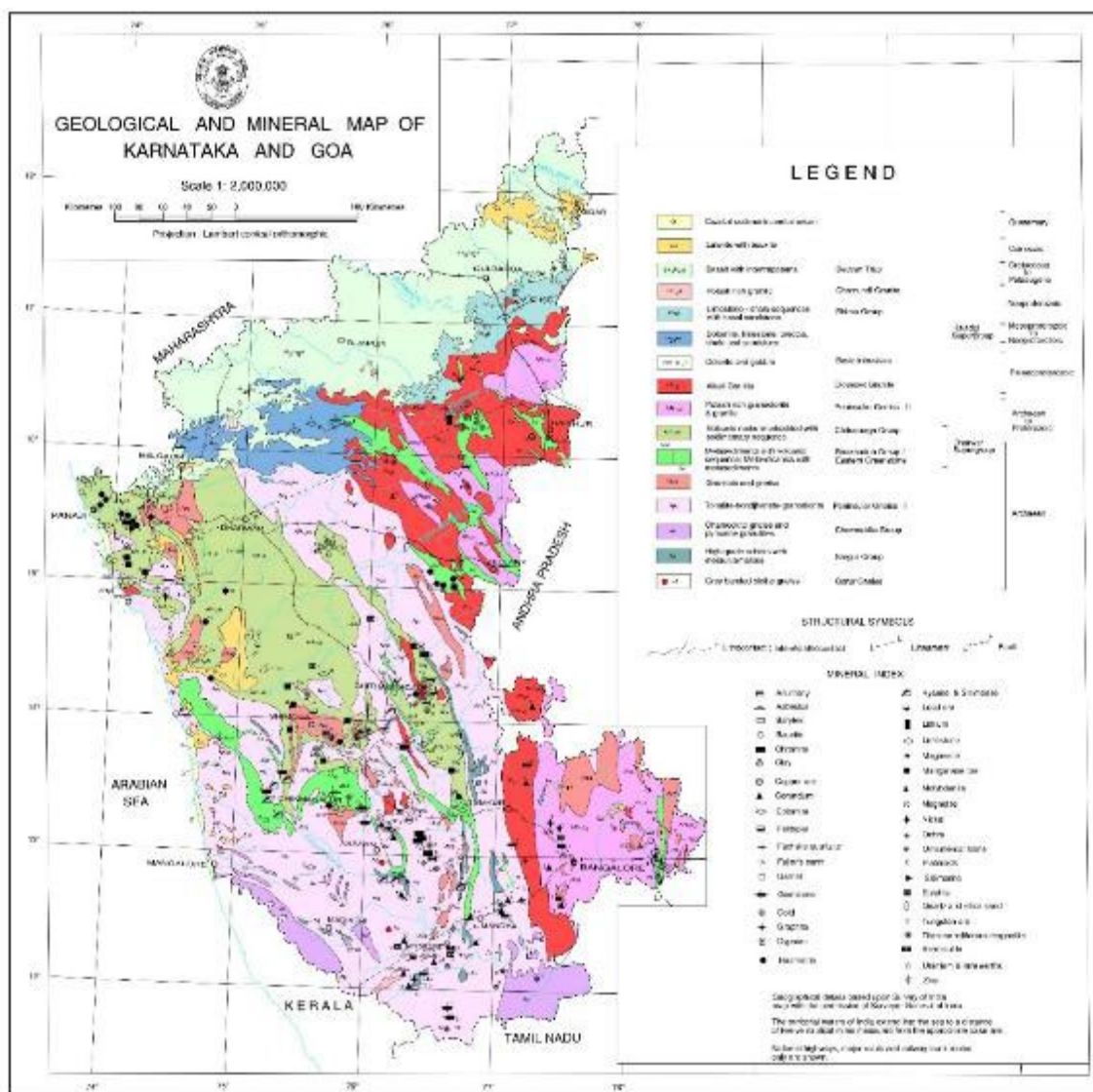
243. The geology of Karnataka is predominantly composed of Archaean crystalline formations of the Peninsular Gneissic Complex and Dharwar Supergroup, comprising granitic gneisses, schists, and metavolcanic sequences distributed across central, southern, and eastern parts of the state.

244. Distinct greenstone belts (e.g., Ballari–Chitradurga trends) and younger granitic intrusions are evident, while Proterozoic sedimentary formations (Kaladgi and Bhima Groups) consisting of sandstone, limestone, and shale occur in northern and northeastern regions.

245. The western coastal and Ghats sections are characterized by extensive laterite with bauxite capping and coastal alluvium, indicating intense weathering under tropical conditions. Structural features such as lineaments, faults, and lithological contacts are observed across the state, reflecting localized zones of weakness within an otherwise stable cratonic setting.

246. Karnataka is endowed with significant mineral resources associated primarily with the Dharwar Supergroup and granitic terrains. Major minerals include iron ore (Ballari–Hospet belt), gold (Kolar and Hutti regions), manganese, limestone, bauxite (in lateritic zones), and minor occurrences of copper, chromite, and feldspar. The geology and mineral map of Karnataka state is presented in Figure IV-12 below.

Figure IV-12: Geology and Mineral Map of Karnataka



Source: Mines Environment and Mineral Conservation Association Bengaluru Region.²⁶

8. Soil

247. The soils of Karnataka are broadly classified into red soils, laterite soils, black soils, colluvio-alluvial soils, brown forest soils and coastal laterite/alluvial soils.²⁷

248. These soil groups are influenced by the state's geology, physiography, rainfall, drainage and vegetation. Red soils are commonly associated with the granitic and gneissic terrain of the southern, central and eastern plateau regions; black soils are generally found in the northern plateau areas and are clay-rich; lateritic and brown forest soils occur mainly in the Western Ghats

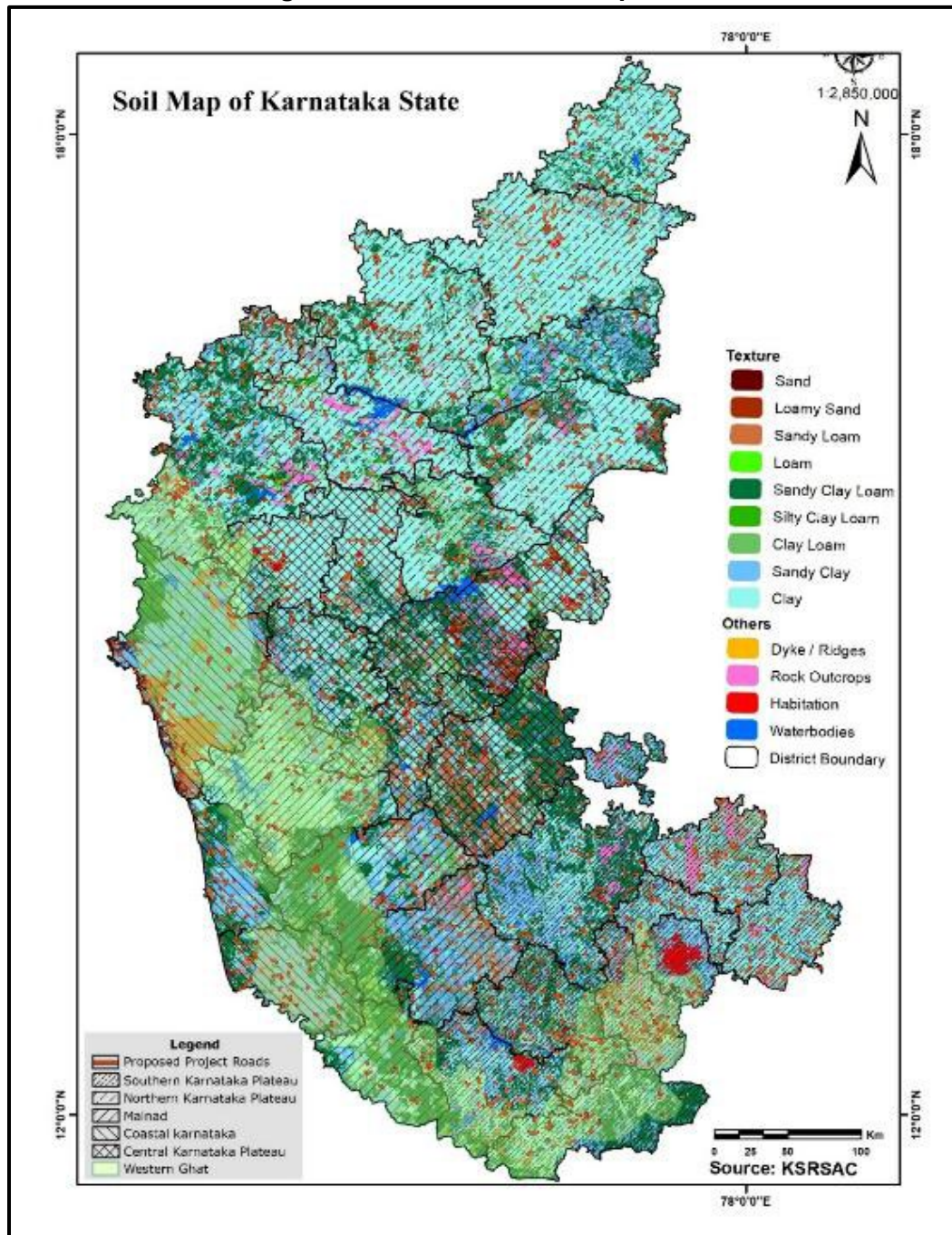
²⁶ About – MEMC – Mines Environment & Mineral Conservation (Accessed July 2026)

²⁷ Karnataka Monitoring and Evaluation Authority, Evaluation of Special Component Programme (SCP) and Tribal Sub Plan (TSP).pdf

and Malnad regions; and coastal laterite/alluvial soils occur along the coastal belt and riverine/low-lying areas.

249. Figure IV-13 represents the soil texture in the Karnataka state, which indicates that most of the Project roads are in sandy clay loam to clay loam textures, particularly in the coastal, Malnad and plateau transition areas.

Figure IV-13: Soil Texture map of Karnataka

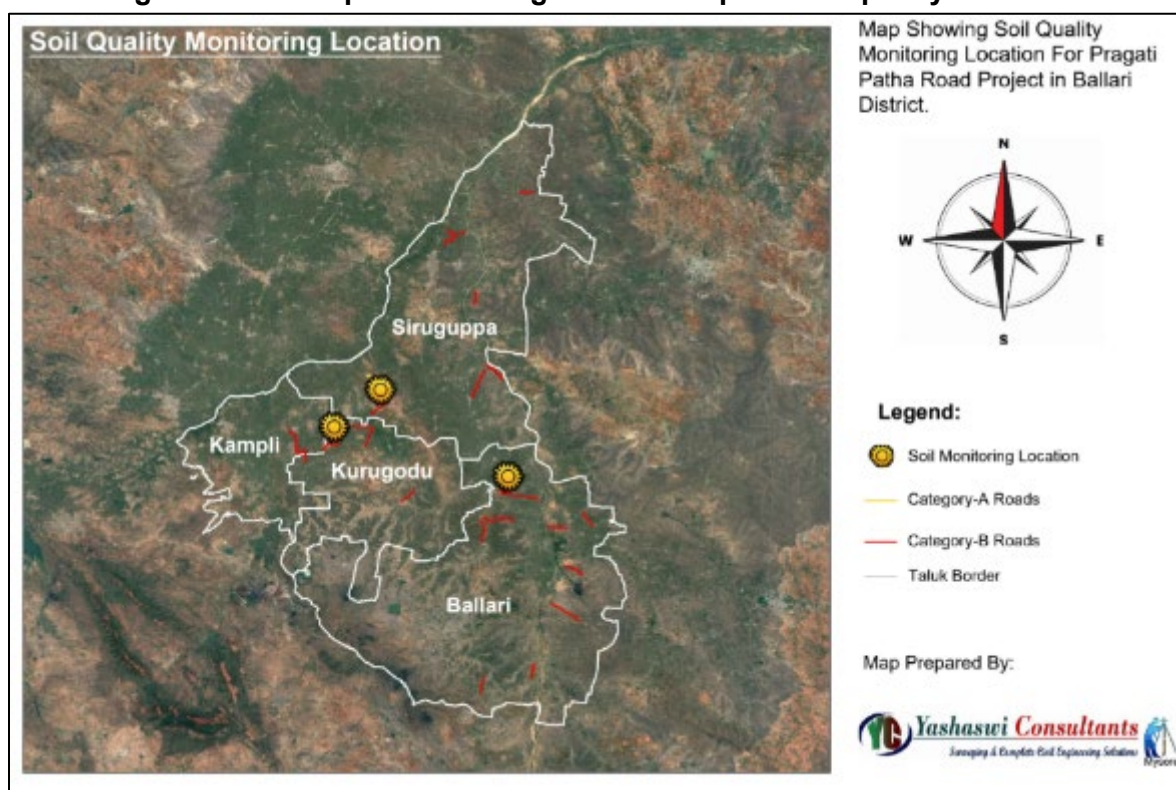


9. Methodology of Soil Quality Monitoring

250. Soil quality monitoring was undertaken to establish the existing physico-chemical characteristics of soils along the project roads. The baseline soil data are required to assess potential impacts related to construction activities, including soil compaction, contamination from fuel or lubricant spills, disposal of construction waste, erosion and disturbance of agricultural land.

251. Representative soil sampling locations 772 in number (Appendix 21), were selected from representative land-use areas along the project roads, including agricultural fields, roadside areas, proposed construction activity zones, borrow area vicinity and other locations likely to be influenced by project activities. Selection of locations considered soil type, land use, agricultural dependency, drainage condition and proximity to construction works. A sample package is provided in the Figure IV-14. Monitoring locations maps for other districts are provided in Appendix 20.

Figure IV-14 Sample monitoring location map for soil quality for Ballari district



252. Composite soil samples were collected from the upper soil layer using clean sampling equipment. Multiple sub-samples were collected from each sampling location and homogenized to obtain a representative composite sample. The samples were packed in clean, labelled containers and transported to the laboratory for analysis.

253. The soil samples were analysed for physical and chemical characteristics, including texture, sand, silt and clay content, moisture content, pH, electrical conductivity, organic carbon, available nitrogen, available phosphorus, available potassium, calcium, magnesium, cation exchange capacity and sodium adsorption ratio. Karnataka rural road EIA documentation has

reported soil parameters such as pH, electrical conductivity, potassium, calcium, magnesium, cation exchange capacity, moisture, sodium absorption ratio, sand, silt and clay.

254. According to the soil baseline data collected along the Project roads, sand content ranges from 0% to 97.44%, with an average value of 45.34% across the Project roads. The highest sand content is recorded at Road ID 973 in Chikkamagaluru district.

255. Silt content ranges from 0% to 97.91%, with an average value of 27.38%. The highest silt content is recorded at Road ID 3691 in Chikkamagaluru district.

256. Clay content ranges from 0% to 66%, with an average value of 21.83%. The highest clay content is recorded at Road ID 3998 in Chikkaballapura district.

257. Overall, the soil texture along the project roads indicates predominance of coarse- to medium-textured soils. These soils generally have moderate to high drainage potential and may be susceptible to erosion where slopes or exposed surfaces remain unprotected.

258. Soil quality monitoring was conducted at representative locations (Appendix 21) across the 1,335 project roads covering different land-use settings such as agricultural lands, settlements, and roadside vegetation corridors to establish baseline conditions. Raw monitoring data is provided in Appendix 22. The monitored soil quality results have been compared, where applicable, with the land-use-specific Soil/Sediment Screening Levels prescribed under Schedule I of the Environment Protection (Management of Contaminated Sites) Rules, 2025. Considering that the Project roads predominantly traverse rural areas comprising agricultural land and settlements, the Agricultural and Residential Screening²⁸ Levels have been considered for comparison. Among the monitored parameters, screening levels are prescribed under the Rules for pH, electrical conductivity and Sodium Adsorption Ratio (SAR). For the remaining monitored parameters, no corresponding Soil/Sediment Screening Levels are prescribed under the Rules; therefore, these parameters have been assessed descriptively based on their observed ranges and general soil characteristics.

259. Analysis of the collected samples indicates that soils are predominantly neutral, non-saline and sandy to loamy soils. The soil pH ranges from 5.21 to 8.8, with an average value of 7.14, indicating slightly acidic to slightly alkaline conditions. While the average pH is within the agricultural and residential screening range of 6–8, the minimum and maximum values indicate localized acidic and alkaline soil conditions, respectively. Such variations may be attributed to differences in the underlying soil and geological characteristics, rainfall and leaching conditions, organic matter content, agricultural practices and local drainage conditions.

260. Electrical conductivity ranges from 0.1 to 1490 $\mu\text{S}/\text{cm}$, with an average value of 207.67 $\mu\text{S}/\text{cm}$, indicating low to moderate salinity conditions. The EC value remains below the agricultural and residential screening²⁸ level of 2 dS/m (2,000 $\mu\text{S}/\text{cm}$), indicating that the monitored soils are generally not characterized by elevated soluble salt concentrations.

²⁸ Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India, Environment Protection (Management of Contaminated Sites) Rules, 2025, notified vide S.O. 3401(E) dated 24 July 2025 under the Environment (Protection) Act, 1986. Agricultural and residential Soil/Sediment Screening Levels presented in the table are adopted from Schedule I of the Rules.

261. Calcium and magnesium are the dominant exchangeable cations, with average concentrations of 859.44mg/kg and 183mg/kg, respectively. Potassium ranges from 6.8 to 1304mg/kg, with an average value of 142.34mg/kg.

262. Cation Exchange Capacity ranges from 3.24 to 619 meq/100 g, with an average value of 27.92 meq/100 g, indicating variable nutrient-holding capacity depending on local soil texture.

263. The Sodium Adsorption Ratio (SAR) ranges from 0.1 to 15, with an average value of 2.22. While the average value is below the applicable screening level of 5, the maximum value of 15, recorded in the Sira region of Tumakuru District, indicates a localized exceedance. Elevated SAR may be associated with naturally sodium-rich parent material, accumulation of sodium under relatively dry conditions, poor drainage, or the use of irrigation water containing elevated sodium concentrations. Localized anthropogenic influences may also contribute to elevated sodium levels.

264. Summary of monitored soil quality data is presented in Table IV-4 below.

Table IV-4: Summary Statistics of Soil Quality Parameters Along the Project Roads

SN	Parameters	Minimum	Maximum	Average	The Environment Protection (Management of Contaminated Sites) Rules, 2025, Schedule I ²⁹	
					Agriculture	Residential
1.	pH	5.21	8.80	7.14	6-8	6-8
2.	Electrical Conductivity (µs/cm)	0.10	1490	207.67	2 dS/m (2,000 µS/cm)	2 dS/m (2,000 µS/cm)
3.	Calcium (mg/kg)	35	5561	859.4	-	-
4.	Potassium (mg/kg)	6.8	1304	142.34	-	-
5.	Magnesium (mg/kg)	6.8	903	183	-	-
6.	Sand (%)	0	97.44	45.34	-	-
7.	Silt (%)	0	97.91	27.38	-	-
8.	Clay (%)	0	66	21.83	-	-
9.	Cation Exchange Capacity (meq/100gm)	3.24	619	27.92	-	-
10.	Moisture (%)	0.8	48.78	11.28	-	-
11.	Sodium Absorption Ratio (SAR)	0.1	15	1.73	5	5

10. Soil Erosion

265. The soil erosion dataset created by Indian Council of Agricultural Research (ICAR), National Bureau of Soil Survey and Land Use Planning (NBSS & LUP)^{30 31} (Figure IV-15) has

²⁹ These values are screening levels under the contaminated-site management framework, rather than general soil-fertility standards. An exceedance of a screening level should therefore be presented as warranting location-specific review, not by itself as confirmation that the location is a legally declared contaminated site.

³⁰ <https://indiaawris.gov.in/wris/#/geoSpatialData>

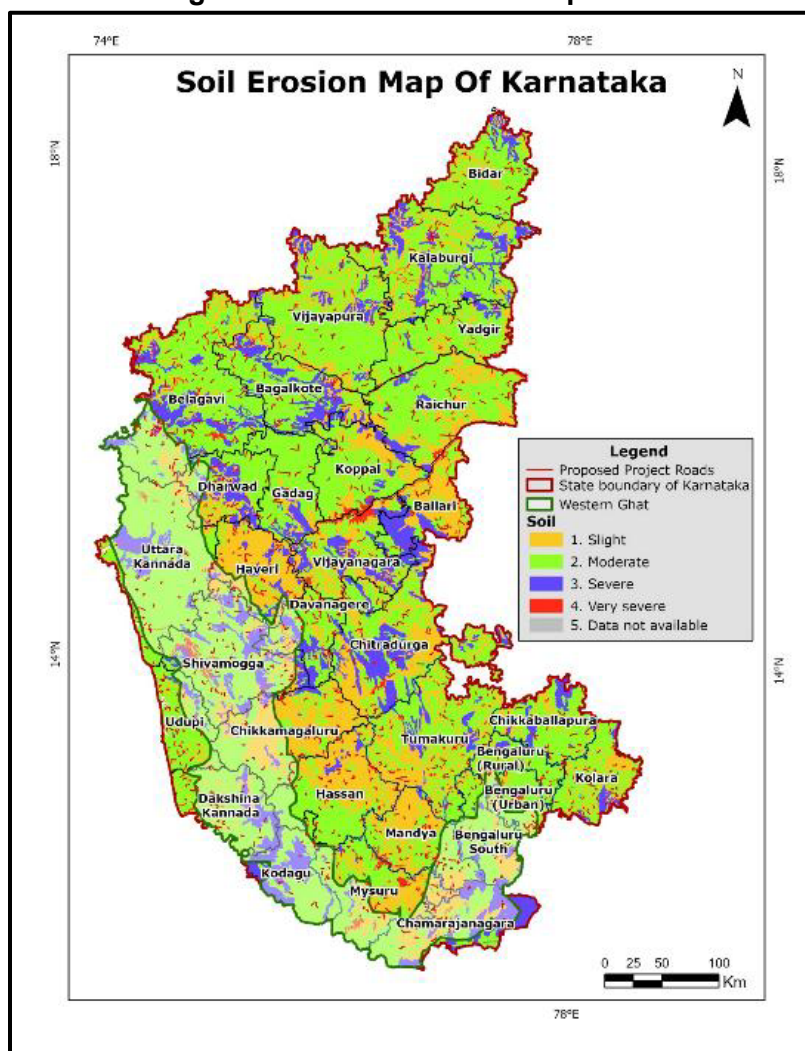
³¹ The Soil Erosion dataset, maintained by ICAR's NBSS & LUP, provides detailed information on soil types across India (excluding the northeastern states). It classifies soils based on sand, silt, and clay percentages, categorizing

been used for the assessment of susceptibility of soil erosion in the areas where Project roads are located.

266. The soil erosion layer was overlaid with the alignments of the 1,335 proposed project roads using GIS. The soil erosion raster was converted into polygon features, and areas classified as Severe and Very Severe or Gullied were extracted. The project-road alignments were spatially intersected with the extracted erosion-category polygons. Roads having either full or partial spatial overlap with these categories were identified based on their unique Road IDs. Duplicate records resulting from roads intersecting multiple erosion polygons were removed to derive the final number and list of affected project roads.

267. The assessment indicates out of the 1335 roads assessed, 223 roads fall either partially or entirely within severe erosion zones, while 28 roads fall either partially or entirely within very severe/gullied erosion zones erosion category, indicating spatial variation in erosion susceptibility along the road alignment.

Figure IV-15: Soil Erosion Map of Karnataka



Source: India WRIS³⁰

them as Sandy, Coarse, Loamy, or Fine textured. Collected using satellite images (IRS LISS-III, SRTM 30m, and Sentinel-2) at a 1:50,000 scale during 2004-2005.

268. A total of 251 roads intersect high-risk erosion³² areas. These road sections may be more vulnerable to soil loss, slope erosion, runoff concentration, embankment instability, and sediment movement during construction, particularly during the monsoon season.

269. Details of the roads (either full or partially) having very severe/gullied soil erosion potential is provided in Table IV-5 below.

Table IV-5 Project Roads Falling Fully or Partly within Very Severe/Gullied Soil Erosion Potential Areas

S N	Road ID	District	Tehsil	Village	Soil Erosion Potential
1	2533	Tumkur	Tiptur	Nonavinakere	Slight, Very Severe/gullied
2	4886	Bellary	Sandur	Toranagal	Slight, Very Severe/gullied
3	828	Bellary	Siruguppa	Malapura	Slight, Very Severe/gullied
4	174	Udupi	Kundapura	Kandavara	Moderate, Very Severe/gullied
5	1323	Udupi	Udupi	Kumragod, Varamballi (CT)	Moderate, Very Severe/gullied
6	1139	Uttar Kannada	Honavar	Beranki	Moderate, Very Severe/gullied
7	1325	Mysuru	Mysuru	Yachegowdanahalli	Moderate, Very Severe/gullied
8	1328	Haveri	Ranibennur	Chikkakuravatti	Slight, Very Severe/gullied
9	1338	Haveri	Ranibennur	Nagenahalli	Slight, Very Severe/gullied
10	1392	Dakshina Kannada	Mangalore	Padupanamboor, Pavanje	Moderate, Very Severe/gullied
11	1444	Kolar	Mulbagal	Mustoor, Kerasamangala, Nangali	Slight, Very Severe/gullied
12	2162	Chitradurga	Hosdurga	Arehalli, Mathodu, Thippenahalli	Slight, Moderate, Very Severe/gullied
13	2456	Chikmagalur	Kadur	Chikkadevanur, Bommenahalli S, Thippagondanalli	Slight, Very Severe/gullied
14	259	Dakshina Kannada	Bantval	Kadeshwalya, Kedila	Moderate, very Severe/gullied
15	2726	Uttara Kannada	Kumta	Torke, Toregazani, Naranapur	Moderate, very Severe/gullied
16	351	Bellary	Bellary	Yerragudi	Slight, Moderate, Very Severe/gullied
17	3526	Kolar	Kolar	Chillapalli, Garudapalya, Annihalli, Mathikunte, Besthenahalli	Slight, Moderate, Very Severe/gullied
18	3896	Gulbarga	Gulbarga	Bhimanahalli, Keribhosga	Slight, Severe, Very Severe/gullied
19	4119	Yadgir	Shahpur	Tangadgi, Chattanahalli	Moderate, severe/gullied
20	4446	Bellary	Hospet	Kaddirampura, Nimbapura, Venkatapura	Moderate, severe/gullied
21	4816	Mysore	Mysore	Sarakariuthanahalli, Lalithadripura, Yandahalli, Choranahalli, Chikkahalli	Slight, Moderate, Very severe/gullied

³² Roads intersecting "Severe" and "Very severe/gullied" categories have been counted as high-risk erosion roads.

S N	Road ID	District	Tehsil	Village	Soil Erosion Potential
22	4938	Mandya	Pandavapura	Malligere, Sundahalli,	Slight, Very Severe/gullied
23	5255	Chikmagalur	Kadur	Chikkadevanur, Kurubarahalli, Karehalli D.	Slight, Very Severe/gullied
24	5277	Bijapur	Sindgi	Kumashigi	Slight, Moderate, Very Severe/gullied
25	5391	Bellary	Hospet	Hampi, Krishnapura	Moderate, Very Severe/gullied
26	838	Bellary	Hagaribommanahalli	Kithanur, Muthukur	Moderate, Very Severe/gullied
27	901	Bellary	Siruguppa	Bagawady, Gajiginahal	Slight, Very severe/gullied
28	904	Bellary	Siruguppa	Kotehalsugur, Hirehal	Slight, Moderate, Very Severe/gullied

Source: GIS analysis based on the overlay of the 1,335 project road alignments with the soil erosion dataset created by Indian Council of Agricultural Research (ICAR), National Bureau of Soil Survey and Land Use Planning (NBSS & LUP)

B. Natural Hazards

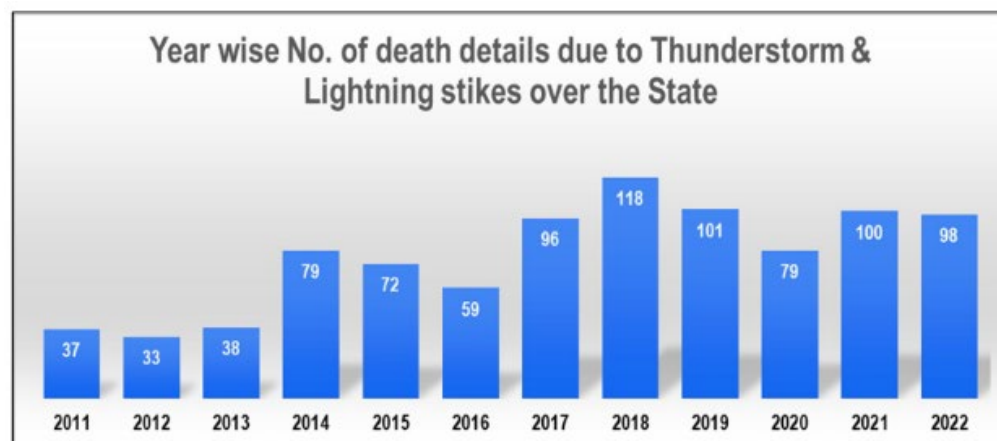
1. Thunderstorm and Lightening

270. Karnataka is prone to thunderstorms and lightning events, which have resulted in recurring loss of life and damage to property across the state.

271. During the period 2011–2022, approximately 910 fatalities were reported due to lightning strikes in Karnataka (Figure IV-16). In addition to human casualties, lightning incidents also cause significant losses to livestock and damage to infrastructure every year.³³

272. Rural and forested areas are particularly vulnerable to lightning strikes due to the presence of tall trees, open agricultural fields, and nearby water bodies. A significant proportion of lightning-related fatalities occur among people working outdoors in agricultural fields and other rural settings.

Figure IV-16: Year wise number of deaths due to Thunderstorm and Lightning in the Karnataka State



³³ Thunderstorm and Lightning network- Karnataka (ksndmc - KSNDMC)

273. According to the Karnataka State Natural Disaster Monitoring Centre (KSNDMC) district-wise cloud-to-ground lightning map (2023) (Figure IV-17), Karnataka recorded approximately 205,025 lightning events during the year, indicating that thunderstorms and lightning are significant natural hazards in the state.

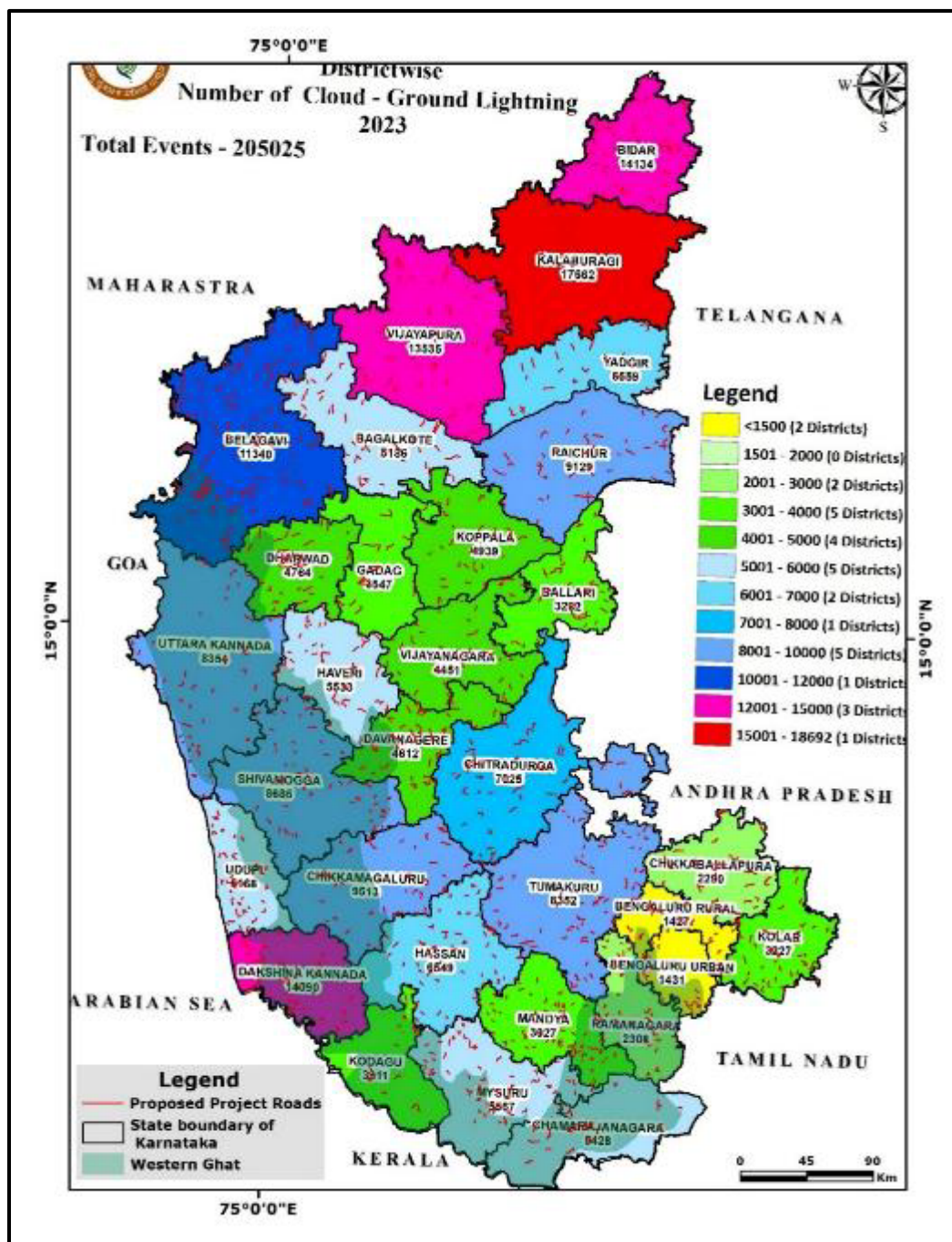
274. The map classifies districts based on the annual number of cloud-to-ground lightning events, with legend ranges representing lightning frequency classes and the bracketed values indicating the number of districts falling within each class.

275. Based on Figure IV-17, road-specific lightning exposure has been assessed at the district level, by assigning each Road ID the lightning incidence category of the district in which it falls. The assessment provides a screening-level indication of relative lightning exposure; accordingly, project roads located in districts with recorded lightning events are considered prone to lightning, with comparatively higher exposure in districts reporting a greater number of events.

276. The map records 205,025 cloud-to-ground lightning events in Karnataka in 2023, with higher incidences observed in districts such as Kalaburagi, Dakshina Kannada, Vijayapura, Belagavi, Chikkamagaluru, Raichur, Shivamogga, Uttara Kannada and Tumakuru. Table **IV-6** presents the districts classified as having High or Very High lightning exposure. Project roads located in these districts are considered comparatively more prone to lightning-related hazards during construction and operation. The assessment is based on district-level incidence and is intended as a screening-level indication of relative exposure.

277. A total of 601 project roads is located in districts with High or Very High lightning exposure, comprising 190 roads in Very High exposure districts and 411 roads in High exposure districts.

Figure IV-17: District-wise Distribution of Cloud-Ground Lightning Events in Karnataka (2023)



Source: Karnataka State Natural Disaster Monitoring Centre (KSNDMC), Government of Karnataka

Table IV-6: Proposed Project Roads Located in Districts with High and Very High Lightning Exposure

District	Lightning Events, 2023	No. of Project Roads	Road IDs	Relative Lightning Exposure ³⁴
Kalaburagi	17,662	59	306, 307, 317, 686, 1494, 1505, 1531, 1532, 1535, 1538, 1547, 2318, 2338, 2409, 2416, 2417, 2436, 2631, 2639, 3321, 3349, 3504, 3613, 3623, 3666, 3669, 3693, 3896, 4175, 4292, 4294, 4336, 4348, 4370, 4374, 4378, 4406, 4434, 4435, 4495, 4504, 4566, 4568, 4592, 4740, 4761, 4763, 4948, 4955, 4980, 5016, 5172, 5173, 5174, 5175, 5464, 5490, 5493, 5494	Very High
Dakshina Kannada	14,090	44	15, 25, 29, 31, 255, 259, 290, 295, 345, 354, 501, 535, 581, 806, 807, 822, 827, 837, 1040, 1041, 1043, 1046, 1052, 1054, 1057, 1059, 1211, 1306, 1368, 1392, 1612, 1643, 1843, 1893, 2202, 2718, 3000, 3152, 3189, 3885, 4420, 4427, 4438, 4867	Very High
Vijayapura	13,535	50	254, 841, 1082, 1618, 1619, 1620, 1622, 2308, 2921, 2923, 3494, 4224, 4252, 4253, 4695, 4696, 4697, 4906, 4907, 4909, 4910, 4918, 4960, 4995, 4998, 4999, 5004, 5005, 5052, 5054, 5152, 5153, 5154, 5155, 5156, 5236, 5237, 5238, 5239, 5240, 5242, 5243, 5244, 5245, 5276, 5277, 5284, 5285, 5300, 5327	Very High
Belagavi / Belgaum	11,340	143	20, 21, 1489, 1644, 1656, 1692, 1693, 1694, 1700, 1702, 1703, 1708, 1712, 1740, 1761, 1782, 1793, 1805, 1813, 1814, 1824, 1826, 1832, 1837, 1842, 1850, 1902, 1911, 1999, 2003, 2005, 2007, 2015, 2024, 2029, 2043, 2044, 2056, 2098, 2100, 2126, 2129, 2132, 2185, 2191, 2357, 2381, 2383, 2425, 2429, 2575, 3372, 3452, 3563, 3616, 3652, 3659, 3686, 3699, 3701, 3813, 4187, 4197, 4330, 4337, 4344, 4384, 4394, 4646, 4720, 4727, 4733, 4768, 4769, 4787, 4788, 4789, 4806, 4808, 4809, 4810, 4813, 4815, 4817, 4820, 4821,	High

³⁴ Relative exposure is a screening classification based on event count: Very High $\geq 12,001$; High 8,001–12,000. It is not an official KSNDMC vulnerability classification.

District	Lightning Events, 2023	No. of Project Roads	Road IDs	Relative Lightning Exposure ³⁴
			4823, 4824, 4828, 4830, 4832, 4849, 4857, 4863, 4879, 4890, 5046, 5048, 5123, 5126, 5127, 5128, 5147, 5148, 5150, 5170, 5171, 5229, 5230, 5266, 5313, 5314, 5315, 5316, 5347, 5348, 5349, 5350, 5352, 5353, 5354, 5376, 5377, 5378, 5380, 5381, 5403, 5404, 5429, 5431, 5432, 5435, 5444, 5445, 5446, 5447, 5467, 5484, 5489, 5499, 5501, 5502, 5510	
Chikkamagaluru	9,513	35	168, 973, 1568, 1573, 2456, 2567, 2568, 2757, 2798, 2978, 3088, 3309, 3471, 3562, 3691, 3703, 3732, 3733, 3853, 4229, 4322, 4415, 4889, 5255, 5256, 5258, 5259, 5270, 5271, 5273, 5274, 5275, 5322, 5323, 5351	High
Raichur	9,129	41	88, 1207, 1931, 2431, 2442, 2529, 2599 (2 records), 2662, 2669, 2699, 3099, 3113, 3114, 3127, 3129, 3190, 3307, 3343, 3397, 3794, 3824, 3825, 3894, 3910, 3913, 4410, 4480, 4481, 4483, 4496, 4506, 4507, 4902, 4920, 4924, 5247, 5248, 5249, 5264, 5265	High
Shivamogga	8,685	61	241, 767, 915, 1252, 1391, 1430, 1455, 1464, 1498, 1647, 1871, 1873, 1887, 1958, 2213, 2214, 2217, 2324, 2330, 2438, 2439, 2474, 2558, 2576, 2584, 2611, 2624, 2628, 2738, 2739, 3173, 3776, 3981, 4117, 4122, 4781, 4785, 4935, 4946, 4954, 4959, 4985, 4988, 4989, 5320, 5329, 5330, 5331, 5332, 5333, 5334, 5335, 5336, 5340, 5343, 5344, 5345, 5346, 5434, 5442, 5443	High
Uttara Kannada	8,354	50	337, 358, 422, 549, 555, 595, 917, 959, 1006, 1139, 1148, 1155, 1206, 1386, 1435, 1520, 1521, 1860, 1927, 1928, 1952, 2124, 2229, 2250, 2251, 2385, 2452, 2621, 2690, 2711, 2726, 2759, 2994, 3181, 3254, 4054, 4457, 4460, 5358, 5359, 5364, 5369, 5392, 5394, 5436, 5437, 5439, 5440, 5441, 5468	High
Tumakuru	8,352	81	311, 361, 374, 688, 1147, 1592, 1679, 1959, 2031, 2035, 2062, 2067, 2114, 2161, 2257, 2266, 2458, 2491, 2516, 2533, 2544,	High

District	Lightning Events, 2023	No. of Project Roads	Road IDs	Relative Lightning Exposure ³⁴
			2559, 2679, 2889, 2929, 2943, 2956, 2972, 2998, 3001, 3011, 3028, 3064, 3070, 3083, 3124, 3168, 3169, 3172, 3177, 3179, 3572, 3695, 3758, 3769, 3927, 3960, 3976, 4045, 4133, 4137, 4159, 4161, 4231, 4277, 4323, 4366, 4456, 4463, 4527, 4618, 4750, 4839, 4840, 4841, 4847, 4864, 4866, 5253, 5326, 5375, 5389, 5458, 5462, 5473, 5476, 5477, 5480, 5487, 5495, 5498	

Source: Karnataka State Natural Disaster Monitoring Centre (KSNDMC), Government of Karnataka

2. Drought

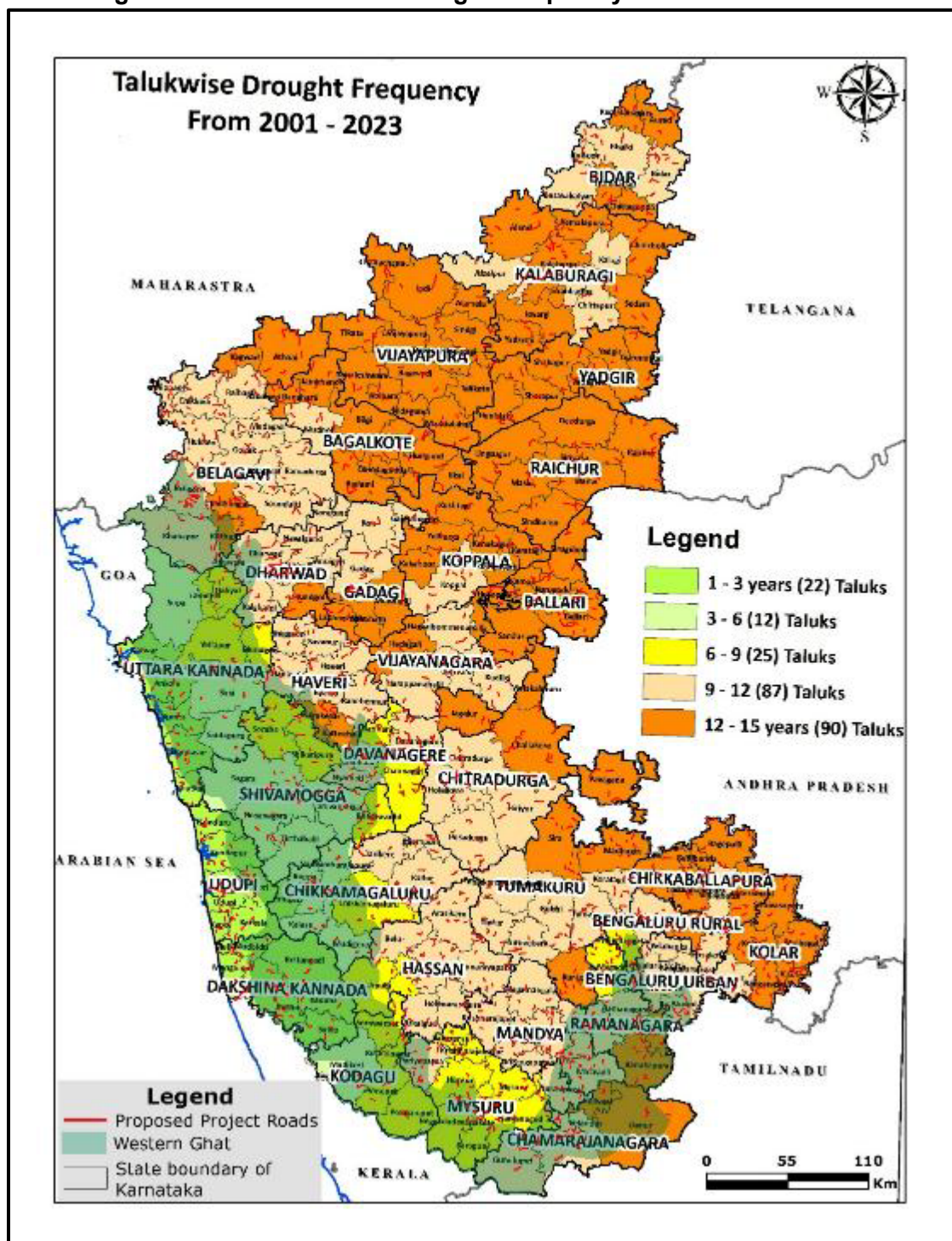
278. Karnataka is highly drought-prone, particularly in the semi-arid northern and interior plateau regions, where recurrent dry spells, deficit/scanty rainfall, declining groundwater levels, reduced drinking-water availability, low reservoir storage and poor storage in minor irrigation tanks have contributed to repeated drought conditions.

279. Karnataka State Disaster Management Plan also notes that drought may occur even in years with normal rainfall due to continuous dry spells of more than three weeks and uneven rainfall distribution.³⁵

280. Taluk-wise Drought Frequency Map (2001–2023) developed by KSNDMC (Figure IV-18) is used to screen the Project roads falling into the talukas having high drought recurrence frequency. Based on the screening, it has been found that a total of 172 Project roads fall within high drought recurrence taluks (12–15 years drought frequency class). These roads are concentrated primarily in the drought-prone districts of Bagalkot, Raichur, Ballari, Haveri Gadag, Kolar, Chikkaballapura Ramanagara and Chamarajanagar. The highest concentration is in Ballari and Vijayanagara with 44 roads, followed by Kolar with 38 roads, Bagalkote with 24 roads, Raichur with 18 roads, Chikkaballapura with 17 roads Haveri with 7 roads, and Gadag and Chamarajanagara with 5 roads each and Ramanagara with 15 roads.

³⁵ Karnataka State Disaster Management Plan (2019-2020), Karnataka State Disaster Management Authority (KSDMA). [final-english-ksdmp-2019-20.pdf](#)

Figure IV-18: Taluka-wise Drought Frequency from 2001-2023 in Karnataka



Source: Karnataka State Natural Disaster Monitoring Centre (KSNDMC), Government of Karnataka

281. Table IV-7 presents the Project roads located in taluks falling under the high drought recurrence category (12–15 years) as per the KSNDMC Taluk-wise Drought Frequency Map (2001–2023).

Table IV-7 Project Roads Located in High Drought Recurrence Taluks (12–15 Year Frequency Class)

District	High Drought-prone Taluka	Drought Frequency	Roads IDs
Bagalkote	Jamkhandi, Badami, Guledagudda	High (12- 15 Years)	24, 109, 117, 118, 125, 131, 136, 141, 1324, 1372, 2085, 2160, 2337, 2818, 2821, 3372, 3644, 4487, 4598, 4606, 4607, 4648, 5183, 5251 Total – 24 Roads
Raichur	Deodurga, Raichur	High (12- 15 Years)	1931, 2442, 3099, 3113, 3114, 3127, 3190, 3307, 4410, 4480, 4481, 4506, 4902, 4920, 5247, 5248, 5249, 5264 Total – 18 Roads
Ballari & Vijayanagara	Siruguppa, Kampli, Hosapete, Sandur, Ballari,	High (12- 15 Years)	351, 630, 660, 671, 679, 695, 700, 808, 810, 825, 828, 892, 901, 904, 909, 913, 925, 2765, 2968, 3257, 3270, 3354, 3367, 3378, 3381, 4007, 4009, 4446, 4468, 4745, 4749, 4756, 4757, 4758, 4759, 4842, 4886, 4925, 4997, 5019, 5252, 5385, 5391, 5479 Total – 44 Roads
Haveri	Hirekerur	High (12- 15 Years)	954, 997, 2214, 2380, 4246, 5343, 5434 Total – 7 Roads
Gadag	Laxmeshwar	High (12- 15 Years)	144, 2301, 4287, 4522, 4580 Total – 5 Roads
Chikkaballapura	Bagepalli, Chikkaballapura, Chintamani	High (12- 15 Years)	60, 409, 417, 462, 470, 476, 491, 1897, 3117, 3186, 3868, 3869, 3870, 3878, 3998, 4081, 5219 Total – 17 Roads
Kolar	Srinivasapura, Kolar, Mulbagal, Bangrapete,	High (12- 15 Years)	120, 382, 438, 596, 748, 912, 950, 960, 1108, 1126, 1203, 1204, 1217, 1302, 1425, 1444, 1663, 1697, 1897, 1975, 2211, 2485, 2492, 2789, 2958, 3462, 3469, 3526, 3539, 3546, 3565, 3609, 3841, 4013, 4578, 5282, 5373, 5508 Total – 38 Roads
Ramanagara	Horohalli, Kanakapura,	High (12- 15 Years)	1817, 1818, 1819, 3891, 5085, 5089, 5130, 5141, 5142, 5180, 5226, 5422, 5423, 5427, 5428 Total – 15 Roads
Chamarajana gara	Kollegal, Hansur	High (12- 15 Years)	2536, 2538, 2540, 2543, 4221 Total – 5 Roads

Note: The classification is based on taluka-level drought frequency and provides a screening-level indication; it does not represent road-specific drought intensity. Road ID 1897 traverses both Chikkaballapura and Kolar and is presented under both districts but counted once in the total.

Source: KSNDMC

3. Landslides

282. Karnataka is vulnerable to landslides primarily in the Western Ghats, Malnad and coastal hill regions, where steep slopes, highly weathered terrain, intense southwest monsoon rainfall, fragile geology and expanding road infrastructure contribute to slope instability.

283. According to the Karnataka State Disaster Management Plan (KSDMP)³⁵, districts such as Kodagu, Chikkamagaluru, Hassan, Shivamogga, Dakshina Kannada and Uttara Kannada are

the major landslide-prone regions of the state due to annual rainfall often exceeding 2,000–4,000 mm, steep escarpments and recurring slope failures.

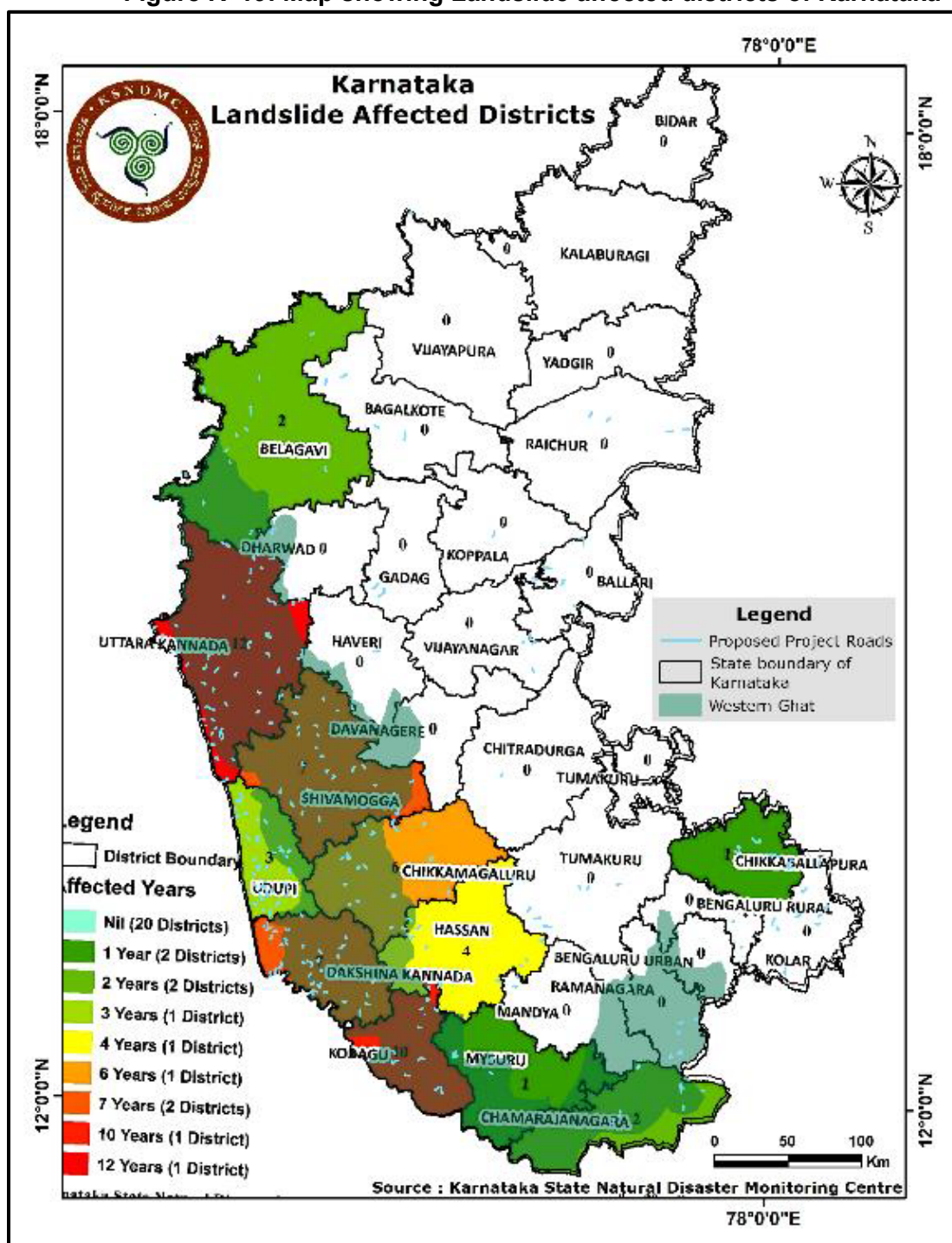
284. Field-validated National Landslide Inventory (NLI) developed by the Geological Survey of India (GSI), landslide occurrences recorded across India were used to identify talukas with high and very high landslide incidence frequency and to screen the Project roads for landslide susceptibility.

285. According to the field-validated National Landslide Inventory and the Landslide Affected Districts of Karnataka map prepared by KSNDMC (Figure IV-19), landslide incidences in Karnataka are mainly concentrated in the Western Ghats and adjoining Malnad/coastal districts. The inventory records 2,276 landslide points across eight districts, with major occurrences in Kodagu, Uttara Kannada, Chikkamagaluru, Shivamogga, Dakshina Kannada, Hassan, Udupi and Belagavi. Repeated landslide incidences are observed in taluks such as Karwar, Ankola, Kumta, Siddapur, Yellapur, Haliyal, Supa, Koppa, Sringeri, Kalasa, Mudigere, Chikkamagaluru, Beltangadi, Puttur, Sulya, Madikeri, Somwarpet, Virajpet, Sagar, Tirthahalli and Hosanagara. The recorded events primarily comprise debris slides, debris flows, soil slides, rock falls and subsidence, reflecting the inherent slope instability of hilly and high-rainfall terrain in the state.

286. High landslide density is particularly associated with:

- Coastal and ghat sections of Uttara Kannada
- Charmadi, Koppa, Sringeri, Kalasa and Bababudangiri belts in Chikkamagaluru
- Kodagu hill slopes
- Dakshina Kannada ghat roads
- Malnad hill regions of Shivamogga and Hassan

Figure IV-19: Map showing Landslide affected districts of Karnataka



Source: Karnataka State Natural Disaster Monitoring Centre (KSNDMC), Government of Karnataka

287. Taluk-wise landslide occurrence was classified based on the number of recorded landslide events in the field-validated National Landslide Inventory for Karnataka. The inventory points were aggregated at taluk level, and taluks were grouped into five classes using the observed distribution of event counts. Since the inventory shows a highly skewed pattern, with the highest number of events recorded in Madikeri taluk, fixed event-count thresholds were applied to provide

a practical and interpretable classification. Taluks recording more than 200 landslide events were classified as Very High, 100–199 events as High, 50–99 events as Moderate, 10–49 events as Low, and 1–9 events as Very Low. This classification represents the relative concentration of recorded landslide events and does not represent a landslide hazard or susceptibility classification. Table IV-8 summarizes Project roads falling within districts/taluks associated with very high and high landslide events record.

288. Madikeri and Mudigere taluks are classified as having Very High landslide incidence, with 467 and 244 recorded events, respectively. Hosanagara and Sakleshpur taluks are classified as having High landslide incidence, with 188 and 105 recorded events, respectively.

289. Matching these taluks with the project road–taluka database indicates that 16 proposed project roads are located wholly or partially within these taluks. Of these, eight roads are in Very High-incidence taluks and eight roads are located in High-incidence taluks. These roads may be comparatively more exposed to landslide-related risks and warrant appropriate consideration during detailed design and construction planning.

Table IV-8: Project Roads Located in Districts/Taluks with Significant Historical Landslide Incidence in Karnataka³⁶

District	Taluk	Recorded Landslide Events	Classification	No. of Project Roads	Road IDs
Kodagu	Madikeri	467	Very High (>200 events)	2	4154, 4162
Chikkamagaluru	Mudigere	244	Very High (>200 events)	6	2978, 4714, 5259, 5273, 5274, 5323
Shivamogga	Hosanagara	188	High (100–199 events)	7	1252, 2438, 2439, 2738, 2739, 4781, 5344
Hassan	Sakleshpur	105	High (100–199 events)	1	4190
Total project roads				16	

Source: National Landslide Inventory for Karnataka

4. Earthquake

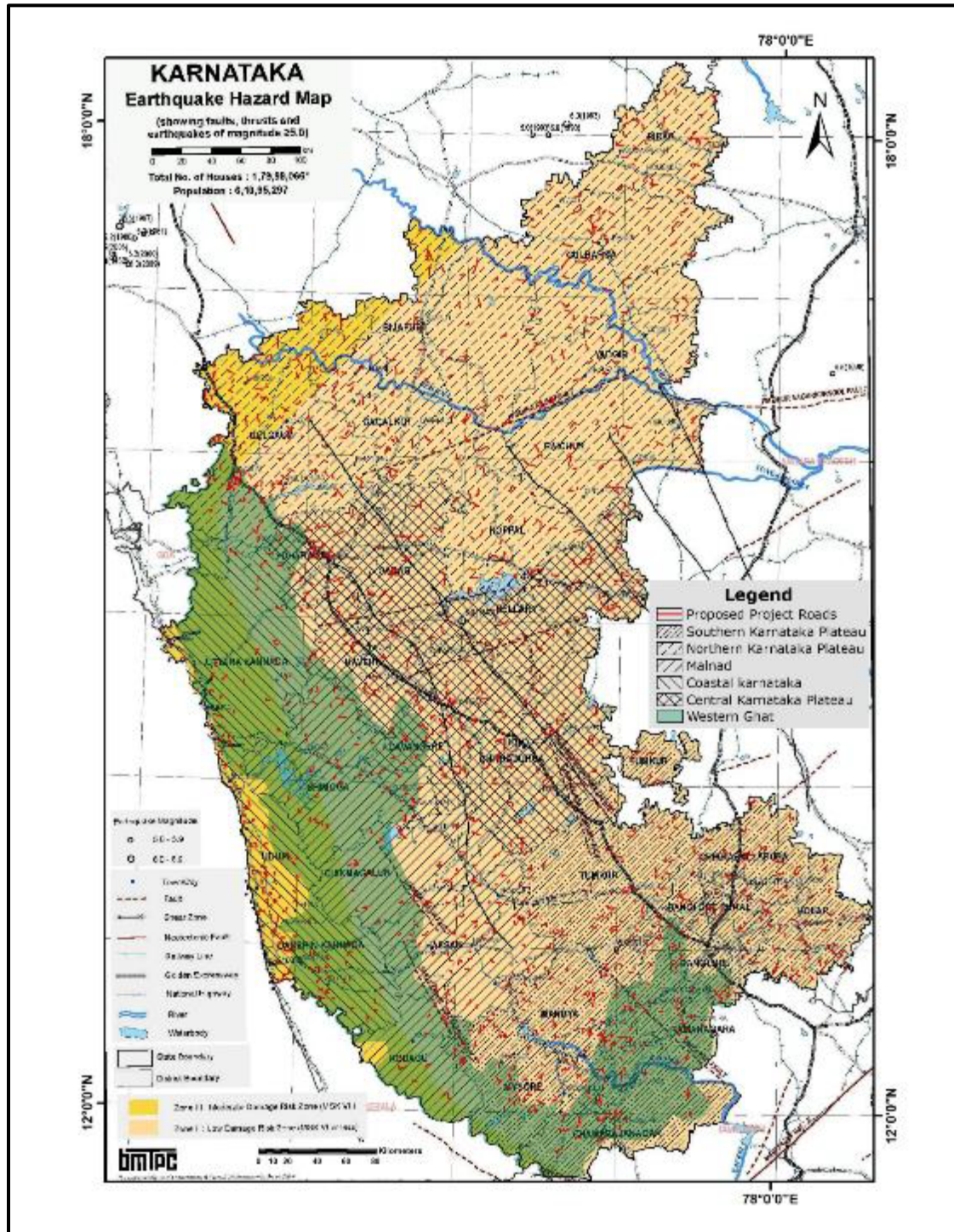
290. According to the Vulnerability Atlas of India (BMTPC, 2002), Karnataka's earthquake hazard is categorized into two seismic zones based on the MSK Intensity Scale³⁷: Seismic Zone III (Moderate Damage Risk Zone – MSK VII) and Seismic Zone II (Low Damage Risk Zone – up to MSK VI). Areas falling under Seismic Zone III include parts of Chamarajanagara, Mysuru, Kodagu, Dakshina Kannada, Chikkamagaluru, Shivamogga, Uttara Kannada, Belagavi and Vijayapura districts, while Udupi district falls entirely within Zone III. The remaining parts of

³⁶ The classification is based on the number of events recorded in the landslide inventory and provides a screening-level indication of relative exposure. Roads crossing more than one taluk have been included once against the relevant High or Very High taluk.

³⁷ The MSK (Medvedev–Sponheuer–Karnik) Intensity Scale is used to classify earthquake hazard based on the observed severity of ground shaking and associated damage to structures and communities.

Karnataka are classified under Seismic Zone II, indicating relatively lower earthquake hazard (Figure IV-20).

Figure IV-20: Earthquake Hazard Map of Karnataka



Source: Building Materials and Technology Promotion Council (BMPTC)

5. Flood

291. Karnataka has experienced severe flooding, particularly within the Krishna and Cauvery river basins during the monsoon season, causing significant impacts on human life, property, agriculture and critical infrastructure. These flood events are primarily driven by intense to extremely heavy rainfall, which results in substantial inflows into the main rivers and their upstream tributaries, often leading to widespread inundation and associated damages.

292. Karnataka has experienced eight years³⁸ of flood hazards including consecutive floods from 2018-2022 in the last ten years. The years wise details of flood/heavy rain incidents during the period 2018-2022³⁹ are shown in Table IV-9.

Table IV-9: Year wise details of flood/heavy rain incidents

District	Calendar year of flood impact
Belagavi	2019, 2020, 2021 and 2022
Chikkaballapura	2021 and 2022
Dakshina Kannada	2018, 2019, 2020, 2021 and 2022
Davanagere	2019, 2020, 2021 and 2022
Haveri	2019, 2020, 2021 and 2022
Kalaburagi	2019, 2020, 2021 and 2022
Kodagu	2018, 2019, 2020, 2021 and 2022
Ramanagara	2021 and 2022
Shivamogga	2018, 2019, 2020, 2021 and 2022

Source: Data furnished by the Revenue Department (Disaster Management)

293. The Heavy Rainfall/Flood Frequency Map (2005-2020) for Karnataka, prepared by KSNDMC, the talukas are classified based on the frequency of flood events. The Talukas are classified into following classes: 6-8 flood events, 4-6 flood events, 2-4 flood events, <2 flood events and no flood event during 2005-2020. The roads falling in 6-8 (very high flood frequency) and 4-6 (High flood frequency) are identified by overlaying the Project roads over the flood frequency map (Figure IV-21). According to Figure IV-21, flood recurrence is highest in the Western Ghats, coastal Karnataka and certain northern river basin taluks, particularly in districts such as Uttara Kannada, Udupi, Dakshina Kannada, Kodagu, Shivamogga, Hassan, Belagavi, Bagalkot, Vijayapura, Raichur and parts of Kalaburagi.

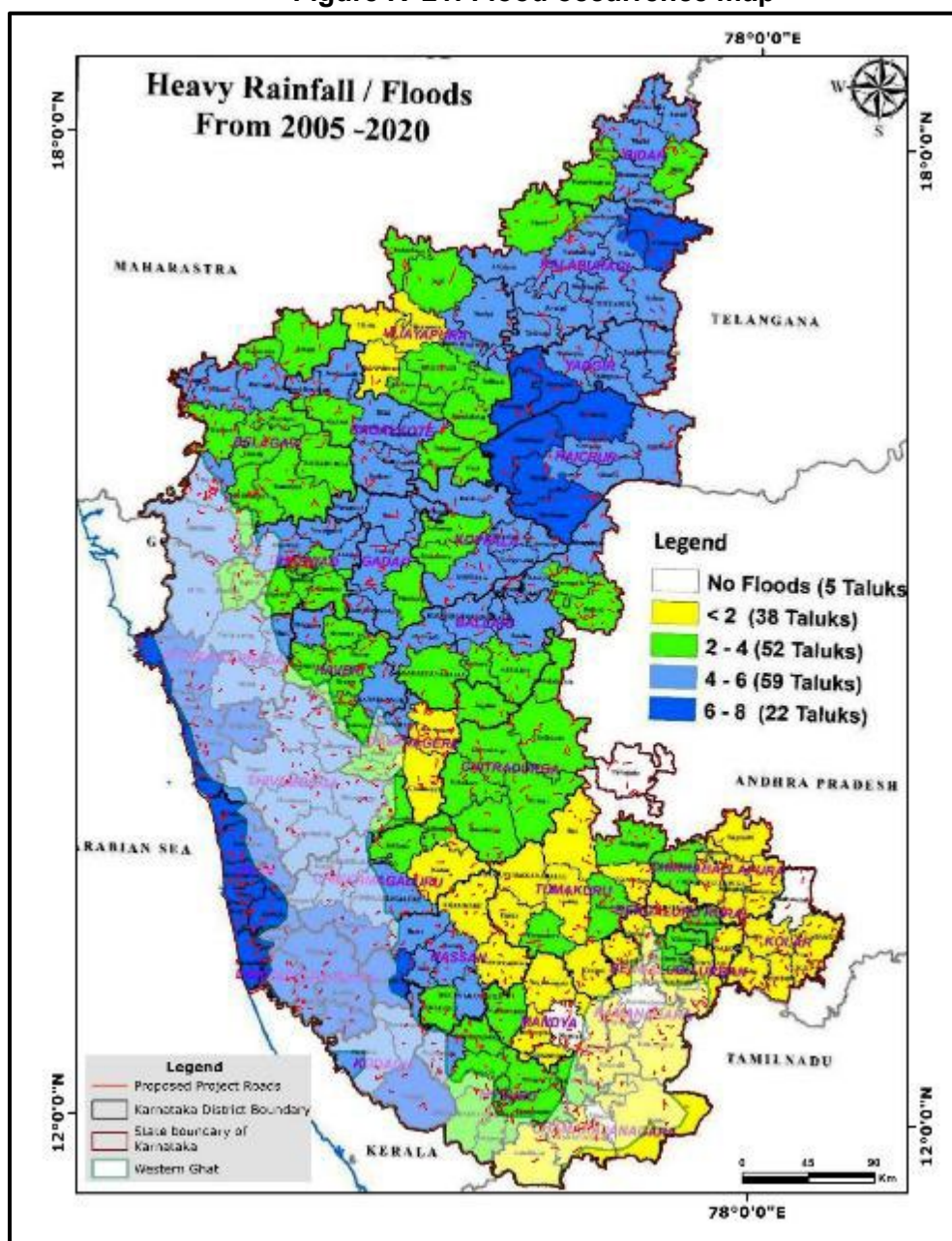
294. Taluks within these districts falling under the 6–8 flood event frequency⁴⁰ class are considered highly flood-prone, while districts in southeastern Karnataka such as Bengaluru Urban, Bengaluru Rural, Kolar, Chikkaballapura, Ramanagara and Chamarajanagar generally show comparatively lower flood recurrence. High flood frequency in the Western Ghats and coastal belt is largely associated with intense monsoonal rainfall, steep terrain and flash flooding, whereas northern Karnataka experiences recurrent flooding mainly due to overflow of the Krishna basin and its tributaries.

³⁸ Karnataka state experienced both drought and floods during 2018-2019

³⁹ Year 2022 was not declared as calamity affected by the State Government, though encountered flood hazard.

⁴⁰ 6 to 8 flood events during 2005-2020

Figure IV-21: Flood occurrence map



Source: Karnataka State Natural Disaster Monitoring Centre (KSNDMC), Government of Karnataka

295. Table IV-10 presents the Project roads falling into the Talukas having high historical flood occurrences.⁴¹

⁴¹ The information furnished is based on the screening of Project roads on taluk-level flood recurrence frequency from the KSNDMC flood map

Table IV-10 Project Roads Located in Talukas with High Flood Vulnerability (6–8 Flood Events, 2005–2020) in Karnataka

SN	District	High Flood-Prone Taluka	No. of Project Roads	Road IDs
1	Kalaburagi	Chincholi	8	686, 1494, 1505, 3693, 4374, 5464, 5490, 5494
2	Yadgir	Shorapur	7	2486, 2502, 3512, 4767, 4992, 5000, 5002
3	Raichur	Devadurga	4	2442, 3099, 3307, 5264
4	Raichur	Lingsugur	5	2431, 2599, 2662, 3397, 4496
5	Raichur	Manvi	13	88, 1207, 2431, 2529, 2669, 3190, 3343, 3824, 3825, 3894, 3910, 3913, 4924
6	Raichur	Sindhanur	7	2699, 3129, 3343, 3794, 4483, 5151, 5265
7	Uttara Kannada	Karwar	4	358, 5358, 5359, 5394
8	Uttara Kannada	Ankola	5	422, 1206, 2124, 2250, 2251
9	Uttara Kannada	Kumta	5	917, 1952, 2452, 2690, 2726
10	Uttara Kannada	Honnavar	10	1139, 1386, 2229, 2711, 2759, 2994, 5369, 5437, 5439, 5440
11	Uttara Kannada	Siddapur	3	337, 555, 1647
12	Uttara Kannada	Bhatkal	5	1435, 5364, 5392, 5436, 5441
13	Udupi	Kundapura	14	174, 547, 556, 1371, 1541, 1549, 1551, 1552, 1741, 2552, 3578, 3581, 4409, 4983
14	Udupi	Udupi	19	309, 519, 1231, 1314, 1315, 1323, 1330, 2314, 2554, 2555, 2860, 2861, 3730, 3731, 4312, 4760, 4784, 4883, 4884
15	Udupi	Karkala	15	329, 354, 501, 535, 1057, 1306, 1893, 1960, 2253, 2892, 2893, 2910, 3424, 3488, 4872
16	Dakshina Kannada	Mangaluru	16	15, 25, 29, 354, 501, 1054, 1057, 1059, 1211, 1392, 1843, 3000, 3885, 4427, 4438, 4867
17	Dakshina Kannada	Bantwal	13	25, 29, 255, 259, 290, 295, 1052, 1612, 2202, 2718, 3000, 3885, 4438
18	Dakshina Kannada	Beltangadi	5	1040, 1041, 1043, 1046, 1052
19	Dakshina Kannada	Puttur	9	806, 827, 837, 1368, 1643, 2202, 3152, 3189, 4420
20	Dakshina Kannada	Sulya	4	345, 581, 807, 822
21	Hassan	Sakleshpur	1	4190
22	Kodagu	Virajpet	4	3148, 3884, 4003, 4042

Source: Karnataka State Natural Disaster Monitoring Centre (KSNDMC), Government of Karnataka

6. Cyclone

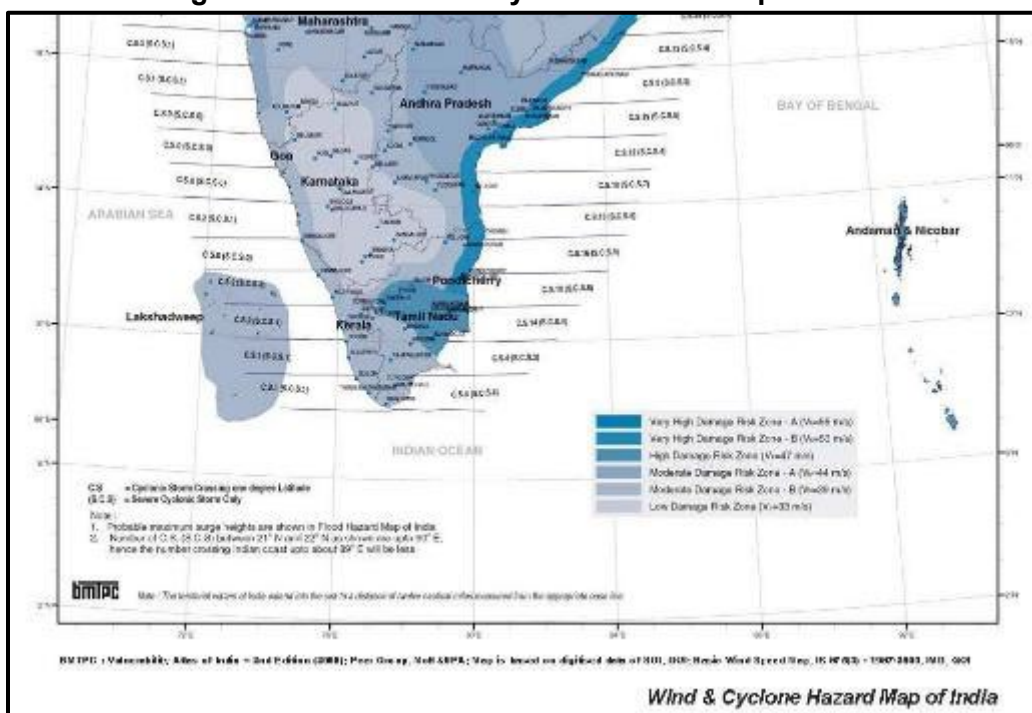
296. According to the Cyclone Hazard Prone Districts of India report (NDMA & IMD)⁴², Karnataka is classified as having moderate cyclone hazard vulnerability compared with the highly

⁴² NDMA and IMD (2013). District-wise Multi-Hazard Risk Assessment of India: Cyclone Hazard Prone Districts of India, Government of India, New Delhi.

exposed east-coast states such as Odisha, Andhra Pradesh, Tamil Nadu, and West Bengal. Cyclone vulnerability in Karnataka is concentrated along the coastal districts of Udupi, Uttara Kannada, and Dakshina Kannada. The cyclone hazard assessment developed by NDMA and IMD classifies districts into four categories ranging from P1 (Very High Hazard) to P4 (Low Hazard)⁴³. The coastal districts of Dakshina Kannada, Udupi and Uttara Kannada fall within the P3 category, indicating moderate cyclone hazard vulnerability.

297. According to the Wind and Cyclone Hazard Map of India (Figure IV-22), published in the Vulnerability Atlas of India (2nd Edition, 2006) by the Building Materials and Technology Promotion Council (BMTPC), Ministry of Housing and Urban Poverty Alleviation, Government of India, Karnataka predominantly falls within the Moderate Damage Risk Zone associated with basic wind speeds of approximately 39–49 m/s. The map indicates that cyclone and high-wind hazards in the state are relatively lower than those along India's eastern coastline; however, the coastal belt of Karnataka remains susceptible to cyclonic storms and associated high-wind events.

Figure IV-22: Wind and Cyclone Hazard Map of India



Source: Building Materials and Technology Promotion Council (BMTPC), Ministry of Housing and Urban Poverty Alleviation, Government of India

C. Air Environment

1. Methodology of Ambient Air Quality Monitoring

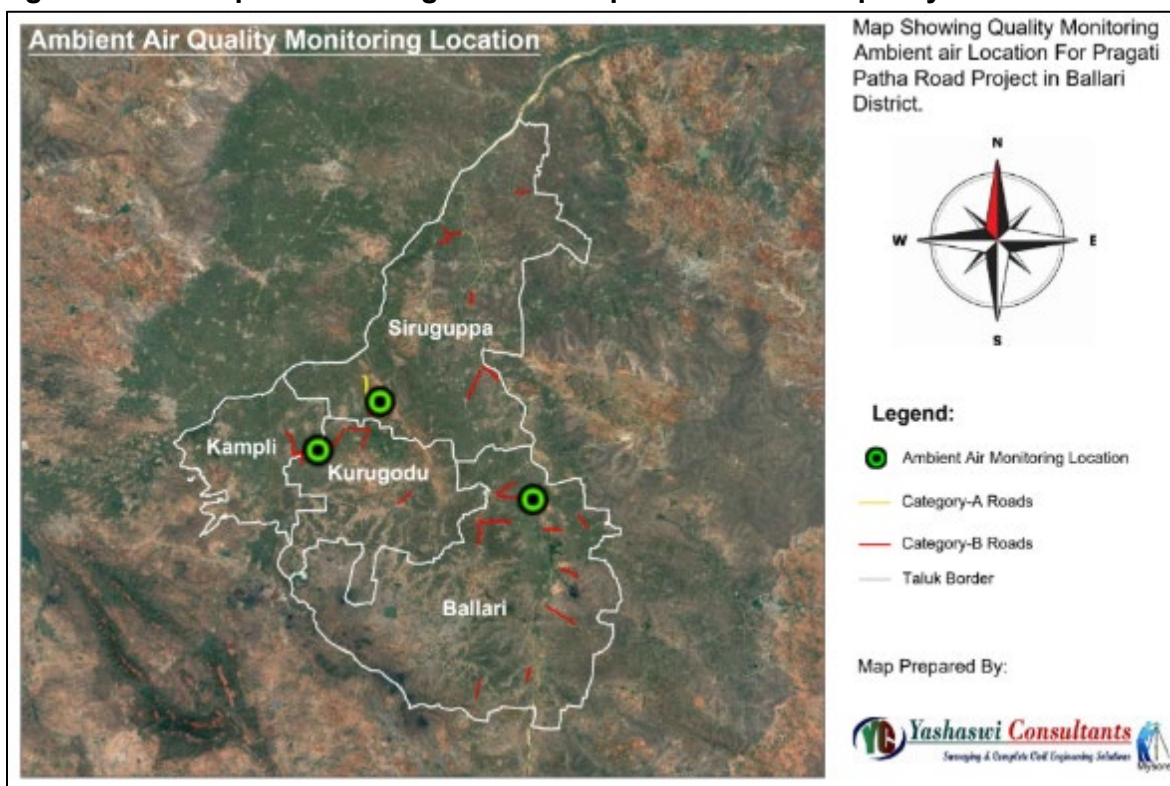
298. Ambient air quality monitoring was undertaken during December 2025 to May 2026 to establish the existing air quality status within the project influence area and to identify any existing air pollution issues near the proposed road improvement corridors. The monitoring also provides

⁴³ The P1–P4 classification is defined in the NDMA–IMD report as a cyclone hazard zonation category based on a composite assessment of: Historical cyclone frequency, Severe cyclone frequency, Probable Maximum Storm Surge (PMSS), Probable Maximum Precipitation (PMP), Maximum wind speed.

a baseline for assessing potential changes in air quality due to construction-stage activities such as earthwork, material handling, transportation of construction materials, operation of construction equipment and movement of vehicles.

299. Monitoring locations were selected at total of 774 representative locations (Appendix 21) along the project roads based on land use, receptor sensitivity, settlement pattern, traffic condition, accessibility and proximity to likely construction activity areas. A sample package is provided in the Figure IV-23. Priority was given to locations near residential areas, schools, Anganwadi centres, health facilities, commercial areas and other sensitive receptors. In rural road settings, the main existing sources of air emissions are generally vehicular movement, agricultural activities, domestic sources and natural dust generation, while major industrial sources are generally absent in the project influence area. This is consistent with project information available for Karnataka rural roads, which indicates that the project area is predominantly rural and that air quality monitoring locations were selected based on land use and sensitive receptor presence.

Figure IV-23 Sample monitoring location map for ambient air quality for Ballari district



Source: Map prepared by DPR consultant of KRRDA

300. Ambient air quality monitoring was carried out through NABL-accredited laboratories following standard monitoring protocols. Given the extensive geographical spread of the 1,335 project roads across multiple districts and diverse land-use settings, ambient air quality monitoring was undertaken at representative road corridors selected to capture the range of environmental and land-use conditions prevalent within the project area. The monitoring was undertaken through 24-hour sampling, twice a week, for four consecutive weeks during the representative monitoring season. The monitored parameters included particulate matter and gaseous pollutants relevant to road projects, such as PM_{10} , $PM_{2.5}$, sulphur dioxide, nitrogen oxides and carbon monoxide. Where required, additional parameters such as ozone, ammonia, lead, benzene, benzo(a)pyrene,

arsenic and nickel may be included in accordance with the National Ambient Air Quality Standards. PM₁₀, PM_{2.5}, sulphur dioxide and nitrogen oxides were monitored using 24-hour averaging periods, while carbon monoxide and ozone were assessed against the applicable 1-hour and 8-hour averaging periods, respectively. Project records for Karnataka rural roads indicate that ambient air quality monitoring was conducted twice a week, over four weeks and that the results were compared with National Ambient Air Quality Standards.

301. The monitoring instruments were calibrated prior to use, and sampling was carried out in accordance with applicable CPCB procedures and standard laboratory methods. The results were analyzed and compared with the National Ambient Air Quality Standards, 2009, to determine the baseline air quality status within the project influence area.

302. Table IV-11 summarizes the baseline ambient air quality monitoring results recorded within the project area, including minimum, maximum and average concentrations of air quality parameters. The monitored values have been compared with the National Ambient Air Quality Standards (NAAQS) for residential areas and WBG EHS guidelines⁴⁴.

303. PM₁₀ concentration ranges from 1.36 µg/m³ at Road ID 4427 in Dakshin Kannada district to 90 µg/m³ at Road IDs 2044, 5313 and 5316 in Belagavi district, with an average value of 58.35 µg/m³. PM_{2.5} varies from 10 µg/m³ at Road IDs 2798 and 3562 in Chikkamagaluru district to 46 µg/m³ at Road IDs 2044, 5313 and 5316 in Belagavi district. The average PM_{2.5} concentration is 27.3 µg/m³.

304. Gaseous pollutants are generally low. NO₂ ranges from 5.1 µg/m³ at Road IDs 1126 and 2477 in Kolar district and Road ID 5217 in Ramanagara district to 37 µg/m³ at Road ID 5146 in Mysuru district, with an average value of 19.7 µg/m³. SO₂ varies from 1.2 µg/m³ at Road ID 2584 in Shivamogga district to 30 µg/m³ at Road ID 476 and 3182 in Chikkaballapura district and Road IDs 928, 986, 4282, 4316, 4874 and 5078 in Mysuru district, with an average value of 11.23 µg/m³. CO concentrations range from below the detection limit to 4.1 mg/m³ at Road IDs 1653, 1662, 2795, 2837, 2838 and 3723 in Hassan district, with an average concentration of 0.61 mg/m³.

305. Other monitored parameters, including O₃, NH₃, Pb, Benzene, Benzo(a)pyrene, Arsenic and Nickel, are mostly below detectable limits or present at low concentrations.

306. The results indicate (Table IV-11) that the monitored concentrations of PM₁₀, PM_{2.5}, NO₂, SO₂, O₃, NH₃, Pb, Benzene, Benzo(a)pyrene, Arsenic and Nickel are within the applicable national standards. The maximum 1 hour-CO concentration of 4.1 mg/m³, recorded at six Project roads in Hassan district, comparable to applicable 1-hour NAAQS⁴⁵ of 4 mg/m³. In comparison with the WBG/WHO guideline values, the maximum and spatial average concentrations of PM₁₀ and PM_{2.5} are higher than the respective guideline values. The maximum SO₂ concentration also exceeds the applicable WBG/WHO guideline value, while the maximum O₃ concentration is equal to, but does not exceed, the applicable guideline value. NO₂ concentrations remain within both the national standard and the WBG/WHO guideline value.

⁴⁴ World Bank Group, Environmental, Health, and Safety Guidelines: General EHS Guidelines – Environmental: Air Emissions and Ambient Air Quality, International Finance Corporation, 30 April 2007.

⁴⁵ Central Pollution Control Board (CPCB), National Ambient Air Quality Standards (NAAQS), 2009, Notification dated 18 November 2009.

Table IV-11: Summary of Ambient Air Quality Monitoring Results and Comparison with Applicable National Standards and WBG/WHO Guideline Values

Parameter	Minimum	Maximum	Average	NAAQS	WB/WBG EHS Guidelines
PM ₁₀ (µg/m ³)	1.36	90	58.35	100*	50*
PM _{2.5} (µg/m ³)	10	46	27.3	60*	25*
NO ₂ (µg/m ³)	5.1	37	19.7	80*	40**
SO ₂ (µg/m ³)	1.2	30	11.23	80*	20*
O ₃ (µg/m ³)	<2 (BDL)	100	10.60	100***	100***
CO (mg/m ³)	<1 (BDL)	4.1	0.61	4****	
NH ₃ (µg/m ³)	<20 (BDL)	55	18.44	400*	
Pb (ng/m ³)	<0.2 (BDL)	1	0.20	1*	
Benzene (µg/m ³)	<3 (BDL)	3.3	0.20	5**	
Benzo(a)pyrene (ng/m ³)	<1 (BDL)	0.95	0.52	1**	
Arsenic (ng/m ³)	<1 (BDL)	6	2.96	6**	
Nickel (ng/m ³)	<5 (BDL)	20	7.86	20**	

Note: Highlighted columns (in red) represent the values exceeding the NAAQS and/or WB/WBG EHS Guidelines

*24-hour guideline value, **Annual guideline value, ***8-hour guideline, ****1-hour guideline

Source: Compiled from the Environmental monitoring results shared by DPR consultants of KRRDA

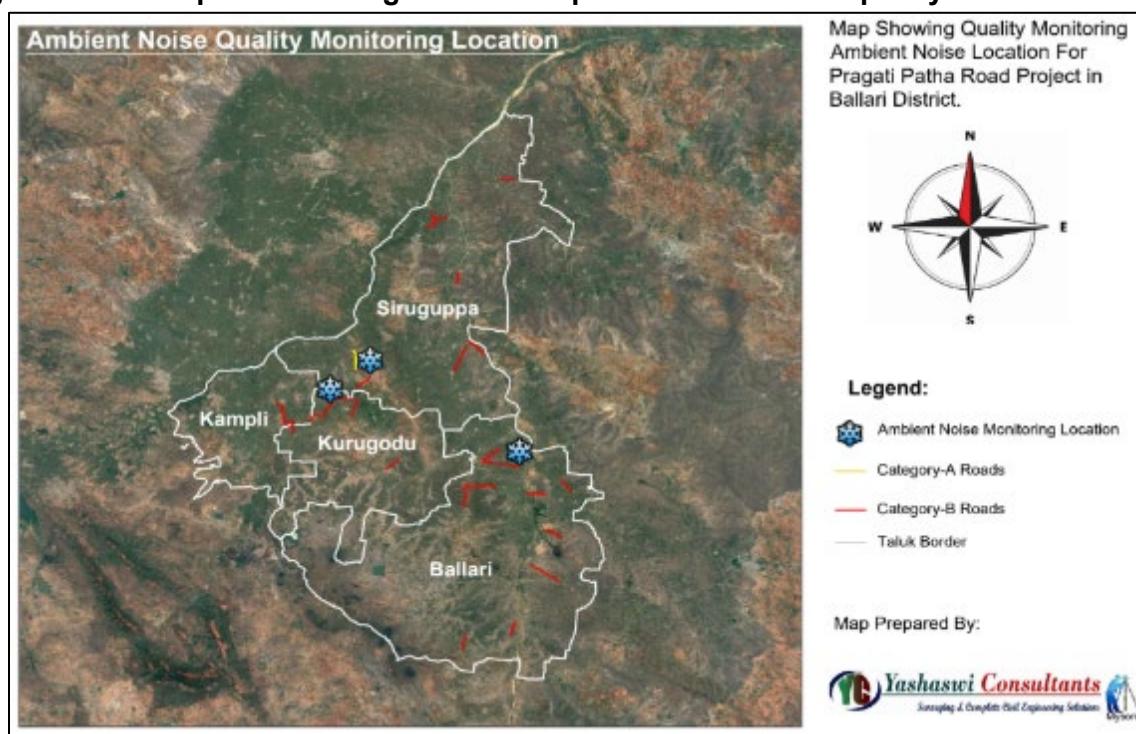
D. Noise Environment

1. Methodology of Ambient Noise Quality Monitoring

307. Ambient noise level monitoring was undertaken to establish existing background noise levels along the project roads and at sensitive receptor locations. The baseline noise data are required to assess potential construction and operation-stage noise impacts and to identify locations where noise mitigation measures may be required.

308. Monitoring locations were selected at 774 numbers of locations (Appendix 21), representative of residential areas, educational institutions, health facilities, religious places, market areas, road junctions and other sensitive receptors located along or close to the project roads. Particular consideration was given to locations where project road improvement works may temporarily increase noise levels due to construction equipment, vehicle movement, material loading and unloading, and other civil works. A sample package is provided in the Figure IV-24.

Figure IV-24 Sample monitoring location map for ambient noise quality for Ballari district



Source: Map prepared by DPR consultant of KRRDA

309. Noise monitoring was carried out using a calibrated integrating sound level meter. The instrument was placed at an appropriate height above ground level and away from walls, buildings or other reflective surfaces to avoid distortion of readings. Monitoring was undertaken over a 24-hour period at each selected location to capture both daytime and night-time noise conditions. The equivalent continuous sound pressure level, L_{eq} , was recorded separately for daytime and night-time periods. Daytime and night-time values were interpreted with reference to applicable ambient noise standards for the relevant land-use category, including residential, commercial and silence zone areas.

310. The baseline noise data provides the reference condition for assessing project-related noise impacts, particularly near schools, hospitals, settlements and other sensitive receptors.

311. Table IV-12 **Table IV-12** summarises the baseline ambient noise monitoring results recorded in the project area during daytime and nighttime periods. The monitored noise levels have been assessed against both the applicable National Ambient Noise Standards and the WBG EHS Guideline values. The national standards have been used for comparison for residential and sensitive/silence zone receptors, as these standards provide receptor-specific criteria applicable to the Project setting, which is not defined separately for silence zone in WBG EHS guidelines. The WBG EHS Guideline values for residential receptors are consistent with the national standards. Therefore, WBG EHS guidelines for residential areas have also been considered to confirm alignment with international good practice.

312. Day-time noise levels range from 32.4 dB(A) to 76.4 dB(A), with an average value of 55.5 dB(A). Night-time noise levels range from 30 dB(A) to 63.4 dB(A), with an average value of 43.18 dB(A).

313. According to the national standards, the applicable limits are 55 dB(A) during daytime and 45 dB(A) during nighttime for residential areas, and 50 dB(A) during daytime and 40 dB(A) during nighttime for silence zones. Silence zone standards are applicable to sensitive receptors such as hospitals, educational institutions and courts. The WBG General EHS Guidelines specify noise guideline values of 55 dB(A) during daytime and 45 dB(A) during nighttime for residential, institutional and educational receptors. The WBG Guidelines do not specify a separate silence zone category; therefore, the residential/institutional/educational guideline values have been used for comparison.

314. The maximum daytime noise level of 76.4 dB(A) is above the national residential standard, national silence zone standard and WBG guideline value. The average daytime noise level of 55.5 dB(A) is marginally above the national residential standard and WBG guideline value of 55 dB(A) and is also above the national silence zone standard of 50 dB(A).

315. The maximum nighttime noise level of 63.4 dB(A) is above the national residential standard, national silence zone standard and WBG guideline value. The average nighttime noise level of 43.18 dB(A) is above the applicable national silence zone standard.

316. Exceedances of the applicable noise standards at certain locations reflect existing baseline conditions associated with traffic movement, commercial activities, and other community activities in and around settlements along the Project roads.

Table IV-12: Summary of Baseline Ambient Noise Levels and Comparison with National Ambient Noise Standards and WBG EHS Guidelines

Parameter	Minimum (dB(A))	Maximum (dB(A))	Average (dB(A))	National Ambient Noise Standards ⁴⁶		WBG (EHS Guidelines) (Residential) ⁴⁷
				Residential	Silence	
Day Time	32.4	76.4	55.5	55	50	55
Night Time	30	63.4	43.18	45	40	45
Day/Night Leq	36	71.7	48.37			

Highlighted columns (in red) represent the values exceeding the national ambient noise and/or WB/WBG EHS Guidelines

*As per National Ambient Noise standards, Day time is from 6:00 AM to 10:00 PM and Night-time is from 10:00 PM to 6:00 AM

aAs per WBG EHS guidelines, Day time is from 7:00 AM to 10:00 PM and Night-time is from 10:00 PM to 7:00 AM

Source: Compiled from the Environmental monitoring results shared by DPR consultants of KRRDA

E. Water Resources

1. Groundwater Resources

317. Groundwater is a critical freshwater resource in Karnataka, supporting more than 60% of irrigation requirements and approximately 90% of rural drinking water supply, making it central to agricultural productivity, domestic consumption and industrial development across the state.

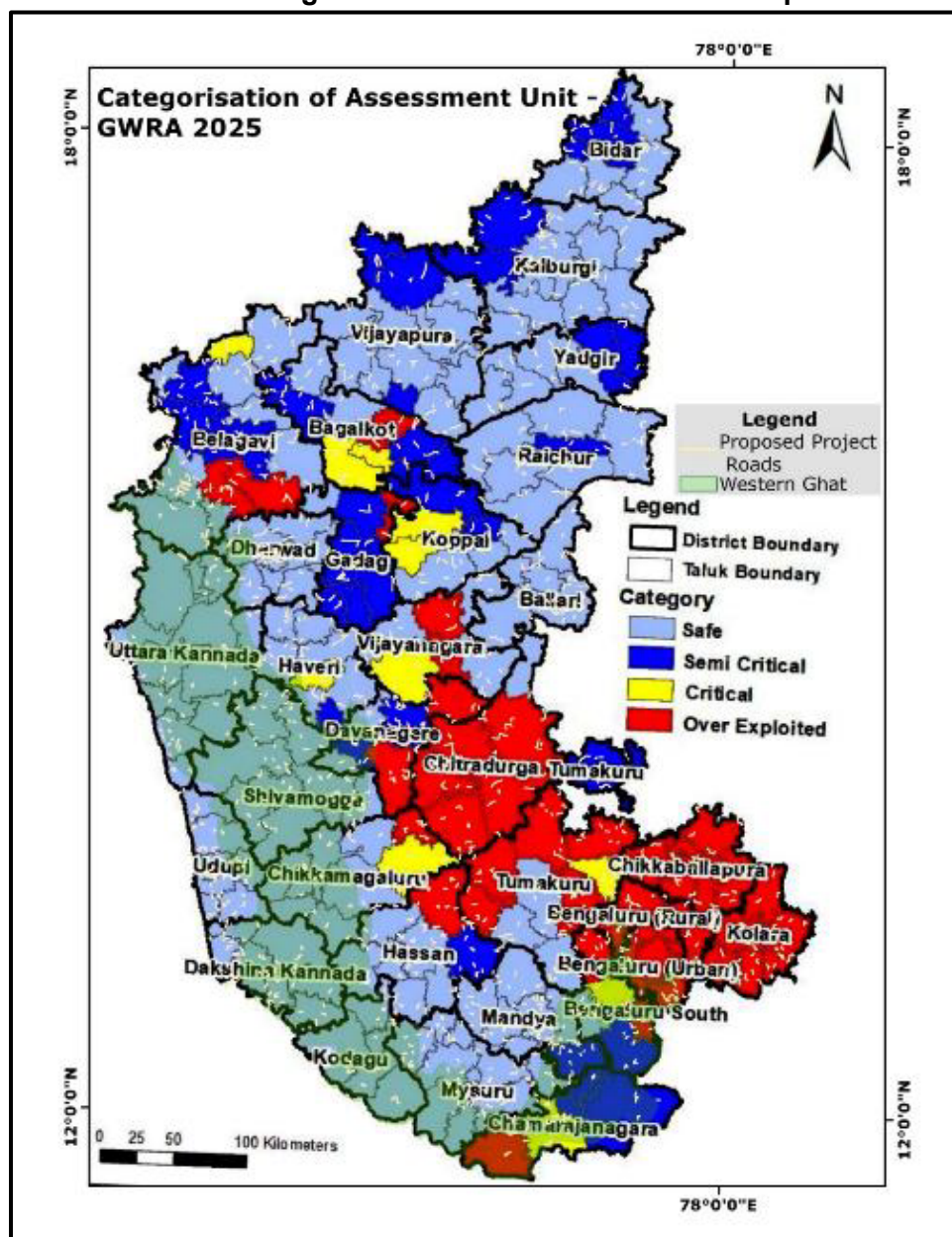
318. The state's annual extractable groundwater resource is estimated at 17.41 BCM, with a gross annual groundwater extraction of 11.58 BCM and an overall stage of groundwater extraction

⁴⁶ The Noise Pollution (Regulation and Control) Rules, 2000, Schedule: Ambient Air Quality Standards in Respect of Noise, Ministry of Environment and Forests, Government of India.

⁴⁷ World Bank Group, Environmental, Health, and Safety Guidelines: General EHS Guidelines – Environmental Noise Management, International Finance Corporation, 30 April 2007.

of 66.49%. Out of 237 groundwater assessment units⁴⁸ (236 taluks + Bengaluru city), 145 units (61.18%) are categorized as Safe, 36 as Semi-Critical, 11 as Critical, and 45 as Over-Exploited⁴⁹ (Figure IV-25), indicating that while much of Karnataka retains sustainable groundwater potential, significant localized over-extraction exists.⁵⁰

Figure IV-25: Groundwater Status Map



Source: Groundwater Risk Assessment-2025, Central Groundwater Authority (CGWA)

⁴⁸ Assessment Unit: Administrative unit (generally a taluk/block/mandal) used for groundwater resource estimation by Central Ground Water Board.

⁴⁹ Category Classification: Safe (<70%), Semi-critical (70–90%), Critical (90–100%), Over-exploited (>100%) as defined by the Central Ground Water Board groundwater assessment methodology, and classification is based on the Stage of Groundwater Extraction (percentage of annual groundwater draft to net annual groundwater availability).

⁵⁰ Dynamic Ground Water Resources of Karnataka (2025), Groundwater Directorate, Government of Karnataka and Central Ground Water Board (CGWB). [GWRA 2025 Final Report_1776754995.pdf](#)

319. District-wise groundwater availability and extraction patterns vary substantially across Karnataka. Relatively groundwater-rich districts include coastal and Western Ghats districts such as Dakshina Kannada, Udupi, Uttara Kannada, Kodagu and parts of Shivamogga and Chikkamagaluru, where higher rainfall and better recharge conditions support safer groundwater conditions. In contrast, northern, northeastern and southeastern dry districts such as Kolar, Chikkaballapura, Bengaluru Rural, Bengaluru Urban, Ramanagara, Tumakuru, Vijayapura, Bagalkot, Kalaburagi, Raichur, Koppal and Ballari exhibit higher extraction pressures due to lower recharge, hard rock aquifers, intensive agriculture and urban demand. Over-exploited and critical groundwater assessment units are concentrated particularly in Kolar, Chikkaballapura, Bengaluru region, Ramanagara, parts of Tumakuru and northern dry zones.

320. The Table IV-13 below summarizes the Project roads located within Over-Exploited and Critical groundwater assessment units to highlight project corridors situated in areas experiencing elevated groundwater extraction pressure and potential water resource stress.⁵¹

Table IV-13: Project roads (Partially/Fully) within Over-Exploited and Critical Groundwater Areas

SN	District	Assessment Unit Name / Taluka	Category ⁴⁹	Roads Falling in These Regions (Road IDs)
1	Kolar	Mulbagal	Over-Exploited	1108, 1204, 1217, 1302, 1444, 1663, 3565, 3609, 3841
		Srinivaspur	Over-Exploited	382, 4013, 438, 912
		Bangarapet	Over-Exploited	596, 1126, 120, 1203, 1975, 2211, 2789, 3539, 3546, 5282, 5373, 748, 950, 960
		Kolar	Critical / Over-Exploited	2958, 3469, 3526, 1425, 1697, 2485, 3462, 3526, 5508
2	Chikkaballapura	Chintamani	Over-Exploited	3186, 3998, 1897, 3117, 3868, 3870, 3878
		Bagepalli	Over-Exploited	417, 4081, 409, 491
		Chikballapur	Critical/Over Exploited	462, 470, 476, 5219, 60
		Hoskote	Over-Exploited	4575, 1717, 1718, 3690, 3909, 4578, 4579, 4589, 5272
3	Ramanagara	Kanakapura (Ramanagara)	Over-Exploited	1817, 1818, 1819, 3891, 5130, 5085, 5089, 5141, 5142, 5180, 5226, 5422, 5423, 5427, 5428
		Magadi (Ramanagara)	Critical	4932, 5187, 5188, 5190, 5193, 5194, 5198, 5206, 5517, 5523
		Channapatna (Ramanagara)	Critical	5135, 5223, 5224, 5227, 5228, 5384
4	Tumkur	Tiptur (Tumakuru)	Critical / Semi-Critical	2533, 2544, 4463, 2458, 2516, 2559, 2679, 3427, 3771, 3772
		Gubbi (Tumakuru)	Critical	3168, 2998, 3169, 3172, 3177, 3179, 3695, 3758, 3960, 4456, 4618, 5326

⁵¹ The information presented has been derived by cross-referencing the taluk-wise groundwater assessment unit categorization provided in the Dynamic Ground Water Resources of Karnataka, 2025 report with the corresponding taluk-level location for each project road alignment.

SN	District	Assessment Unit Name / Taluka	Category ⁴⁹	Roads Falling in These Regions (Road IDs)
		Turuvekere (Tumakuru)	Critical	1679, 2956, 2972, 5480
5	Bagalkot	Badami (Bagalkot)	Critical / Over-Exploited	136, 24, 109, 117, 118, 125 131, 141, 3644, 4598, 4648, 5251
		Mudhol (Bagalkot)	Over-Exploited	1579, 1972, 2087, 3313 4582, 4744
		Jamkhandi (Bagalkot)	Critical	2160, 1324, 1372, 2085, 2337, 2818, 3372, 4487, 4606, 4607, 5183
6	Vijayapura	Indi (Vijayapura)	Over-Exploited	5052, 4224, 4252, 4253, 4998, 4999, 5004, 5327
7	Raichur	Deodurg (Raichur)	Over-Exploited	2442, 3099, 3307, 5264
8	Chamarajanagara	Kollegal (Chamarajanagar)	Semi-Critical / Critical	2536, 2538, 2540, 2543, 4221
		Chamarajanagar	Critical	2216, 1356, 2459, 2462, 2494, 2503, 344, 3780, 3786, 4062, 4156, 4600, 4876, 5465, 677, 707, 713
9	Belagavi	Athni / Raybag belt (Belagavi dry zone)	Semi-Critical / Critical	3452
10	Gadag	Shirhatti (Gadag)	Critical	144, 4287, 4580, 2301
11	Chitradurga	Holalkere	Overexploited	897, 1607, 1610, 1659, 3938, 3943, 4843

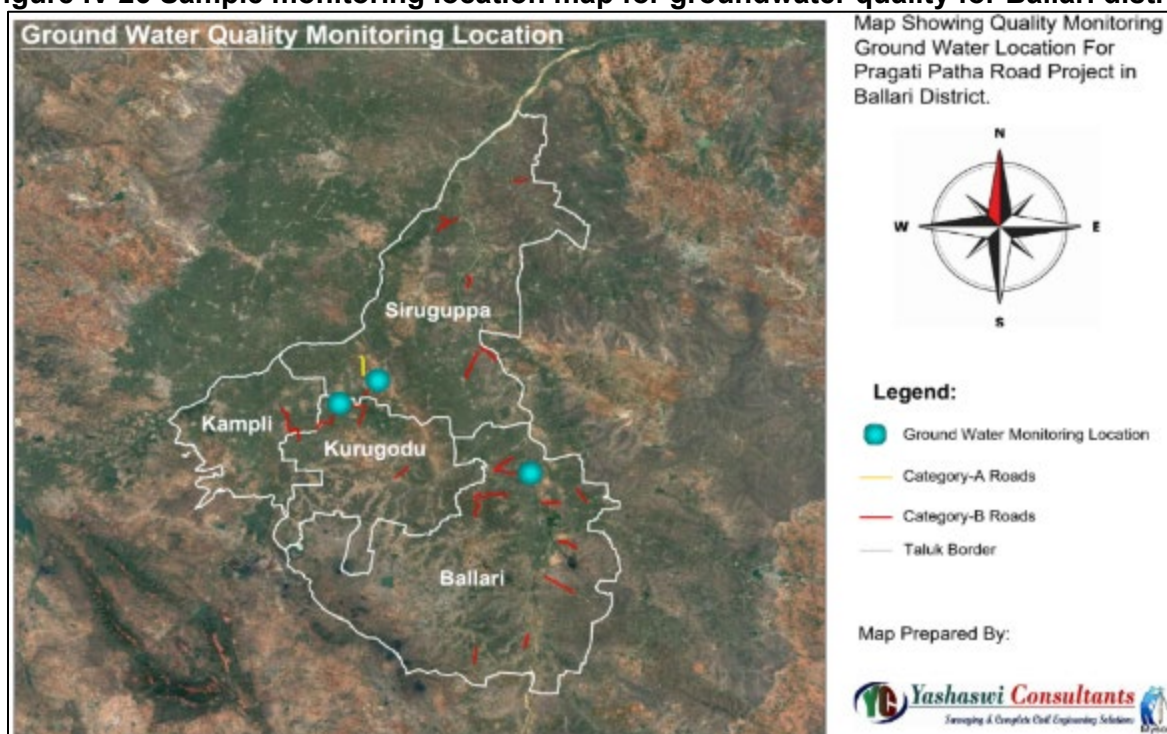
Source: GIS analysis based on the overlay of the 1,335 project road alignments with the Categorization of Groundwater Assessment Unit Map by CGWB

2. Groundwater Quality

321. **Methodology of Groundwater Quality Monitoring.** Groundwater quality monitoring was undertaken to establish the existing quality of groundwater sources used by local communities for drinking, domestic use, irrigation and livestock purposes. In rural Karnataka, groundwater is an important source of water supply, particularly in villages and agricultural areas. Baseline groundwater quality therefore provides important information for assessing potential project-related risks associated with accidental spills, improper storage of construction materials, wastewater discharge and other construction-stage activities.

322. Representative groundwater sampling locations, 769 in number, were selected from representative sources such as borewells, hand pumps, dug wells and community drinking water sources located near the project roads. The list of sampling locations is provided in Appendix 21. Preference was given to sources used by local communities and those located close to proposed construction activity areas, material storage locations or settlements. A sample package is provided in the Figure IV-26.

Figure IV-26 Sample monitoring location map for groundwater quality for Ballari district



Source: Map prepared by DPR consultant of KRRDA

323. Groundwater samples were collected using clean, sterilized and properly labelled containers. Samples for physico-chemical and bacteriological analysis were preserved and transported to the laboratory in accordance with standard procedures. The analysis was carried out by NABL-accredited laboratories.

324. The parameters analysed included pH, electrical conductivity, turbidity, total dissolved solids, total hardness, calcium, magnesium, chloride, sulphate, nitrate, fluoride, iron, selected heavy metals and bacteriological parameters such as total coliform and faecal coliform. Groundwater quality interpretation for Karnataka rural road EIA documents has included parameters such as TDS, hardness, fluoride and nitrate, with comparison against drinking water requirements under BIS IS 10500.

325. The results were compared with BIS IS 10500 drinking water standards to determine the suitability of groundwater for domestic use and to identify any existing quality concerns. The baseline data also provide a reference for future environmental monitoring during the construction and operation phases.⁵²

326. WHO provides health-based guideline values for selected parameters, while for some parameters, such as TDS and turbidity, WHO provides acceptability or operational guidance rather than health-based permissible limits.

⁵² Bureau of Indian Standards, IS 10500:2012, Indian Standard Drinking Water — Specification, Second Revision, New Delhi, 2012; World Health Organization, Guidelines for Drinking-water Quality: Fourth Edition Incorporating the First, Second and Third Addenda, Geneva, 2026.

327. The pH ranges from 4.7 to 8.6, with an average value of 7.27 (consistent with Table IV-14). The pH is outside the BIS range at some monitored locations with the minimum value below 6.5 and the maximum value above 8.5.

328. Total Dissolved Solids (TDS) ranges from 70 mg/L to 2,460 mg/L, with an average value of 456.3mg/L. The maximum TDS concentration exceeds the BIS permissible limit of 2,000 mg/L. The maximum TDS value is also above the WHO palatability/acceptability threshold of about 1,000 mg/L; however, WHO has not established a health-based guideline value for TDS. Total hardness ranges from 20 mg/L to 633 mg/L, with an average value of 195.1 mg/L, and the maximum concentration marginally exceeds the BIS permissible limit of 600 mg/L.

329. Major ions are largely within the applicable limits. Calcium ranges from 4 mg/L to 633 mg/L, with an average value of 77.6 mg/L, and the maximum concentration exceeds the BIS permissible limit of 200 mg/L. Magnesium, alkalinity, chloride, sulphate and nitrate remain within BIS permissible limits. The maximum sulphate concentration of 454 mg/L exceeds the BIS permissible limit of 400 mg/L. Nitrate also remains within the WHO guideline value of 50 mg/L.

330. Fluoride ranges from below detectable limit to 2.3 mg/L, with an average value of 0.61 mg/L. The maximum fluoride concentration exceeds both the BIS permissible limit and WHO guideline value of 1.5 mg/L. Iron ranges up to 0.6 mg/L and exceeds the BIS permissible limit of 0.3 mg/L. Turbidity ranges from below 1 NTU to 5.8 NTU, and the maximum concentration exceeds the BIS permissible limit of 5 NTU as well as the WHO operational guidance value for effective disinfection. Most trace metals are below detectable limits or within BIS permissible limits and WHO guideline values. However, manganese exceeds both the BIS permissible limit and the WHO provisional guideline value with a maximum concentration of 5 mg/L. Mercury exceeds the BIS permissible limit with a maximum concentration of 0.004 mg/L. Although the maximum value remains below the WHO guideline value for inorganic mercury. Nickel exceeds both the BIS permissible limit and WHO guideline value with a maximum concentration of 10 mg/L. Selenium also exceeds the respective BIS and WHO guideline values, with a maximum concentration of 4.8 mg/L. Other trace metals, including copper, arsenic, lead, cadmium and chromium, are within the respective BIS and WHO guideline values.

331. Bacteriological contamination is absent at most monitored locations. However, faecal coliform and E. coli are detected at approximately 32 monitored locations. These detections exceed both BIS requirements and WHO guideline values.

Table IV-14: Summary of Groundwater Quality Monitoring Results and Comparison with BIS and WHO Guideline Values

Parameter	Minimum	Maximum	Average	Standard (BIS permissible)	WHO
pH	4.7	8.6	7.27	6.5-8.5	
Colour	<1 (BDL)	12	7.43	15	
Odour	Qualitative	—	—	agreeable	
Turbidity (NTU)	<1	5.8	5	5	0.2
Total Dissolved Solids (mg/L)	70	2460	456.252	2000	1000*
Total Hardness (CaCO ₃) (mg/L)	20	633	195.08	600	
Calcium (mg/L)	4	633	77.59	200	
Magnesium (mg/L)	0.7	100	28.14	100	
Alkalinity (mg/L)	BDL <1	449	136.81	600	

Parameter	Minimum	Maximum	Average	Standard (BIS permissible)	WHO
Chloride (mg/L)	BDL <1	755	101.16	1000	
Sulphate (mg/L)	BDL <1	454	52.9	400	
Nitrate (mg/L)	BDL <1	45	7.04	45	50
Fluoride (mg/L)	BDL <1	2.3	0.61	1.5	1.5
Iron (mg/L)	0.1	0.6	0.17	0.3	0.3
Manganese (mg/L)	<0.1	5	0.798	0.3	0.08 ^a
Copper (mg/L)	BDL <0.3	0.16	0.11	1.5	2
Zinc (mg/L)	BDL <0.02	9	0.629	15	0.01 ^a
Aluminium (mg/L)	BDL <0.03	0.152	0.02	0.2	
Arsenic (mg/L)	BDL	0.03	0.017	0.05	0.01 ^a
Lead (mg/L)	BDL	BDL <0.01	<0.0055	0.01	0.01 ^a
Cadmium (mg/L)	BDL	<0.003	<0.0015	0.003	0.003
Chromium (mg/L)	BDL	BDL <0.05	<0.026	0.05	0.05
Mercury (mg/L)	BDL	0.004	0	<0.0005	0.006
Nickel (mg/L)	BDL	10	0.436	0.02	0.07 ^a
Selenium (mg/L)	BDL	4.8	2.0505	0.01	0.04
Cyanide (mg/L)	BDL	BDL <0.05	<0.026	0.05	
Faecal Coliform (MPN/100mL)	0	NA	NA	0	Must not be detectable in any 100 mL sample
E. coli (per 100 mL)	0	NA	NA	0	Must not be detectable in any 100 mL sample

*Value is related to palatability/acceptability, not health-based permissibility, no health-based guideline value.

^a Provisional guideline value

Source: Compiled from the Environmental monitoring results shared by DPR consultants of KRRDA.

3. Surface Water Resources

332. Karnataka's surface water resources are distributed across seven major river basin systems, namely the Krishna, Cauvery, Godavari, Pennar, East Flowing Rivers between Pennar and Kanyakumari, West Flowing Rivers from Tadri to Kanyakumari, and West Flowing Rivers from Tapi to Tadri. Among these, the Krishna Basin is the largest, covering much of northern and central Karnataka, followed by the Cauvery Basin in southern Karnataka.

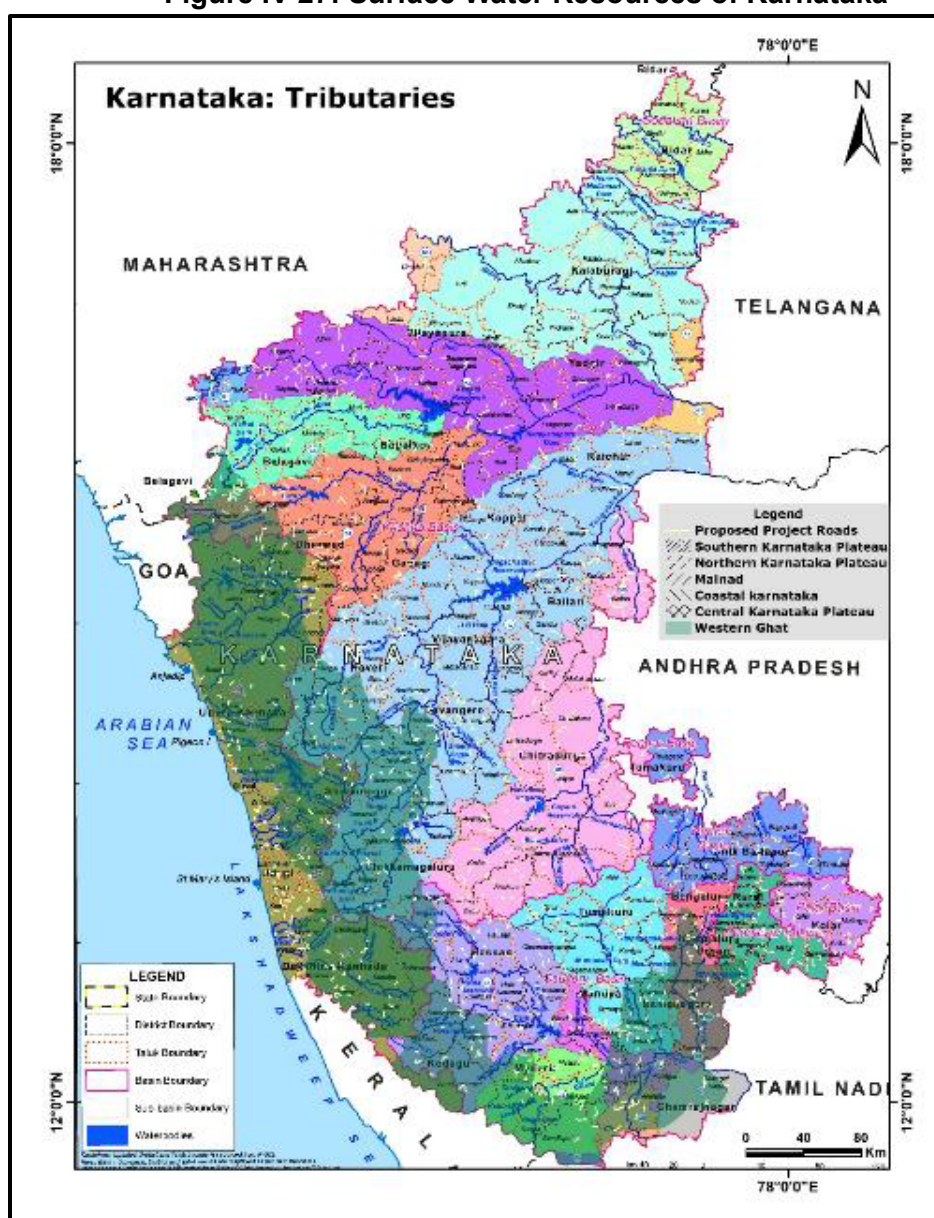
333. The Krishna Basin includes major rivers and tributaries such as the Krishna, Bhima, Ghataprabha, Malaprabha, Tungabhadra, Vedavathi, Hagari and Don rivers, and supports some of Karnataka's largest irrigation and reservoir systems, including: Almatti Dam, Narayanpur Dam, Tungabhadra Reservoir, Malaprabha Dam, Hidkal (Ghataprabha) Dam, Hipparagi Barrage and Upper Krishna Projects.

334. The Cauvery Basin, covering southern Karnataka, includes the Cauvery River and major tributaries such as Kabini, Hemavathi, Harangi, Lakshmana Tirtha, Shimsha, Arkavathi, and

Suvarnavathi. Major reservoirs and irrigation systems within this basin includes Krishna Raja Sagara (KRS) Dam, Kabini Reservoir, Hemavathi (Gorur) Reservoir, Harangi Dam, Suvarnavathi Reservoir, Markonahalli Dam, and Thippagondanahalli Reservoir. This basin supports major irrigation command areas, drinking water supply and hydropower infrastructure across Kodagu, Mysuru, Mandya, Hassan and Bengaluru regions. The Godavari Basin occupies only a small portion of northeastern Karnataka, primarily through tributaries such as the Manjira and Karanja rivers (Figure IV-27).

335. Western Karnataka, particularly the Western Ghats and coastal belt, is characterized by numerous west-flowing rivers, including the Kali, Sharavathi, Aghanashini, Netravati, Gurupur, Bedti and Varahi rivers, which are short but high-yielding due to intense monsoonal rainfall. These rivers contribute significantly to hydropower generation, biodiversity conservation and regional water security.

Figure IV-27: Surface Water Resources of Karnataka



Source: Water Resource Department, Karnataka

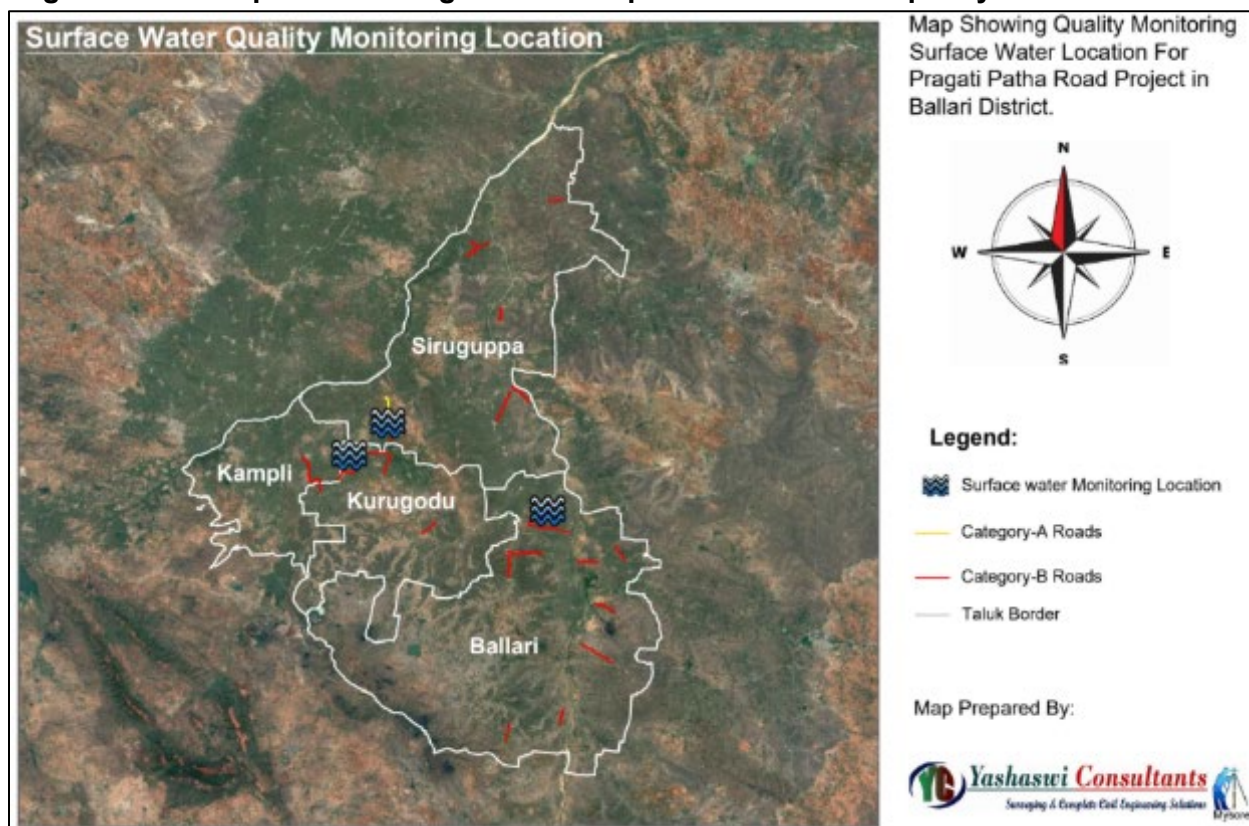
336. Out of the 1335 project roads, 547 roads are reported to have surface water body within 500m. The details are presented in Appendix 16.

4. Surface water Quality

337. **Methodology of Surface Water Quality Monitoring.** Surface water quality monitoring was undertaken to establish the existing quality of water bodies located within or near the project influence area. The objective was to assess the baseline condition of rivers, streams, tanks, ponds, lakes, canals, roadside drains and other surface water features that may be affected during construction or operation of the project roads.

338. Representative sampling locations at 551 number of locations (Appendix 21) were selected based on the presence of surface water bodies along or close to the road corridors, road crossings over natural drains or streams, community use of water bodies, irrigation use and ecological sensitivity. Locations downstream of road crossings and water bodies adjacent to construction activity areas were considered important for baseline assessment. A sample package is provided in the Figure IV-28.

Figure IV-28 Sample monitoring location map for surface water quality for Ballari district



Source: Map prepared by DPR consultant of KRRDA

339. Surface water samples were collected as grab samples in clean and properly preserved containers following standard sampling procedures. Field observations were recorded at the time of sampling, including water body type, surrounding land use, flow condition, visible pollution

sources, community use and accessibility. The samples were transported to the laboratory under appropriate preservation conditions and analysed by NABL-accredited laboratories.

340. The parameters analysed included physical, chemical, biological and heavy metal parameters. These typically included pH, temperature, turbidity, electrical conductivity, total dissolved solids, total suspended solids, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, chloride, sulphate, nitrate, phosphate, ammonia, oil and grease, selected heavy metals and bacteriological parameters such as total coliform and faecal coliform. Similar surface water parameters have been reported in Karnataka rural road EIA documentation, including pH, dissolved oxygen, BOD, COD, TSS, TDS, turbidity, chloride, sulphate, nitrate, phosphate, ammonia, oil and grease, heavy metals and coliform parameters.

341. The data were used to assess the existing condition of surface water resources and to identify locations requiring protection measures during construction. The monitored results were compared with the CPCB Designated Best Use water quality criteria⁵³ for Classes A, B, C, D and E, and with BIS IS 10500:2012 drinking water permissible limits, wherever relevant.

342. Overall, the monitored surface water quality generally meets CPCB Class B/C criteria at most locations. However, localized deviations are observed for pH, dissolved oxygen, BOD and total/faecal coliform. With respect to BIS drinking-water limits, exceedances are noted for pH, TDS, turbidity, ammonia and bacteriological parameters (Table IV-15). These localized deviations may be influenced by a combination of natural catchment characteristics, seasonal hydrological conditions and local anthropogenic activities, including agricultural runoff, domestic wastewater discharge, livestock access and other activities occurring in the vicinity of the monitored water bodies.

343. The pH ranges from 6.28 to 10, with an average value of 7.32. The minimum value is below the CPCB Class A/B/D and BIS prescribed range of 6.5–8.5, while the maximum value is above the applicable range. The maximum pH value of 10 is above the prescribed pH range for all CPCB classes and BIS drinking-water criteria. The observed variation in pH may be attributed to site-specific geological and geochemical conditions, interaction with surrounding soils and rocks, and biological processes within the water bodies. Elevated pH may also be associated with increased photosynthetic activity, particularly in relatively stagnant or nutrient-enriched surface waters, whereas lower pH may reflect local runoff, organic matter decomposition or naturally acidic catchment conditions.

344. Dissolved oxygen ranges from 2 mg/L to 52 mg/L, with an average value of 5.93 mg/L. The minimum DO value of 2 mg/L is below the CPCB Class A, B, C and D criteria, while the average value is marginally below the Class A criterion of 6 mg/L. Low dissolved oxygen may be associated with relatively stagnant flow conditions, decomposition of organic matter and localized organic loading, which increase oxygen consumption within the water body.

345. BOD ranges from <1 mg/L to 12 mg/L, with an average value of 2.5 mg/L. The maximum BOD value exceeds the CPCB Class A, B and C criteria, while the average BOD value exceeds the Class A criterion. The elevated BOD levels may be attributed to the presence of biodegradable

⁵³ Central Pollution Control Board, Water Quality Criteria – Designated Best Use Classification. Where Class A: drinking water source without conventional treatment but after disinfection, Class B: outdoor bathing, Class C: drinking water source after conventional treatment and disinfection, Class D: propagation of wildlife and fisheries, Class E: irrigation, industrial cooling and controlled waste disposal

organic matter introduced through surface runoff, domestic wastewater, agricultural activities, livestock movement or other local sources of organic loading.

346. Total/faecal coliform ranges from 0 to more than 500 MPN/100 mL, with an average value of 7 MPN/100 mL. The maximum reported concentration exceeds the CPCB Class A and Class B criteria. It also does not meet the BIS drinking-water requirement, which requires absence of thermotolerant coliform/E. coli in any 100 mL sample. The elevated bacteriological concentrations may be associated with localized inputs from domestic wastewater, open defecation, livestock access to surface water bodies and runoff carrying faecal material from surrounding settlements and agricultural areas.

347. Other monitored parameters, including COD, TSS, temperature, phosphate, oil and grease, phenolic compounds and heavy metals, do not have specific CPCB Designated Best Use criteria under Classes A to E. Therefore, these parameters have not been directly classified under CPCB surface water criteria. and turbidity exceed the relevant BIS permissible limits at the maximum recorded concentrations. TDS ranges from 14 mg/L to 2,280 mg/L, while turbidity ranges from 0.2 NTU to 86 NTU. Elevated turbidity may be attributed to suspended soil and sediment carried by surface runoff, bank erosion, disturbance of the waterbed and other localized catchment activities. Ammonia remains within the applicable BIS limit based on the reported maximum and average values. Chloride, sulphate and nitrate remain within the BIS permissible limits. Phenolic compounds are recorded up to the BIS permissible limit. The combined heavy metals result should be interpreted cautiously, as BIS specifies metal-specific limits and an aggregate heavy metal comparison is not appropriate.

348. Overall, surface water quality is generally suitable for CPCB Class B/C designated uses at most monitored locations. However, it is not uniformly suitable for Class A use due to localized pH variation, low dissolved oxygen, elevated BOD and coliform presence. The reported maximum coliform concentration also indicates potential non-compliance with the Class B criterion at some monitored locations.

Table IV-15: Summary of Surface Water Quality Monitoring Results and Comparison with CPCB and BIS Standards.

Parameter	Minimum	Max	Average	Standard (BIS permissible)	CPCB Guideline Criteria
pH	6.28	10	7.32	6.5-8.5	Class A/B/D: 6.5–8.5; Class C: 6.0–9.0; Class E: 6.0–8.5
Dissolved Oxygen (mg/L)	2	52	5.93		Class A: ≥6; Class B: ≥5; Class C/D: ≥4
BOD (mg/L)	<1	12	2.5		Class A: ≤2; Class B/C: ≤3
COD (mg/L)	<1	49	8.34		
TSS (mg/L)	1	380	23.31		
TDS (mg/L)	14	2280	296.67	2000	
Temperature (°C)	18.2	42	26		
Turbidity (NTU)	0.2	86	5	5	
Chloride (mg/L)	0.4	250	63.5	1000	
Sulphate (mg/L)	10	385	35.50	400	
Nitrate (mg/L)	BDL	40	4	45	
Phosphate (mg/L)	<0.1	0.8	0.18		
Ammonia (mg/L)	BDL	0.34	0.41	0.5	Class D: free ammonia as N ≤1.2 mg/L

Parameter	Minimum	Max	Average	Standard (BIS permissible)	CPCB Guideline Criteria
Oil & Grease (mg/L)	BDL	2	0.31		
Phenolic Compounds (mg/L)	BDL	0.002	0.0004		
Heavy metals (As, Pb, Cd, Cr, Ni, Zn, Cu, Hg)	BDL	3	0.05	<0.001	
Total / Faecal Coliform	0	>500	7	0	Class A: ≤50; Class B: ≤500; Class C: ≤5,000 MPN/100 mL

Source: Compiled from the Environmental monitoring results shared by DPR consultants of KRRDA.

F. Biological Environment

349. The biological environment of the road stretches has been assessed using available GIS layers, spatial overlays with ecological features, secondary data sources, and primary surveys for baseline biodiversity assessment (BBA) and critical habitat assessment (CHA) in the summer season (March and May 2026). The distribution of these road segments indicates a strong concentration in ecologically sensitive regions of Karnataka, particularly within the Western Ghats, which is globally recognized for its high biodiversity and endemism, and is a UNESCO-designated World Heritage Site.

350. In addition to the Western Ghats, several road stretches traverse or lie in proximity to forested landscapes, protected areas, and wildlife corridors in central, southern, and northern Karnataka. These areas include a range of habitat types supporting diverse flora and fauna, including several species of conservation importance.

351. The ecological sensitivity of the study area is primarily influenced by the presence of legally protected areas, their eco-sensitive zones, forest lands, habitat heterogeneity, and connectivity between wildlife habitats, characterised by movement corridors, particularly for such fauna as Tiger and Elephant.

1. Habitat Types

352. The roads traverse a variety of habitat types, reflecting the ecological diversity of Karnataka. These habitats range from dense forest ecosystems in the Western Ghats to dry scrublands and agricultural landscapes in the interior regions.

353. The dominant habitat types observed include wet evergreen and semi-evergreen forests in the Western Ghats belt where rainfall is high, and are characterized by dense canopy cover, and multi-layered vegetation. These habitats support rich biodiversity, including endemic flora and fauna, and are particularly sensitive to disturbances.

354. Moving eastward, the habitat transitions into moist deciduous forests, which exhibit a mix of evergreen and deciduous species. These forests serve as important buffer zones around protected areas and support a range of wildlife species.

355. In the central and northern parts of Karnataka, the habitat is largely characterized by dry deciduous forests and scrublands. These ecosystems, though less dense, provide essential

habitats for grassland and scrub-dependent species and play a role in maintaining ecological balance.

356. The southern parts of the state, particularly around Mysuru and Chamarajanagar, consist of dry deciduous forests interspersed with riparian vegetation and agricultural lands. These areas are ecologically significant due to their role as wildlife corridors connecting major protected areas in the Nilgiri landscape.

357. The eastern rain shadow parts of the state are covered by scrub and tropical thorn forests as well as grasslands. The transition in the forest types from west to east is influenced by the amount of rainfall received, elevational gradient, soil depth, types and texture, other environmental variables, and geological history.

358. Agricultural lands, plantations (coffee, tea, arecanut, coconut), and human-modified landscapes are also observed along several stretches. These modified habitats contribute to landscape heterogeneity and often support secondary biodiversity.

359. In terms of habitat types, the road alignments themselves occupy modified habitat since the roads proposed for improvement are pre-existing roads; no new roads have been proposed as part of the Project. A belt of between 1 and 4 metre along the road will be utilized for the provision of drains and shoulders; however, owing to vehicular movement, construction, maintenance by KRRDA or other road development agencies in the state, this belt, too, can be considered as modified, compacted habitat, as the vegetation composition as well as characteristics contrast those in the adjoining natural habitats. The vegetation in this belt is primarily composed of grasses, herbs, shrubs, and tree seedlings.

360. Based on the GIS assessment performed for the roads proposed for improvement, the land use and land cover patterns in the 500 m of the road alignment indicates that the roads are largely situated in modified habitats – agriculture (44.3%), built-up/settlements (21.9%), bare rock/compacted ground (0.12%), and unclassified modified land use patterns (0.1%) – cumulatively amounting to 66.45%. Amongst the natural habitats categories, 16.84% comprises tree cover and forests, whereas scrublands constitute 12.36%. Table IV-16 shows a breakup of the involved habitats and their categorisation as natural, modified, and critical.

Table IV-16: Habitat Types, Area (Hectares) and Habitat Categorisation

Land Use Type	Area (ha)	Percentage	Habitat Category
Agricultural/Crops	2351.39	44.33	Modified
Built-up area / Human settlements	1161.58	21.9	Modified
Bare rock/Ground/Compacted Surface	6.32	0.12	Modified
Others	5.16	0.1	Modified
Tree cover / Forest (Outside Protected Area - Managed/Plantations)	893.53	16.84	Natural/Critical
Scrubland	655.76	12.36	Natural/Critical
Waterbodies	27.21	0.51	Natural/Critical
Grassland	12.04	0.23	Natural/Critical
Flooded vegetation / Wetlands (Outside Protected Area)	2.69	0.05	Natural
Tree cover / Forest (Inside Protected Area)	188.93	3.56	Natural/Critical

Land Use Type	Area (ha)	Percentage	Habitat Category
Flooded vegetation / Wetlands (Inside Protected Area)	0.07	0	Natural/Critical
Total	5304.68	100	-

Source: GIS assessment undertaken as part of the desktop study

361. It should be noted, however, that these are the habitat types within 500 m and do not necessarily indicate that the implementation of the Project will lead to a loss of these habitats in entirety. This is primarily because the proposed Project deals only with the improvement activities on existing roads, that too, within the available ROW. The provision for the calculation of actual losses is made in the BAP.

362. Primary surveys indicate that the vegetation growing in the ROW, although natural, is primarily composed of grasses and shrubs, typical to disturbed habitats, and the species composition, stratification, canopy structure etc. was not similar to the adjacent natural habitats. Thereby, although specific data regarding how much vegetation will be cleared for works including drains and shoulders are not available at this stage and will be calculated prior to the start of the construction for each road by the contractor, it is likely that the involvement of natural habitat in this Project is minimal, although the Project roads, particularly those in Western Ghats and/or legally protected areas, and forest lands lie within a landscape that is composed of natural habitats, in the form of forests, scrublands, thorn vegetation, grasslands, waterbodies etc. Nonetheless, the BAP provides for the restoration at offset sites identified by Karnataka Forest Department equivalent to the amount of natural/critical habitat lost during the construction works.

363. ADB's SPS (2009) prohibit significant conversion or degradation of natural habitats, unless the following conditions are met:

- No alternatives are available
- A comprehensive assessment demonstrates that the overall Project benefits will substantially outweigh the costs, including environmental costs
- Any conversion or degradation is appropriately mitigated

364. Available data suggest that the Project likely fulfils the conditions set out in the preceding point. However, the same will be concluded after the baseline biodiversity assessment and CHA have been concluded in April 2027. The EIA report will be updated accordingly.

365. A dedicated critical habitat assessment (CHA) is ongoing and is slated for completion in April 2027. The CHA involves GIS assessment, secondary data and literature review, consultations with stakeholders and subject-matter experts, primary surveys in four seasons – summer (March-May 2026), monsoon (June-August 2026), post-monsoon (September-November 2026), and winter (December 2026-February 2027) – along the Project roads to document the baseline species and ecosystems diversity along the Project roads, to determine the presence of critical habitats, to establish the critical habitat triggers, determine impacts and residual impacts to critical habitat triggering biological values and the critical habitats themselves.

366. Critical habitat assessment has followed a systematic approach. A list of critical habitat candidate species for the state was generated using Integrated Biodiversity Assessment (IBAT). Species therein were supplemented with migratory and/or congregatory species as well as range-restricted species, which are not threatened or have not yet been evaluated by IUCN to ensure that all potential critical habitat candidate species were assessed. The critical habitat candidate species were then subjected to a screening process wherein species' occurrences were verified

through literature review, primary surveys (first season), and stakeholder consultations. A list of screened species with the likelihood of occurrence within the state and the Project's Aol was prepared. Critical habitat assessment will focus on determining these species can trigger the requirements of the CHA criteria.

367. Although the CHA has not been concluded as of now, the CHA has nevertheless identified EAAAs which can serve as critical habitats. The critical habitat status of these EAAAs has been established. However, the listing of critical habitat candidate species and the delineation of the EAAAs has enabled the designing of the BAP in a way that is overarching and addresses ecosystem/habitat-related issues, such as ecological restoration at sites identified with the assistance of Karnataka Forest Department, thereby ensuring conservation and the trajectory towards the no-net loss of these critical habitat triggering species as well. For example, the Western Ghats and the adjoining broadleaved forests have been determined to be critical habitats for threatened and range-restricted mammalian and reptilian species. Documentation and assessment of amphibian diversity of the Western Ghats will be undertaken in August and September of 2026. These assessments will establish if any of the threatened and/or range-restricted amphibian species will be determined to be critical habitat triggers. However, the fact that amphibians can trigger critical habitat requirements has been factored into the designing of the mitigation measures and the BAP, ensuring that those species whose status as critical habitat triggers is unknown at this stage are covered too. The BAP action items have been discussed with the key stakeholders. This ensures that the risk assessment is holistic and not restricted to only those species that have been documented in the BBA and CHA as of July 2026.

368. Based on the first-season data, five critical habitats have been identified in Karnataka. These include the Western Ghats or the Broadleaf Forests Ecologically Appropriate Area of Analysis (EAAA), which has been designated as a critical habitat for such threatened species as Asian Elephant [*Elephas maximus*; EN (IUCN v.2025-254)], Tiger [*Panthera tigris*; EN (IUCN v.2025-2)], Dhole [*Cuon alpinus*; EN (IUCN v.2025-2)], Lion-tailed Macaque [*Macaca Silenus*; EN (IUCN v.2025-2)], as well as for range-restricted species of reptiles and amphibians (cumulatively referred to as herpetofauna). With regards to range-restricted species of herpetofauna, although quantitative data in terms of population sizes or extent of occurrence are unavailable or rudimentary, the critical habitat determination was and will be performed based on available distribution maps⁵⁵ and expert opinions.

369. Other critical habitats determined in the CHA include:

- Hampi-Ballari EAAA, which has been designated as critical habitat for two range-restricted geckos – Aadi's Day Gecko [*Cnemaspis adii*; CR (IUCN v.2025-2)] and Hampi Rock Gecko [*Hemidactylus siva*; EN (IUCN v.2025-2)]. Although the EAAA may serve as critical habitats for the Critically Endangered (IUCN v.2025-2)] Great India Bustard (*Ardeotis nigriceps*) and Lesser Florican (*Sypheotides indicus*), additional surveys are required to ascertain their presence and status in

⁵⁴ As this EIA report was being drafted, the 2026-1 version of IUCN was released in July 2026. However, since the assessments had begun in February 2026, and the Project was in advanced stage in July 2026, version 2025-2 was followed for this report.

⁵⁵ For reptiles, we relied on the up-to-date reptile geographic distribution data as available on Global Assessment of Reptile Distribution (GARD): Roll et. al. 2017 [The global distribution of tetrapods reveals a need for targeted reptile conservation](#). *Nature Ecology & Evolution* 1:1677-1682 and Caetano, et al. 2022. Automated assessment reveals that the extinction risk of reptiles is widely underestimated across space and phylogeny. *PLoS Biology*, 20(5): e3001544

Karnataka. Surveys in the upcoming seasons will be instrumental in determining if these species qualify as critical habitat triggers.

- Mysuru Plateau EAAA, which has been designated as a critical habitat for threatened and range-restricted species of geckos – *Hemiphyllodactylus jnana* [LC; IUCN v.2025-2]), Bengaluru Geckoella [*Cyrtodactylus srilekhae*; NT (IUCN v.2025-2)], and Mysore Day Gecko [*Cnemaspis mysoriensis*; LC (IUCN v.2025-2)].
- Kolar Leaf-Nosed Bat EAAA, which has been designated as a critical habitat for the Critically Endangered, range-restricted species of bats – the Kolar Leaf-Nosed Bat (*Hipposideros hypophyllus*). The EAAA encompasses the Kolar Leaf-Nosed Bat Conservation Reserve, the ‘Cave at Hanumahalli’ Alliance for Zero Extinction Site, and a radius of 5 km around the conservation reserve, which include the other subterranean caves on granulitic hills in the Kolar region where the species may occur and utilize.
- *Sarada darwini* EAAA, which has been designated for the range-restricted Darwin’s Large Fan-throated Lizard [*Sarada darwini*; LC (IUCN v.2025-2)], occurs along the northern boundary of Karnataka and the southern boundary of Maharashtra and encompasses dry scrub and thorn forests, as well as modified habitats.

370. Additionally, EAAAs delineated for such point-endemic species as *Sitana gokakensis* [DD (IUCN v.2025-2)] and *Pseudotyphlops exiguus* [DD (IUCN v.2025-2)] were found to serve as critical habitats for the nominate range-restricted species; however, these were not found to be much material, as no roads proposed for improvement occur in their respective habitats.

371. It is to be noted that the outcomes presented in the bullet points above as preliminary and based on desk-based assessment, stakeholder (including subject-matter experts) consultations, and summer season (March-May 2026) surveys. A few notable, potentially critical habitat triggering taxa such as amphibians and fish have not been documented owing to seasonality. Subsequent surveys will lead towards the documentation of the aforementioned and other taxa during the primary surveys, and the CHA, therefore this EIA, will be revised accordingly.

372. In areas of critical habitats, ADB’s SPS (2009) requires that the Project demonstrates:

- There are no measurable adverse impacts, or likelihood of such, on the critical habitat which could impair its high biodiversity value or the ability of the function.
- The Project is not anticipated to lead to a reduction in the population of any recognized endangered or critically endangered species, or a loss in areas of the habitat concerned such that the persistence of a viable and representative host ecosystem be compromised.
- Any lesser impacts are mitigated in accordance with paragraph 27 of ADB’s SPS (2009).

373. A Biodiversity Action Plan (BAP) has been developed to achieve no-net loss followed by net gains in critical habitats has been developed and agreed upon, with the help of the Karnataka Forest Department. While it is acknowledged that subsequent surveys may lead to the designation of additional critical habitat triggers, the BAP is designed in a way that it is overarching and can accommodate additional critical habitat triggering species, as may be determined at the conclusion of the CHA in February 2027, therefore the EIA report will be finalised in April 2027.

Table IV-17: A Breakup of Roads in Legally Designated Areas and EAAAs

Legal Designation	Roads within EAAA
Legally Protected Areas	13
Eco-sensitive Zone	67
Forest Lands	91
Outside the legally designated areas	420

2. Forest Types

374. The forest types along the project roads can broadly be classified based on Champion and Seth⁵⁶ classification into tropical evergreen, semi-evergreen, moist deciduous, dry deciduous, and thorn/scrub forests.

375. Tropical evergreen and semi-evergreen forests are primarily confined to the Western Ghats districts and are characterized by dense canopy, high biomass, and perennial vegetation. Moist deciduous forests are found in transitional zones and exhibit seasonal leaf shedding.

376. Dry deciduous forests dominate central and southern Karnataka and are characterized by species adapted to lower rainfall and seasonal drought conditions. Thorn and scrub forests are present in northern districts and represent the driest forest type, with sparse vegetation and open landscapes.

377. These forest types collectively support varied ecological niches and contribute to the overall biodiversity of the region.

378. In addition, Karnataka has a network of streams and rivers, many of which originate in the Western Ghats and flow eastward and confluence into other larger rivers, or flow westward into the Arabian Sea. These rivers support high levels of aquatic diversity, including threatened and range-restricted fishes. The stream and river network has been considered as natural habitat in this assessment.

3. Flora

379. A total of 561 species of plants belonging to 111 families were recorded during the primary surveys in the state of Karnataka in the summer season within the AoI. Trees are the dominant habitat with 224 representative species, followed by herbs at 158. The family Fabaceae is the largest family with 81 species, followed by Malvaceae and Poaceae with 28 and 26 species respectively. No Critically Endangered (IUCN v.2025-2) species were recorded during the surveys; two species – Coffee (*Coffea arabica*) and Teak (*Tectona grandis*) were Endangered (IUCN v.2025-2), whereas 14 were Vulnerable (IUCN v.2025-2). Both the Endangered species, i.e., Coffee and Teak, occurred in plantations or estates, ruling out their natural occurrence along the roads proposed for improvement.

380. A table showing the recorded floral diversity is presented in Table 4-18.

⁵⁶ Champion, H. G., and S. K. Seth. *A Revised Survey of the Forest Types of India*. Manager of Publications, 1968

Table IV-18 Plant Diversity Recorded During Summer Season Primary Surveys

Sr. No.	Botanical Name	Common Name	Family	Habit	Endemism status	IUCN Status (Global)	Remarks
1	<i>Abelmoschus angulosus</i> Wall. ex Wight & Arn.	Angled Wild Mallow	Malvaceae	Shrub		LC	
2	<i>Abelmoschus</i> sp.	Wild okra / Bhindi relative	Malvaceae	Herb		-	
3	<i>Abrus precatorius</i> L.	Rosary pea / Gunja	Fabaceae	Climber		-	
4	<i>Abutilon bidentatum</i> (Hochst.) A.Rich.	Double-Toothed Mallow	Malvaceae	Herb		-	
5	<i>Abutilon indicum</i> (L.) Sweet	Indian Mallow	Malvaceae	Shrub		-	
6	<i>Acacia auriculiformis</i> A.Cunn. ex Benth.	Earleaf acacia	Fabaceae	Tree		LC	Planted
7	<i>Acacia catechu</i> (L.f.) Willd.	Khair / Cutch tree	Fabaceae	Tree		LC	Planted
8	<i>Acacia chundra</i> (Rottler) Willd.	Red cutch tree	Fabaceae	Tree		LC	
9	<i>Acacia concinna</i> (Willd.) DC.	Shikakai	Fabaceae	Climber		-	
10	<i>Acacia ferruginea</i> DC.	Rusty Acacia	Fabaceae	Tree		VU	
11	<i>Acacia mangium</i> Willd.	Black wattle / Mangium	Fabaceae	Tree		LC	Planted
12	<i>Acacia nilotica</i> (L.) Delile	Babul / Kikar	Fabaceae	Tree		LC	
13	<i>Acacia polyacantha</i> Willd.	White thorn acacia	Fabaceae	Tree		LC	
14	<i>Acacia suma</i> (Roxb.) Buch.-Ham. ex Voigt	Suma / Gum acacia	Fabaceae	Tree		-	
15	<i>Acampe praemorsa</i> (Roxb.) Blatt. & McCann	Clipped Acampe	Orchidaceae	Herb		-	
16	<i>Acanthospermum hispidum</i> DC.	Bristly Starbur	Asteraceae	Herb		-	
17	<i>Achyranthes aspera</i> L.	Prickly Chaff Flower	Amaranthaceae	Herb		-	
18	<i>Acmella paniculata</i> (Wall. ex DC.) R.K. Jansen	Panicled Spot Flower	Asteraceae	Herb		LC	
19	<i>Actinodaphne hookeri</i> Meisn.	Pisa	Lauraceae	Tree		VU	
20	<i>Actinodaphne</i> sp.	Actinodaphne	Lauraceae	Tree		-	
21	<i>Adenanthera pavonina</i> L.	Red bead tree / Raktakambal	Fabaceae	Tree		LC	
22	<i>Adina cordifolia</i> (Roxb.) Brandis	Haldina	Rubiaceae	Tree		LC	

Sr. No.	Botanical Name	Common Name	Family	Habit	Endemism status	IUCN Status (Global)	Remarks
23	<i>Aegle marmelos</i> (L.) Corrêa	Bael	Rutaceae	Tree		NT	Planted
24	<i>Aerides</i> sp.	Aerides	Orchidaceae	Herb		-	
25	<i>Aeschynomene indica</i> L.	Indian Joint Vetch	Fabaceae	Herb		LC	
26	<i>Agave</i> sp.	Century plant	Asparagaceae	Herb		-	Planted
27	<i>Ageratum conyzoides</i> L.	Billy goat weed	Asteraceae	Herb		-	
28	<i>Aglaia lawii</i> (Wight) C.J. Saldanha	Four-Petal Aglaia	Meliaceae	Tree		LC	
29	<i>Ailanthus excelsa</i> Roxb.	Indian Tree of Heaven	Simaroubaceae	Tree		DD	
30	<i>Alangium salviifolium</i> (L.f.) Wangerin	Sage Leaved Alangium	Cornaceae	Tree		LC	
31	<i>Albizia amara</i> (Roxb.) B. Boivin	Krishna Siris	Fabaceae	Tree		LC	
32	<i>Albizia chinensis</i> (Osbeck) Merr.	Chinese albizia	Fabaceae	Tree		LC	
33	<i>Albizia lebbek</i> (L.) Benth.	Siris / Lebbek tree	Fabaceae	Tree		LC	
34	<i>Albizia odoratissima</i> (L.f.) Benth.	Black siris	Fabaceae	Tree		LC	
35	<i>Albizia procera</i> (Roxb.) Benth.	White siris	Fabaceae	Tree		LC	
36	<i>Allophylus cobbe</i> (L.) Raeusch.	Indian Allophylus	Sapindaceae	Climber		LC	
37	<i>Alocasia macrorrhizos</i> (L.) G. Don	Giant taro	Araceae	Herb		-	
38	<i>Alstonia scholaris</i> (L.) R.Br.	Devil tree / Saptaparni	Apocynaceae	Tree		LC	
39	<i>Alternanthera pungens</i> Kunth	Khaki Weed	Amaranthaceae	Herb		-	
40	<i>Alternanthera sessilis</i> (L.) R.Br. ex DC.	Sessile joyweed	Amaranthaceae	Herb		LC	
41	<i>Alysicarpus bupleurifolius</i> (L.) DC.	Lanceleaf Alyce Clover	Fabaceae	Herb		LC	
42	<i>Alysicarpus tetragonolobus</i> Edgew.	Red Alyce Clover	Fabaceae	Herb		-	
43	<i>Amaranthus viridis</i> L.	Green amaranth / Chaulai	Amaranthaceae	Herb		-	
44	<i>Ammannia baccifera</i> L.	Blistering Ammannia	Lythraceae	Herb		LC	
45	<i>Amorphophallus commutatus</i> (Schott) Engl.	Dragon Stalk Yam	Araceae	Herb		-	
46	<i>Ampelocissus latifolia</i> (Roxb.) Planch.,	Wild grape	Vitaceae	Climber		-	
47	<i>Anacardium occidentale</i> L.	Cashew	Anacardiaceae	Tree		LC	
48	<i>Ananas comosus</i> (L.) Merr.	Pineapple	Bromeliaceae	Herb		-	Planted

Sr. No.	Botanical Name	Common Name	Family	Habit	Endemism status	IUCN Status (Global)	Remarks
49	<i>Anisomeles</i> sp.	Anisomeles	Lamiaceae	Herb		-	Planted
50	<i>Annona reticulata</i> L.	Custard apple / Ramphal	Annonaceae	Tree		LC	Planted
51	<i>Annona squamosa</i> L.	Sugar Apple	Annonaceae	Tree		LC	
52	<i>Anodendron paniculatum</i> A.DC.	Andamanese Bowstring Plant	Apocynaceae	Liana		-	
53	<i>Anogeissus latifolia</i> (Roxb. ex DC.) Wall. ex Guill. & Perr.	Dhawda / Axlewood	Combretaceae	Tree		-	
54	<i>Antidesma montanum</i> Blume	Mountain Currant Tree	Phyllanthaceae	Tree		LC	
55	<i>Antigonon leptopus</i> Hook. & Arn.	Coral Vine	Polygonaceae	Climber		-	
56	<i>Aphanamixis polystachya</i> (Wall.) R.Parker	Rohituka	Meliaceae	Tree		LC	Planted
57	<i>Apluda mutica</i> L.	Mauritius grass	Poaceae	Grass		-	
58	<i>Aponogeton natans</i> (L.) Engl. & K.Krause	Floating Lace Plant	Aponogetonaceae	Herb		LC	
59	<i>Aporosa cardiosperma</i> (Gaertn.) Merr	Aporosa	Phyllanthaceae	Tree		VU	
60	<i>Araucaria columnaris</i> (G.Forst.) Hook.	Christmas tree / Cook pine	Araucariaceae	Tree		LC	Planted
61	<i>Ardisia solanacea</i> Roxb.	Shoebutton ardisia	Primulaceae	Tree		LC	
62	<i>Areca catechu</i> L.	Areca nut / Supari	Arecaceae	Palm		LC	
63	<i>Argemone mexicana</i> L.	Mexican poppy / Satyanashi	Papaveraceae	Herb		-	
64	<i>Argyreia involucrata</i> C.B.Clarke	Argyreia	Convolvulaceae	Climber		-	
65	<i>Argyreia nervosa</i> (Burm.f.) Bojer	Elephant creeper	Convolvulaceae	Climber		-	
66	<i>Aristida setacea</i> Retz.	Three-awn grass	Poaceae	Grass		-	
67	<i>Aristolochia ringens</i> Vahl	Gaping Dutchman's Pipe	Aristolochiaceae	Climber		-	
68	<i>Arthraxon lancifolius</i> (Trin.) Hochst.	Lanceleaf Carpetgrass	Poaceae	Grass		-	

Sr. No.	Botanical Name	Common Name	Family	Habit	Endemism status	IUCN Status (Global)	Remarks
69	<i>Artocarpus altilis</i> (Parkinson ex F.A.Zorn) Fosberg	Breadfruit	Moraceae	Tree		DD	
70	<i>Artocarpus heterophyllus</i> Lam.	Jackfruit / Kathal	Moraceae	Tree		-	
71	<i>Artocarpus hirsutus</i> Lam.	Wild Jackfruit	Moraceae	Tree		LC	
72	<i>Asclepias curassavica</i> L.	Scarlet Milkweed	Apocynaceae	Herb		-	
73	<i>Asparagus racemosus</i> Willd.	Shatavari	Asparagaceae	Climber		-	
74	<i>Averrhoa carambola</i> L.	Star Fruit	Oxalidaceae	Tree		DD	Planted
75	<i>Azadirachta indica</i> A.Juss.	Neem	Meliaceae	Tree		LC	
76	<i>Azima tetraacantha</i> Lam.	Mulsangu	Salvadoraceae	Shrub		LC	
77	<i>Bambusa vulgaris</i> Schrad. ex J.C.Wendl.	Common bamboo	Poaceae	Grass		-	
78	<i>Barleria cristata</i> L.	Philippine Violet	Acanthaceae	Herb		-	
79	<i>Barleria prionitis</i> L.	Porcupine Flower	Acanthaceae	Herb		-	
80	<i>Barringtonia acutangula</i> (L.) Gaertn.	Barringtonia	Lecythydaceae	Tree		LC	
81	<i>Basella alba</i> L.	Malabar Spinach	Basellaceae	Climber		-	
82	<i>Bauhinia phenicea</i> Wight & Arn.	Malabar bauhinia	Fabaceae	Climber		-	
83	<i>Bauhinia purpurea</i> L.	Purple bauhinia	Fabaceae	Tree		LC	Planted
84	<i>Bauhinia racemosa</i> Lam.	Bidi Leaf Tree	Fabaceae	Tree		LC	
85	<i>Bauhinia variegata</i> L.	Kachnar	Fabaceae	Tree		LC	Planted
86	<i>Beilschmiedia wightii</i> (Nees) Benth. ex Hook.f.	Ceylon Purplenut	Lauraceae	Tree		NT	
87	<i>Bidens biternata</i> (Lour.) Merr. & Sherff	Yellow Flowered Blackjack	Asteraceae	Herb		-	
88	<i>Biophytum sensitivum</i> (L.) DC.	Tropical Little Tree Plant	Oxalidaceae	Herb		-	
89	<i>Blainvillea acmella</i> (L.) Philipson	Para Cress Flower	Asteraceae	Herb		-	
90	<i>Blumea eriantha</i> DC.	Wool-Flower Knob-Bush	Asteraceae	Herb		-	

Sr. No.	Botanical Name	Common Name	Family	Habit	Endemism status	IUCN Status (Global)	Remarks
91	<i>Blumea lacera</i> (Burm.f.) DC.	Lettuce-Leaf Knob-Bush	Asteraceae	Herb		-	
92	<i>Blumea</i> sp.	Blumea	Asteraceae	Herb		-	
93	<i>Boerhavia diffusa</i> L.	Punarnava	Nyctaginaceae	Herb		-	
94	<i>Bombax ceiba</i> L.	Semal / Silk cotton tree	Malvaceae	Tree		LC	
95	<i>Bombax insigne</i> Wall.	Showy Silk Cotton Tree	Malvaceae	Tree		LC	
96	<i>Borassus flabellifer</i> L.	Palmyra palm / Taal	Arecaceae	Palm		LC	
97	<i>Bothriochloa pertusa</i> (L.) A. Camus	Bothriochloa	Poaceae	Grass		-	
98	<i>Boucerosia umbellata</i> (Haw.) Wight & Arn.	Umbelled Caralluma	Apocynaceae	Herb		-	
99	<i>Bougainvillea spectabilis</i> Willd.	Bougainvillea	Nyctaginaceae	Shrub		-	Planted
100	<i>Breynia retusa</i> (Dennst.) Alston	Cup Saucer Plant	Phyllanthaceae	Shrub		LC	
101	<i>Bridelia retusa</i> (L.) A.Juss.	Spinous kino tree	Phyllanthaceae	Tree		LC	
102	<i>Buchanania cochinchinensis</i> (Lour.) M.R.Almeida	Chironji	Anacardiaceae	Tree		LC	
103	<i>Bulbophyllum fimbriatum</i> (Lindl.) Rchb.f.	Fringed Bulb-Leaf Orchid	Orchidaceae	Herb		-	
104	<i>Bulbophyllum sterile</i> (Lam.) Suresh	Nilgiri Bulb-Leaf Orchid	Orchidaceae	Herb		-	
105	<i>Bulbostylis barbata</i> (Rottb.) C.B.Clarke	Bearded Watergrass	Cyperaceae	Herb		-	
106	<i>Butea monosperma</i> (Lam.) Taub.	Palash / Flame of forest	Fabaceae	Tree		LC	
107	<i>Byttneria herbacea</i> Roxb.	Deccan Spinefruit	Malvaceae	Herb		-	
108	<i>Cadaba fruticosa</i> (L.) Druce	Indian Cadaba	Capparaceae	Shrub		-	
109	<i>Caesalpinia bonduc</i> (L.) Roxb.	Fever nut / Kantaki karanja	Fabaceae	Shrub		LC	Planted
110	<i>Caesalpinia crista</i> L.	Crested Fever Nut	Fabaceae	Climber		-	
111	<i>Caesalpinia decapetala</i> (Roth) Alston	Mysore thorn	Fabaceae	Shrub		LC	

Sr. No.	Botanical Name	Common Name	Family	Habit	Endemism status	IUCN Status (Global)	Remarks
112	<i>Caesalpinia pulcherrima</i> (L.) Sw.	Peacock flower	Fabaceae	Shrub		LC	Planted
113	<i>Caesulia axillaris</i> Roxb.	Pink Node Flower	Asteraceae	Herb		LC	
114	<i>Cajanus lineatus</i> (Wight & Arn.) Maesen	Wild Toor	Fabaceae	Shrub		-	
115	<i>Cajanus scarabaeoides</i> (L.) Thouars	Showy Pigeonpea	Fabaceae	Climber		LC	
116	<i>Calamus rotang</i> L.	Cane / Rattan palm	Arecaceae	Shrub		-	
117	<i>Calliandra haematocephala</i> Hassk.	Red powder puff	Fabaceae	Shrub		LC	Planted
118	<i>Callicarpa tomentosa</i> (L.) L.	Beautyberry	Lamiaceae	Tree		LC	
119	<i>Calotropis gigantea</i> (L.) Dryand.	Giant milkweed / Aak	Apocynaceae	Shrub		-	
120	<i>Calotropis procera</i> (Aiton) Dryand.	Apple of Sodom / Aak	Apocynaceae	Shrub		LC	
121	<i>Canna indica</i> L.	Indian Shot	Cannaceae	Herb		-	Planted
122	<i>Canscora diffusa</i> (Vahl) R.Br. ex Roem. & Schult.	Spreading Canscora	Gentianaceae	Herb		-	
123	<i>Canthium coromandelicum</i> (Burm.f.) Alston	Coromandel Boxwood	Rubiaceae	Shrub		-	
124	<i>Capparis divaricata</i> Lam.	Spreading Caper	Capparaceae	Shrub		-	
125	<i>Capparis sepiaria</i> L.	Wild Caper Bush	Capparaceae	Shrub		LC	
126	<i>Capparis zeylanica</i> L.	Ceylon Caper	Capparaceae	Climber		-	
127	<i>Cardiospermum halicacabum</i> L.	Balloon vine	Sapindaceae	Climber		LC	
128	<i>Carex filicina</i> Nees	Carex	Cyperaceae	Herb		LC	
129	<i>Careya arborea</i> Roxb.	Kumbhi / Wild guava	Lecythidaceae	Tree		LC	
130	<i>Carica papaya</i> L.	Papaya	Caricaceae	Tree		DD	Planted
131	<i>Carissa carandas</i> L.	Karonda	Apocynaceae	Shrub		DD	

Sr. No.	Botanical Name	Common Name	Family	Habit	Endemism status	IUCN Status (Global)	Remarks
132	<i>Carissa spinarum</i> L.	Wild Karanda	Apocynaceae	Shrub		LC	
133	<i>Caryota urens</i> L.	Fishtail palm	Arecaceae	Palm		LC	
134	<i>Cascabela thevetia</i> (L.) Lippold	Yellow oleander	Apocynaceae	Shrub		LC	Planted
135	<i>Casearia graveolens</i> Dalzell	Chilla	Salicaceae	Tree		-	
136	<i>Cassia absus</i> L.	Chaksu	Fabaceae	Herb		LC	
137	<i>Cassia fistula</i> L.	Amaltas / Golden shower	Fabaceae	Tree		LC	
138	<i>Cassine paniculata</i> (Wight & Arn.) Lobl.-Callen,	Panicled Cassine	Celastraceae	Tree		-	
139	<i>Cassytha filiformis</i> L.	Love Vine	Lauraceae	Climber		-	
140	<i>Casuarina equisetifolia</i> L.	Casuarina / Australian pine	Casuarinaceae	Tree		LC	Planted
141	<i>Catharanthus roseus</i> (L.) G.Don	Periwinkle / Sadabahar	Apocynaceae	Herb		-	Planted
142	<i>Catunaregam spinosa</i> (Thunb.) Tirveng.	Mountain Pomegranate	Rubiaceae	Tree		LC	
143	<i>Cayratia trifolia</i> (L.) Domin	Bush Grape	Vitaceae	Climber		-	
144	<i>Ceiba pentandra</i> (L.) Gaertn.	Kapok tree	Malvaceae	Tree		LC	Planted
145	<i>Celosia argentea</i> L.	Silver Cockscomb	Amaranthaceae	Herb		LC	
146	<i>Celtis tetrandra</i> Roxb.	Nilgiri Elm	Cannabaceae	Tree		LC	
147	<i>Celtis timorensis</i> Span.	Stinkwood	Cannabaceae	Tree		LC	
148	<i>Centipeda minima</i> (L.) A.Braun & Asch.	Spreading sneezeweed	Asteraceae	Herb		LC	
149	<i>Chamaecrista absus</i> (L.) H.S.Irwin & Barneby	Tropical Sensitive Pea	Fabaceae	Herb		LC	
150	<i>Chassalia curviflora</i> var. <i>ophioxylodes</i> (Wall.) Deb & B.Krishna	Curved Flower Snake Chassalia	Rubiaceae	Herb		-	
151	<i>Chloris barbata</i> Sw.	Swollen finger grass	Poaceae	Grass		-	

Sr. No.	Botanical Name	Common Name	Family	Habit	Endemism status	IUCN Status (Global)	Remarks
152	<i>Chloroxylon swietenia</i> DC.	Ceylon Satinwood	Rutaceae	Tree		VU	Planted
153	<i>Chromolaena odorata</i> (L.) R.M.King & H.Rob.	Siam weed	Asteraceae	Herb		-	
154	<i>Chrozophora rottleri</i> (Geiseler) A.Juss. ex Spreng.	Suryavarti	Euphorbiaceae	Herb		-	
155	<i>Chrysopogon fulvus</i> (Spreng.) Chiov.	Reddish-Yellow Beardgrass	Poaceae	Grass		-	
156	<i>Chrysopogon zizanioides</i> (L.) Roberty	Khas	Poaceae	Herb		-	
157	<i>Chukrasia tabularis</i> A.Juss.	Chikrassy	Meliaceae	Tree		LC	
158	<i>Cinnamomum tamala</i> (Buch.-Ham.) T.Nees & C.H.Eberm.	Indian Bay Leaf	Lauraceae	Tree		LC	
159	<i>Cinnamomum verum</i> J.Presl	Cinnamon	Lauraceae	Tree		VU	
160	<i>Cissampelos pareira</i> L.	Velvet Leaf	Menispermaceae	Climber		-	
161	<i>Cissus quadrangularis</i> L.	Veldt Grape	Vitaceae	Climber		-	Planted
162	<i>Cleome gynandra</i> L.	Wild Spider Flower	Cleomaceae	Herb		-	
163	<i>Cleome</i> sp.	Spider flower	Cleomaceae	Herb		-	
164	<i>Clerodendrum inerme</i> (L.) Gaertn.	Seaside clerodendrum	Lamiaceae	Shrub		-	
165	<i>Clerodendrum paniculatum</i> L.	Pagoda flower	Lamiaceae	Shrub		-	
166	<i>Clitoria ternatea</i> L.	Butterfly Pea	Fabaceae	Climber		-	
167	<i>Coccinia grandis</i> (L.) Voigt	Ivy gourd	Cucurbitaceae	Climber		-	
168	<i>Cocculus hirsutus</i> (L.) W.Theob.	Broom creeper	Menispermaceae	Climber		-	
169	<i>Cocos nucifera</i> L.	Coconut / Nariyal	Arecaceae	Palm		-	Planted
170	<i>Coffea arabica</i> L.	Coffee	Rubiaceae	Shrub		EN	Planted
171	<i>Coffea liberica</i> W.Bull	Liberian Coffee	Rubiaceae	Tree		LC	Planted
172	<i>Coffea robusta</i> L.Linden	Robusta Coffee	Rubiaceae	Tree		LC	Planted

Sr. No.	Botanical Name	Common Name	Family	Habit	Endemism status	IUCN Status (Global)	Remarks
173	<i>Coix lacryma-jobi</i> L.	Adlay Millet	Poaceae	Grass		-	
174	<i>Coldenia procumbens</i> L.	Creeping Coldenia	Boraginaceae	Herb		LC	
175	<i>Colebrookea oppositifolia</i> Sm.	Indian Squirrel Tail	Lamiaceae	Shrub		LC	
176	<i>Colocasia esculenta</i> (L.) Schott	Taro / Arbi	Araceae	Herb		LC	
177	<i>Combretum coccineum</i> (Sonn.) Lam.	Scarlet Comb	Combretaceae	Climber		-	
178	<i>Commelina benghalensis</i> L.	Bengal Dayflower	Commelinaceae	Herb		LC	
179	<i>Commelina diffusa</i> Burm.f.	Creeping Dayflower	Commelinaceae	Herb		LC	
180	<i>Commiphora caudata</i> (Wight & Arn.) Engl.	Deccan Corkwood	Burseraceae	Tree		-	Planted
181	<i>Conchidium</i> sp.	Conchidium	Orchidaceae	Herb		-	
182	<i>Convolvulus arvensis</i> L.	Field Bindweed	Convolvulaceae	Climber		-	
183	<i>Corallocarpus epigaeus</i> (Rottler) Hook.f.	Redfruit Creeper	Cucurbitaceae	Climber		-	
184	<i>Corchorus capsularis</i> L.	White Jute	Malvaceae	Herb		-	
185	<i>Cordia dichotoma</i> G.Forst.	Indian Cherry	Boraginaceae	Tree		LC	
186	<i>Cordia ghara</i> Ehrenb. ex Asch.	Long-Leaf Cordia	Boraginaceae	Tree		LC	
187	<i>Costus speciosus</i> (J.Koenig) Sm.	Crepe ginger	Costaceae	Herb		-	
188	<i>Cottonia peduncularis</i> (Lindl.) Rchb.f.	Bee Orchid	Orchidaceae	Herb		-	
189	<i>Crateva religiosa</i> G.Forst.	Varuna	Capparaceae	Tree		LC	
190	<i>Crotalaria calycina</i> Schrank	Silky-Haired Rattlepod	Fabaceae	Herb		-	
191	<i>Crotalaria heyneana</i> Wight & Arn.	Blue-Flowered Rattlepod	Fabaceae	Shrub		-	
192	<i>Crotalaria pallida</i> Aiton	Smooth crotalaria	Fabaceae	Herb		-	
193	<i>Crotalaria pallida</i> Aiton	Smooth Rattlepod	Fabaceae	Herb		-	
194	<i>Crotalaria retusa</i> L.	Rattleweed	Fabaceae	Herb		-	
195	<i>Crotalaria spectabilis</i> Roth	Showy Rattlepod	Fabaceae	Shrub		-	

Sr. No.	Botanical Name	Common Name	Family	Habit	Endemism status	IUCN Status (Global)	Remarks
196	<i>Croton bonplandianus</i> Baill.	Railway Weed	Euphorbiaceae	Herb		-	
197	<i>Cryptocarya wightiana</i> Thwaites	Cupped-Fruit Litsea	Lauraceae	Tree		LC	
198	<i>Cucumis prophetarum</i> L.	Wild Gourd	Cucurbitaceae	Climber		-	
199	<i>Cuscuta reflexa</i> Roxb.	Amar Bel	Convolvulaceae	Climber		LC	
200	<i>Cyclea peltata</i> (Lam.) Hook.f. & Thomson	Padathaali	Menispermaceae	Climber		-	
201	<i>Cymbidium</i> sp.	Cymbidium orchid	Orchidaceae	Herb		-	
202	<i>Cymbopogon citratus</i> (DC.) Stapf	Lemon grass	Poaceae	Grass		-	
203	<i>Cymbopogon coloratus</i> (Hook.f.) Stapf	Cymbopogon	Poaceae	Grass		-	
204	<i>Cyperus alternifolius</i> L.	Umbrella Palm	Cyperaceae	Herb		LC	
205	<i>Cyperus compressus</i> L.	Poorland Flat Sedge	Cyperaceae	Herb		LC	
206	<i>Cyperus distans</i> L.f.	Slender Sedge	Cyperaceae	Herb		LC	
207	<i>Cyperus iria</i> L.	Rice Flat Sedge	Cyperaceae	Herb		LC	
208	<i>Cyperus pulchellus</i> R.Br.	Cyperus	Cyperaceae	Herb		LC	
209	<i>Cyperus rotundus</i> L.	Common Nut Sedge	Cyperaceae	Herb		LC	
210	<i>Cyperus</i> sp.	Sedge	Cyperaceae	Herb		-	
211	<i>Dactyloctenium aegyptium</i> (L.) Willd.	Crowfoot Grass	Poaceae	Grass		-	
212	<i>Dalbergia horrida</i> (Dennst.) Mabb.	Prickly dalbergia	Fabaceae	Liana		NT	
213	<i>Dalbergia lanceolaria</i> L.f.	Dalbergia	Fabaceae	Tree		LC	
214	<i>Dalbergia latifolia</i> Roxb.	Indian rosewood	Fabaceae	Tree		VU	
215	<i>Datura innoxia</i> Mill.	Datura	Solanaceae	Herb		-	
216	<i>Datura metel</i> L.	Datura	Solanaceae	Herb		-	
217	<i>Debregeasia longifolia</i> (Burm.f.) Wedd.	Orange Wild Rhea	Urticaceae	Shrub		LC	
218	<i>Delonix elata</i> (L.) Gamble	White Gulmohar	Fabaceae	Tree		LC	Planted
219	<i>Delonix regia</i> (Bojer ex Hook.) Raf.	Gulmohar	Fabaceae	Tree		LC	Planted
220	<i>Dendrobium barbatulum</i> Lindl.	Small Bearded Dendrobium	Orchidaceae	Herb		-	

Sr. No.	Botanical Name	Common Name	Family	Habit	Endemism status	IUCN Status (Global)	Remarks
221	<i>Dendrobium herbaceum</i> Lindl.	Herbaceous Dendrobium	Orchidaceae	Herb		-	
222	<i>Dendrobium lawianum</i> Lindl.	White Konkan Dendrobium	Orchidaceae	Herb		-	
223	<i>Dendrobium ovatum</i> (Willd.) Kranzl.	Green Lipped Dendrobium	Orchidaceae	Herb		-	
224	<i>Dendrocalamus strictus</i> (Roxb.) Nees	Male bamboo	Poaceae	Grass		-	
225	<i>Dendrophthoe falcata</i> (L.f.) Ettingsh.	Honey Suckle Mistletoe	Loranthaceae	Shrub		-	
226	<i>Derris scandens</i> (Roxb.) Benth.	Jewel Vine	Fabaceae	Climber		LC	
227	<i>Dichanthium annulatum</i> (Forssk.) Stapf	Sheda Grass	Poaceae	Grass		-	
228	<i>Dichrostachys cinerea</i> (L.) Wight & Arn.	Sickle Bush	Fabaceae	Tree		LC	
229	<i>Dicliptera paniculata</i> (Forssk.) I.Darbysh.	Panicled Foldwing	Acanthaceae	Herb		-	
230	<i>Digera muricata</i> (L.) Mart.	Chanchali	Amaranthaceae	Herb		-	
231	<i>Digitaria ciliaris</i> (Retz.) Koeler	Wild Crabgrass	Poaceae	Grass		-	
232	<i>Dillenia pentagyna</i> Roxb.	Karmal / Dillenia	Dilleniaceae	Tree		-	
233	<i>Dioscorea</i> sp.	Yam	Dioscoreaceae	Climber		-	
234	<i>Diospyros melanoxylon</i> Roxb.	Coromandel Ebony	Ebenaceae	Tree		-	
235	<i>Diospyros</i> sp.	Diospyros	Ebenaceae	Tree		-	
236	<i>Diploclisia glaucescens</i> (Blume) Diels	Glaucous Diploclisia	Menispermaceae	Liana		-	
237	<i>Diplocyclos palmatus</i> (L.) C.Jeffrey	Lollipop Climber	Cucurbitaceae	Climber		-	
238	<i>Dracaena terniflora</i> Roxb.	Wild dracaena	Asparagaceae	Herb		-	
239	<i>Dregea volubilis</i> (L.f.) Benth. ex Hook. f.	Sneeze Wort	Apocynaceae	Climber		-	
240	<i>Duranta erecta</i> L.	Golden dewdrop	Verbenaceae	Shrub		LC	
241	<i>Dypsis lutescens</i> (H.Wendl.) Beentje & J.Dransf.	Areca palm / Yellow palm	Arecaceae	Palm		NT	Planted

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242	<i>Ecbolium viride</i> (Forssk.) Alston	Green Shrimp Plant	Acanthaceae	Herb		-	
243	<i>Echinochloa</i> sp.	Echinochloa	Poaceae	Grass		-	
244	<i>Ehretia laevis</i> Roxb.	Chamror	Boraginaceae	Tree		DD	
245	<i>Elaeagnus conferta</i> Roxb.	Eastern Silverberry	Elaeagnaceae	Shrub		LC	
246	<i>Elaeis guineensis</i> Jacq.	African Oil Palm	Arecaceae	Tree		LC	Planted
247	<i>Elaeocarpus serratus</i> L.	Ceylon Olive	Elaeocarpaceae	Tree		LC	
248	<i>Eleocharis atropurpurea</i> (Retz.) J.Presl & C.Presl	Purple Spike-Rush	Cyperaceae	Herb		LC	
249	<i>Elephantopus scaber</i> L.	Elephant foot	Asteraceae	Herb		LC	
250	<i>Eleusine indica</i> (L.) Gaertn.	Indian Crowfoot Grass	Poaceae	Grass		LC	
251	<i>Embelia tsjeriam-cottam</i> (Roem. & Schult.) A.DC.,	Malabar Embelia	Primulaceae	Shrub		-	
252	<i>Emilia sonchifolia</i> (L.) DC.	Purple Sow Thistle	Asteraceae	Herb		-	
253	<i>Entada rheedei</i> Spreng.	Entada	Fabaceae	Liana		-	
254	<i>Eragrostis</i> sp.	Eragrostis	Poaceae	Grass		-	
255	<i>Eranthemum roseum</i> (Vahl) R. Br.	Rosy Eranthemum	Acanthaceae	Herb		LC	
256	<i>Erycibe paniculata</i> Roxb.	Panicled Erycibe	Convolvulaceae	Climber		-	
257	<i>Erythrina stricta</i> Roxb.	Indian coral tree	Fabaceae	Tree		LC	
258	<i>Erythrina suberosa</i> Roxb.	Corky coral tree	Fabaceae	Tree		LC	
259	<i>Erythrina variegata</i> L.	Coral tree	Fabaceae	Tree		LC	Planted
260	<i>Eucalyptus</i> sp.	Eucalyptus / Safeda	Myrtaceae	Tree		-	Planted
261	<i>Euphorbia caducifolia</i> Haines	Leafless euphorbia	Euphorbiaceae	Shrub		-	
262	<i>Euphorbia heterophylla</i> L.	Wild Poinsettia	Euphorbiaceae	Herb		LC	

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263	<i>Euphorbia hirta</i> L.	Asthma Weed	Euphorbiaceae	Herb		-	
264	<i>Euphorbia indica</i> Lam.	Euphorbia	Euphorbiaceae	Herb		-	
265	<i>Euphorbia neriifolia</i> L.	Indian Spurge Tree	Euphorbiaceae	Shrub		LC	
266	<i>Euphorbia tithymaloides</i> L.	Devil's backbone	Euphorbiaceae	Shrub		LC	Planted
267	<i>Euphorbia umbellata</i> (Pax) Bruyns	African Milk Bush	Euphorbiaceae	Shrub		-	Planted
268	<i>Evolvulus alsinoides</i> (L.) L.	Dwarf Morning Glory	Convolvulaceae	Herb		-	
269	<i>Evolvulus nummularius</i> (L.) L.	Roundleaf Bindweed	Convolvulaceae	Herb		-	
270	<i>Ficus amplissima</i> Sm.	Indian Bat Tree	Moraceae	Tree		LC	
271	<i>Ficus arnottiana</i> (Miq.) Miq.	Indian Rock Fig	Moraceae	Tree		-	
272	<i>Ficus auriculata</i> Lour.	Elephant Ear Fig	Moraceae	Tree		LC	Planted
273	<i>Ficus benghalensis</i> L.	Banyan / Bargad	Moraceae	Tree		-	
274	<i>Ficus benjamina</i> L.	Weeping fig	Moraceae	Tree		LC	
275	<i>Ficus drupacea</i> Thunb.	Mysore fig	Moraceae	Tree		LC	
276	<i>Ficus elastica</i> Roxb. ex Hornem.	Rubber fig	Moraceae	Tree		LC	Planted
277	<i>Ficus exasperata</i> Vahl	Sandpaper fig	Moraceae	Tree		LC	
278	<i>Ficus heterophylla</i> L.f.	Climbing fig relative	Moraceae	Shrub		-	
279	<i>Ficus hispida</i> L.f.	Hairy fig	Moraceae	Tree		LC	
280	<i>Ficus microcarpa</i> L.f.	Indian laurel fig	Moraceae	Tree		LC	
281	<i>Ficus racemosa</i> L.	Cluster fig / Gular	Moraceae	Tree		LC	
282	<i>Ficus religiosa</i> L.	Peepal	Moraceae	Tree		LC	
283	<i>Ficus virens</i> Aiton	White fig / Pilkhan	Moraceae	Tree		LC	
284	<i>Fimbristylis cymosa</i> R.Br.	Tropical Fimbry	Cyperaceae	Herb		LC	
285	<i>Firmiana colorata</i> (Roxb.) R. Br.	Scarlet Sterculia	Malvaceae	Tree		LC	
286	<i>Flacourtia indica</i> (Burm.f.) Merr.	Governor's plum	Salicaceae	Tree		LC	
287	<i>Flacourtia jangomas</i> (Lour.) Raeusch.	Indian plum	Salicaceae	Tree		-	Planted

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288	<i>Flueggea leucopyrus</i> Willd.	Bushweed	Phyllanthaceae	Shrub		LC	
289	<i>Galinsoga parviflora</i> Cav.	Quick Weed	Asteraceae	Herb		-	
290	<i>Garcinia gummi-gutta</i> (L.) Roxb.	Malabar tamarind	Clusiaceae	Tree		LC	
291	<i>Garcinia indica</i> (Thouars) Choisy	Kokum	Clusiaceae	Tree		VU	
292	<i>Garuga pinnata</i> Roxb.	Garuga	Burseraceae	Tree		LC	
293	<i>Getonia floribunda</i> Roxb.	Ukshi	Combretaceae	Climber		-	
294	<i>Gliricidia sepium</i> (Jacq.) Kunth ex Walp.	Gliricidia	Fabaceae	Tree		LC	
295	<i>Glochidion</i> sp.	Glochidion	Phyllanthaceae	Tree		-	
296	<i>Gmelina arborea</i> Roxb.	Gamhar	Lamiaceae	Tree		LC	
297	<i>Gmelina asiatica</i> L.	Asian Bushbeech	Lamiaceae	Tree		LC	Planted
298	<i>Gnaphalium</i> sp.	Cudweed	Asteraceae	Herb		-	
299	<i>Gnetum ula</i> Brongn.	Gnetum	Gnetaceae	Liana		LC	
300	<i>Grevillea robusta</i> A.Cunn. ex R.Br.	Silver oak	Proteaceae	Tree		LC	Planted
301	<i>Grewia flavescens</i> Juss.	Grewia	Malvaceae	Shrub		LC	
302	<i>Grewia hirsuta</i> Vahl	Nagbala Crossberry	Malvaceae	Tree		LC	
303	<i>Grewia serrulata</i> DC.	Kaori Crossberry	Malvaceae	Tree		-	
304	<i>Gymnema sylvestre</i> (Retz.) R. Br. ex Schult.	Gurmar	Apocynaceae	Climber		-	
305	<i>Gymnosporia emarginata</i> (Willd.) Thwaites	Notched-Leaf Spike Thorn	Celastraceae	Shrub		-	
306	<i>Gyrocarpus americanus</i> Jacq.	Helicopter tree	Hernandiaceae	Tree		LC	
307	<i>Haldina cordifolia</i> (Roxb.) Ridsdale	Haldina / Kadam	Rubiaceae	Tree		LC	
308	<i>Helicanthes elastica</i> (Desr.) Danser	Rubbery Mango Mistletoe	Loranthaceae	Shrub		-	
309	<i>Heliconia</i> sp.	Heliconia	Heliconiaceae	Herb		-	
310	<i>Helicteres isora</i> L.	East-Indian Screw Tree	Malvaceae	Shrub		LC	

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311	<i>Heliotropium indicum</i> L.	Indian Heliotrope	Boraginaceae	Herb		-	
312	<i>Hemidesmus indicus</i> (L.) W. T. Aiton	Indian Sarsaparilla	Apocynaceae	Climber		-	
313	<i>Heterophragma quadriloculare</i> (Roxb.) K.Schum.	Waras	Bignoniaceae	Tree		LC	
314	<i>Heteropogon contortus</i> (L.) P Beauv. ex Roem. & Schult.	Black Speargrass	Poaceae	Grass		-	
315	<i>Hevea brasiliensis</i> (Willd. ex A.Juss.) Müll.Arg.	Rubber tree	Euphorbiaceae	Tree		LC	Planted
316	<i>Hibiscus rosa-sinensis</i> L.	Hibiscus	Malvaceae	Shrub		-	
317	<i>Hiptage benghalensis</i> (L.) Kurz	Madhavi Lata	Malpighiaceae	Climber		LC	
318	<i>Holarrhena pubescens</i> Wall. ex G.Don	Kurchi	Apocynaceae	Tree		LC	
319	<i>Holigarna arnottiana</i> Hook. f.	Black Varnish Tree	Anacardiaceae	Tree		LC	
320	<i>Holoptelea integrifolia</i> Planch.	Indian elm / Chilbil	Ulmaceae	Tree		LC	
321	<i>Homalium</i> sp.	Homalium	Salicaceae	Tree		-	
322	<i>Homonoia riparia</i> Lour.	Willow-Leaved Water Croton	Euphorbiaceae	Shrub		LC	
323	<i>Hopea ponga</i> (Dennst.) Mabb.	Hopea	Dipterocarpaceae	Tree		VU	
324	<i>Hydnocarpus pentandrus</i> (Buch.-Ham.) Oken	Jangli Almond	Achariaceae	Tree		VU	
325	<i>Hydrilla verticillata</i> (L.f.) Royle	Water Thyme	Hydrocharitaceae	Herb		LC	
326	<i>Hygrophila schullii</i> (Buch.-Ham.) M.R.Almeida & S. M. Almeida	Marsh Barbel	Acanthaceae	Herb		-	
327	<i>Hymenocallis littoralis</i> (Jacq.) Salisb.	Beach Spider Lily	Amaryllidaceae	Herb		-	
328	<i>Hyptis suaveolens</i> (L.) Poit.	Bush mint	Lamiaceae	Herb		-	
329	<i>Ichnocarpus frutescens</i> (L.) R. Br.	Black Creeper	Apocynaceae	Climber		-	
330	<i>Indigofera linifolia</i> (L.f.) Retz.	Narrowleaf Indigo	Fabaceae	Herb		LC	
331	<i>Indigofera tinctoria</i> L.	True Indigo	Fabaceae	Shrub		-	

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332	<i>Ipomoea aquatica</i> Forssk.	Water Morning Glory	Convolvulaceae	Herb		LC	
333	<i>Ipomoea cairica</i> (L.) Sweet	Railway Creeper	Convolvulaceae	Climber		LC	
334	<i>Ipomoea carnea</i> Jacq.	Bush morning glory	Convolvulaceae	Shrub		-	
335	<i>Ipomoea staphylinia</i> Roem. & Schult.	Clustered Morning Glory	Convolvulaceae	Climber		-	
336	<i>Isachne globosa</i> (Thunb.) Kuntze	Swamp Millet	Poaceae	Grass		LC	
337	<i>Ixora brachiata</i> Roxb.	Ixora	Rubiaceae	Shrub		LC	
338	<i>Ixora coccinea</i> L.	Jungle geranium	Rubiaceae	Shrub		-	
339	<i>Jacaranda mimosifolia</i> D.Don	Blue Jacaranda	Bignoniaceae	Tree		VU	Planted
340	<i>Jasminum auriculatum</i> Vahl	Jasmine	Oleaceae	Shrub		-	
341	<i>Jatropha curcas</i> L.	Physic nut	Euphorbiaceae	Shrub		LC	Planted
342	<i>Jatropha gossypifolia</i> L.	Bellyache bush	Euphorbiaceae	Shrub		LC	
343	<i>Justicia adhatoda</i> L.	Adusa / Vasaka	Acanthaceae	Shrub		LC	Planted
344	<i>Justicia procumbens</i> L.	Water Willow	Acanthaceae	Herb		-	
345	<i>Justicia</i> sp.	Justicia	Acanthaceae	Herb		-	
346	<i>Khaya senegalensis</i> (Desr.) A.Juss.	African Mahogany	Meliaceae	Tree		VU	Planted
347	<i>Kigelia africana</i> (Lam.) Benth.	Sausage Tree	Bignoniaceae	Tree		LC	Planted
348	<i>Kydia calycina</i> Roxb.	Kydia	Malvaceae	Tree		LC	
349	<i>Kyllinga brevifolia</i> Rottb	Green Water Sedge	Cyperaceae	Herb		LC	
350	<i>Lagenandra ovata</i> (L.) Thwaites	Malayan Sword	Araceae	Herb		LC	
351	<i>Lagerstroemia parviflora</i> Roxb.	Small Flowered Crape Myrtle	Lythraceae	Tree		LC	
352	<i>Lagerstroemia speciosa</i> (L.) Pers.	Queen Crape Myrtle	Lythraceae	Tree		LC	Planted

Sr. No.	Botanical Name	Common Name	Family	Habit	Endemism status	IUCN Status (Global)	Remarks
353	<i>Lannea coromandelica</i> (Houtt.) Merr.	Indian ash tree / Jhingan	Anacardiaceae	Tree		LC	
354	<i>Lantana camara</i> L.	Lantana	Verbenaceae	Shrub		-	
355	<i>Lawsonia inermis</i> L.	Henna / Mehndi	Lythraceae	Shrub		LC	Planted
356	<i>Leea indica</i> (Burm.f.) Merr.	Bandicoot berry	Vitaceae	Shrub		LC	
357	<i>Leonotis nepetifolia</i> (L.) R.Br.	Lion's Ear	Lamiaceae	Herb		-	
358	<i>Leucaena leucocephala</i> (Lam.) de Wit	Subabul	Fabaceae	Tree		-	
359	<i>Leucas aspera</i> (Willd.) Link	Thumbai	Lamiaceae	Herb		-	
360	<i>Leucas biflora</i> (Vahl) Sm.	Two-Flowered Leucas	Lamiaceae	Herb		-	
361	<i>Leucas lavandulifolia</i> Sm.	Lavender-Leaf Leucas	Lamiaceae	Herb		-	
362	<i>Leucas stelligera</i> Wall. ex Benth.	Starry Leucas	Lamiaceae	Herb		-	
363	<i>Ligustrum perrottetii</i> A.DC.	Nilgiri Privet	Oleaceae	Tree		-	
364	<i>Limonia acidissima</i> L.	Wood-apple	Rutaceae	Tree		-	Planted
365	<i>Lindernia crustacea</i> (L.) F.Muell.	Malaysian Lindernia	Linderniaceae	Herb		LC	
366	<i>Litsea stocksii</i> (Meisn.) Hook.f.	Nilgiri Litsea	Lauraceae	Tree		NT	
367	<i>Lobelia nicotianifolia</i> Roth ex Schult.	Wild Tobacco	Campanulaceae	Herb		-	
368	<i>Lophopetalum wightianum</i> Arn.	Frilly Crest-Petal	Celastraceae	Tree		LC	
369	<i>Ludwigia perennis</i> L.	Perennial Water Primrose	Onagraceae	Herb		LC	
370	<i>Macaranga peltata</i> (Roxb.) Müll.Arg.	Chanda / Macaranga	Euphorbiaceae	Tree		-	
371	<i>Macroptilium atropurpureum</i> (DC.) Urb.	Purple Bush-Bean	Fabaceae	Climber		-	
372	<i>Madhuca longifolia</i> var. <i>latifolia</i> (Roxb.) A.Chev.	Mahua	Sapotaceae	Tree		-	
373	<i>Madhuca longifolia</i> var. <i>longifolia</i>	South Indian Mahua	Sapotaceae	Tree		LC	
374	<i>Magnolia champaca</i> (L.) Baill. ex Pierre	Champa	Magnoliaceae	Tree		LC	Planted
375	<i>Mallotus nudiflorus</i> (L.) Kulju & Welzen	False White Teak	Euphorbiaceae	Tree		LC	

Sr. No.	Botanical Name	Common Name	Family	Habit	Endemism status	IUCN Status (Global)	Remarks
376	<i>Mallotus philippensis</i> (Lam.) Müll.Arg.	Kamala tree	Euphorbiaceae	Tree		LC	
377	<i>Mallotus tetracoccus</i> (Roxb.) Kurz	Rusty Kamala	Euphorbiaceae	Tree		-	
378	<i>Mammea suriga</i> (Buch.-Ham. ex Roxb.) Kosterm.	Surangi	Calophyllaceae	Tree		LC	
379	<i>Mangifera indica</i> L.	Mango / Aam	Anacardiaceae	Tree		DD	Planted
380	<i>Manilkara hexandra</i> (Roxb.) Dubard	Ceylon Iron Wood	Sapotaceae	Tree		LC	
381	<i>Manilkara zapota</i> (L.) P.Royen	Chikoo / Sapodilla	Sapotaceae	Tree		LC	Planted
382	<i>Markhamia lutea</i> (Benth.) K.Schum.	Nile tulip tree	Bignoniaceae	Tree		LC	
383	<i>Melastoma malabathricum</i> L.	Malabar melastome	Melastomataceae	Shrub		-	
384	<i>Melia azedarach</i> L.	Persian lilac / Bakain	Meliaceae	Tree		LC	
385	<i>Melia dubia</i> Cav.	Malabar neem	Meliaceae	Tree		-	
386	<i>Memecylon umbellatum</i> Burm.f.	Ironwood / Memecylon	Melastomataceae	Tree		LC	
387	<i>Meyna laxiflora</i> Robyns	Muyna	Rubiaceae	Shrub		-	
388	<i>Microstachys chamaelea</i> (L.) Mull.Arg.	Creeping Sebastiana	Euphorbiaceae	Herb		-	
389	<i>Miliusa tomentosa</i> (Roxb.) Finet & Gagnep.	Woolly Miliusa	Annonaceae	Tree		LC	
390	<i>Millettia pinnata</i> (L.) Panigrahi	Karanj / Pongamia	Fabaceae	Tree		-	
391	<i>Millingtonia hortensis</i> L. f.	Indian Cork Tree	Bignoniaceae	Tree		LC	Planted
392	<i>Mimosa pudica</i> L.	Touch-me-not / Lajwanti	Fabaceae	Herb		LC	
393	<i>Mimusops elengi</i> L.	Bakul / Maulsari	Sapotaceae	Tree		LC	Planted
394	<i>Mitragyna parvifolia</i> (Roxb.) Korth.	Kaim	Rubiaceae	Tree		LC	
395	<i>Morinda citrifolia</i> L.	Noni	Rubiaceae	Tree		LC	
396	<i>Morinda pubescens</i> Sm.	Indian Mulberry	Rubiaceae	Tree		-	
397	<i>Moringa oleifera</i> Lam.	Drumstick tree / Sahjan	Moringaceae	Tree		LC	
398	<i>Morus alba</i> L.	Mulberry	Moraceae	Tree		LC	Planted

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399	<i>Mucuna monosperma</i> Wight	Negro Bean	Fabaceae	Climber		-	
400	<i>Muntingia calabura</i> L.	Jamaican cherry	Muntingiaceae	Tree		LC	Planted
401	<i>Murraya koenigii</i> (L.) Spreng.	Curry leaf	Rutaceae	Tree		LC	
402	<i>Musa</i> sp.	Banana / Kela	Musaceae	Herb		-	Planted
403	<i>Mussaenda frondosa</i> L.	Dhobi Tree	Rubiaceae	Shrub		LC	
404	<i>Myristica fragrans</i> Houtt.	Nutmeg	Myristicaceae	Tree		DD	Planted
405	<i>Nelumbo nucifera</i> Gaertn.	Lotus	Nelumbonaceae	Herb		-	
406	<i>Neolamarckia cadamba</i> (Roxb.) Bosser	Kadamba	Rubiaceae	Tree		-	
407	<i>Nerium oleander</i> L.	Oleander / Kaner	Apocynaceae	Shrub		LC	Planted
408	<i>Nymphaea nouchali</i> Burm.f.	Blue Water Lily	Nymphaeaceae	Herb		LC	
409	<i>Nymphoides indica</i> (L.) Kuntze	Water Snowflake	Menyanthaceae	Herb		LC	
410	<i>Oberonia</i> sp.	Oberonia	Orchidaceae	Herb		-	
411	<i>Ochreinauclea missionis</i> (Wight & Arn.) Ridsd.	Ochreinauclea	Rubiaceae	Tree		VU	
412	<i>Ocimum americanum</i> L.	Hoary Basil	Lamiaceae	Herb		-	
413	<i>Olea dioica</i> Roxb.	Indian olive	Oleaceae	Tree		-	
414	<i>Opuntia dillenii</i> (Ker Gawler) Haw.	Erect Prickly Pear	Cactaceae	Shrub		LC	
415	<i>Opuntia elatior</i> (Willd.) Mill.	Prickly Pear	Cactaceae	Shrub		LC	
416	<i>Osbeckia muralis</i> Naud.	Wall Osbeckia	Melastomataceae	Shrub		-	
417	<i>Pandanus</i> sp.	Screw pine	Pandanaceae	Shrub		-	
418	<i>Panicum</i> sp.	Panic grass	Poaceae	Grass		-	
419	<i>Paracalyx scariosus</i> (Roxb.) Ali	Indian Husk-Pea	Fabaceae	Climber		-	

Sr. No.	Botanical Name	Common Name	Family	Habit	Endemism status	IUCN Status (Global)	Remarks
420	<i>Parkia biglandulosa</i> Wight & Arn.	Badminton Ball Tree	Fabaceae	Tree		DD	Planted
421	<i>Parthenium hysterophorus</i> L.	Congress grass	Asteraceae	Herb		-	
422	<i>Paspalum notatum</i> Flügge	Bahia grass	Poaceae	Grass		-	
423	<i>Passiflora foetida</i> L.	Wild passion fruit	Passifloraceae	Climber		-	
424	<i>Pavetta crassicaulis</i> Repert.	Pavetta	Rubiaceae	Shrub		LC	
425	<i>Peltophorum pterocarpum</i> (DC.) Backer ex K.Heyne	Copper pod / Yellow flame tree	Fabaceae	Tree		LC	Planted
426	<i>Pennisetum pedicellatum</i> Trin.	Deenanath grass	Poaceae	Grass		LC	
427	<i>Pergularia daemia</i> (Forssk.) Chiov.	Trellis-Vine	Apocynaceae	Climber		LC	
428	<i>Persea americana</i> Mill.	Avocado	Lauraceae	Tree		LC	Planted
429	<i>Persicaria glabra</i> (Willd.) M.Gómez	Denseflower Knotweed	Polygonaceae	Herb		LC	
430	<i>Phoenix sylvestris</i> (L.) Roxb.	Wild date palm	Arecaceae	Palm		-	
431	<i>Pholidota imbricata</i> Hook.	Pholidota orchid	Orchidaceae	Herb		-	
432	<i>Phragmites karka</i> (Retz.) Trin. ex Steud.	Tall Reed	Poaceae	Grass		LC	
433	<i>Phyla nodiflora</i> (L.) Greene	Frog Fruit	Verbenaceae	Herb		LC	
434	<i>Phyllanthus acidus</i> (L.) Skeels	Star gooseberry	Phyllanthaceae	Tree		-	
435	<i>Phyllanthus emblica</i> L.	Amla	Phyllanthaceae	Tree		LC	
436	<i>Phyllanthus reticulatus</i> Poir.	Black honey shrub	Phyllanthaceae	Shrub		LC	
437	<i>Pinus</i> sp.	Pinus	Pinaceae	Tree		-	Planted
438	<i>Piper nigrum</i> L.	Black pepper	Piperaceae	Climber		-	
439	<i>Piper</i> sp.	Piper	Piperaceae	Climber		-	

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440	<i>Pithecellobium dulce</i> (Roxb.) Benth.	Jungle jalebi	Fabaceae	Tree		LC	Planted
441	<i>Plumbago zeylanica</i> L.	Ceylon leadwort	Plumbaginaceae	Herb		-	
442	<i>Plumeria alba</i> L.	White Frangipani	Annonaceae	Tree		LC	Planted
443	<i>Plumeria rubra</i> L.	Red Frangipani	Annonaceae	Tree		LC	Planted
444	<i>Pogostemon benghalensis</i> (Burm.f.) Kuntze	Bengal Shrub-Mint	Lamiaceae	Herb		-	
445	<i>Polyalthia longifolia</i> (Sonn.) Thwaites	False ashoka	Annonaceae	Tree		LC	Planted
446	<i>Polygonum plebeium</i> R.Br.	Small Knotweed	Polygonaceae	Herb		LC	
447	<i>Pongamia pinnata</i> (L.) Pierre	Karanj	Fabaceae	Tree		LC	
448	<i>Potamogeton nodosus</i> Poir	Long Leaf Pondweed	Potamogetonaceae	Herb		LC	
449	<i>Pothos scandens</i> L.	Climbing aroid	Araceae	Climber		-	
450	<i>Premna mollissima</i> Roth	Dusky Fire-Brand Teak	Lamiaceae	Tree		LC	
451	<i>Prosopis juliflora</i> (Sw.) DC.	Vilayati babul	Fabaceae	Tree		LC	
452	<i>Psidium guajava</i> L.	Guava / Amrud	Myrtaceae	Tree		LC	Planted
453	<i>Psydrax dicoccos</i> Gaertn.	Ceylon Boxwood	Rubiaceae	Tree		LC	
454	<i>Pterocarpus marsupium</i> Roxb.	Bija / Indian kino tree	Fabaceae	Tree		NT	
455	<i>Pterospermum acerifolium</i> (L.) Willd	Kanak Champa	Malvaceae	Tree		LC	Planted
456	<i>Pterospermum diversifolium</i> Blume	Pterospermum	Malvaceae	Tree		LC	
457	<i>Pueraria tuberosa</i> (Willd.) DC.	Vidarikand	Fabaceae	Climber		-	
458	<i>Punica granatum</i> L.	Pomegranate	Lythraceae	Shrub		LC	Planted
459	<i>Pupalia lappacea</i> (L.) Juss.	Forest Burr	Amaranthaceae	Herb		LC	
460	<i>Rhynchosia</i> sp.	Rhynchosia	Fabaceae	Herb		-	
461	<i>Rhynchostylis retusa</i> (L.) Blume	Rhynchostylis	Orchidaceae	Herb		-	

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462	<i>Ricinus communis</i> L.	Castor / Arandi	Euphorbiaceae	Shrub		LC	
463	<i>Roystonea regia</i> (Kunth) O.F.Cook	Royal Palm	Arecaceae	Tree		LC	Planted
464	<i>Rubia cordifolia</i> L.	Indian Madder	Rubiaceae	Herb		-	
465	<i>Ruellia tuberosa</i> L.	Popping Pod	Acanthaceae	Herb		-	
466	<i>Rungia</i> sp.	Rungia	Acanthaceae	Herb		-	
467	<i>Saccharum</i> sp.	Saccharum	Poaceae	Grasses		-	
468	<i>Sambucus canadensis</i> L.	American elder	Viburnaceae	Shrub		-	Planted
469	<i>Santalum album</i> L.	Sandalwood / Chandan	Santalaceae	Tree		VU	Planted
470	<i>Sapindus laurifolius</i> Vahl	Soap nut / Reetha	Sapindaceae	Tree		-	
471	<i>Sapium insigne</i> (Royle) Benth. ex Hook.f.	Sapium	Euphorbiaceae	Tree		-	
472	<i>Saraca asoca</i> (Roxb.) W.J.de Wilde	Ashoka	Fabaceae	Tree		NT	Planted
473	<i>Schleichera oleosa</i> (Lour.) Oken	Kusum	Sapindaceae	Tree		LC	
474	<i>Scleria levis</i> Retz.	Smooth Nut-Rush	Cyperaceae	Herb		LC	
475	<i>Scoparia dulcis</i> L.	Sweet Broom Weed	Plantaginaceae	Herb		-	
476	<i>Semecarpus anacardium</i> L. f.	Marking Nut	Anacardiaceae	Tree		LC	
477	<i>Senna alata</i> (L.) Roxb.	Candle bush	Fabaceae	Shrub		LC	
478	<i>Senna auriculata</i> (L.) Roxb.	Avaram / Tarwar	Fabaceae	Shrub		LC	
479	<i>Senna siamea</i> (Lam.) H.S.Irwin & Barneby	Kassod tree	Fabaceae	Tree		LC	Planted
480	<i>Senna sophora</i> (L.) Roxb.	Sophera Senna	Fabaceae	Shrub		-	
481	<i>Senna tora</i> (L.) Roxb.	Sickle senna / Chakunda	Fabaceae	Herb		-	
482	<i>Senna uniflora</i> (Mill.) H.S.Irwin & Barneby	Oneleaf Senna	Fabaceae	Herb		-	
483	<i>Sesbania grandiflora</i> (L.) Pers.	Agati	Fabaceae	Tree		-	Planted

Sr. No.	Botanical Name	Common Name	Family	Habit	Endemism status	IUCN Status (Global)	Remarks
484	<i>Shorea roxburghii</i> G.Don	Taloor Lac Tree	Dipterocarpaceae	Tree		DD	
485	<i>Sida acuta</i> Burm.f.	Common Wireweed	Malvaceae	Herb		-	
486	<i>Sida rhombifolia</i> L.	Rhombic-Leaf Sida	Malvaceae	Herb		-	
487	<i>Smilax zeylanica</i> L.	Ceylon Smilax	Smilacaceae	Climber		-	
488	<i>Solanum erianthum</i> D.Don	Big Eggplant	Solanaceae	Shrub		LC	
489	<i>Solanum indicum</i> L.	Indian nightshade	Solanaceae	Herb		LC	
490	<i>Sonchus oleraceus</i> L.	Sow thistle	Asteraceae	Herb		-	
491	<i>Soymida febrifuga</i> (Roxb.) A. Juss.	Indian Redwood	Meliaceae	Tree		LC	
492	<i>Spathodea campanulata</i> P.Beauv.	African tulip tree	Bignoniaceae	Tree		LC	Planted
493	<i>Spondias pinnata</i> (L.f.) Kurz	Wild mango / Ambada	Anacardiaceae	Tree		LC	
494	<i>Stachytarpheta jamaicensis</i> (L.) Vahl	Blue porterweed	Verbenaceae	Herb		LC	
495	<i>Stephania hernandifolia</i> (Willd.) Walp.	Stephania	Menispermaceae	Climber		-	
496	<i>Sterculia foetida</i> L.	Java Olive	Malvaceae	Tree		LC	Planted
497	<i>Sterculia guttata</i> Roxb.	Spotted Sterculia	Malvaceae	Tree		LC	
498	<i>Sterculia urens</i> Roxb.	Gum Karaya	Malvaceae	Tree		LC	
499	<i>Stereospermum</i> sp.	Padri tree relative	Bignoniaceae	Tree		-	
500	<i>Streblus asper</i> Lour.	Toothbrush tree	Moraceae	Tree		LC	
501	<i>Strobilanthes callosa</i> Nees	Karvy	Acanthaceae	Shrub		-	
502	<i>Strychnos nux-vomica</i> L.	Nux-vomica / Kuchla	Loganiaceae	Tree		LC	
503	<i>Strychnos potatorum</i> L.f.	Clearing Nut Tree	Loganiaceae	Tree		-	
504	<i>Swietenia mahagoni</i> (L.) Jacq.	Mahogany	Meliaceae	Tree		NT	
505	<i>Synedrella nodiflora</i> (L.) Gaertn.	Cinderella Weed	Asteraceae	Herb		-	
506	<i>Syzygium caryophyllatum</i> (L.) Alston	Pretty-Leaved Plum	Myrtaceae	Tree		VU	
507	<i>Syzygium cumini</i> (L.) Skeels	Jamun	Myrtaceae	Tree		LC	
508	<i>Syzygium salicifolium</i> (Wight) J.Graham	Willow-leaved syzygium	Myrtaceae	Tree		LC	
509	<i>Tabernaemontana alternifolia</i> L.	Alternate-Leaved Crape Jasmine	Annonaceae	Tree		LC	

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510	<i>Tabernaemontana divaricata</i> (L.) R.Br. ex Roem. & Schult.	Crape jasmine / Chandni	Apocynaceae	Shrub		LC	Planted
511	<i>Tamarindus indica</i> L.	Tamarind / Imli	Fabaceae	Tree		LC	Planted
512	<i>Tecoma stans</i> (L.) Juss. ex Kunth	Yellow Bells	Bignoniaceae	Shrub		LC	Planted
513	<i>Tectona grandis</i> L.f.	Teak / Sagwan	Lamiaceae	Tree		EN	Planted
514	<i>Tephrosia purpurea</i> (L.) Pers.	Common Tephrosia	Fabaceae	Herb		LC	
515	<i>Terminalia arjuna</i> (Roxb. ex DC.) Wight & Arn.	Arjun	Combretaceae	Tree		LC	
516	<i>Terminalia bellirica</i> (Gaertn.) Roxb.	Baheda	Combretaceae	Tree		LC	
517	<i>Terminalia catappa</i> L.	Indian almond	Combretaceae	Tree		LC	Planted
518	<i>Terminalia chebula</i> Retz.	Chebolic Myrobalan	Combretaceae	Tree		LC	
519	<i>Terminalia elliptica</i> Willd.	Asna / Indian laurel	Combretaceae	Tree		LC	
520	<i>Terminalia paniculata</i> Roth	Kindal / Maruthu	Combretaceae	Tree		LC	
521	<i>Themeda quadrivalvis</i> (L.) Kuntze	Grader Grass	Poaceae	Grass		-	
522	<i>Theobroma cacao</i> L.	Cocoa	Malvaceae	Tree		-	Planted
523	<i>Thespesia lampas</i> (Cav.) Dalzell	Wild Cotton	Malvaceae	Shrub		LC	
524	<i>Thespesia populnea</i> (L.) Sol. ex Corrêa	Indian Tulip Tree	Malvaceae	Tree		LC	Planted
525	<i>Thuja orientalis</i> L.	Morpankhi	Cupressaceae	Shrub		NT	Planted
526	<i>Thunbergia alata</i> Bojer ex Sims	Black-Eyed Susan Vine	Acanthaceae	Climber		-	Planted
527	<i>Thunbergia grandiflora</i> (Roxb. ex Rottl.) Roxb.	Bengal Clock Vine	Acanthaceae	Climber		-	Planted
528	<i>Tiliacora acuminata</i> (Lam.) Miers	Tapering-Leaf Tiliacora	Menispermaceae	Climber		-	

Sr. No.	Botanical Name	Common Name	Family	Habit	Endemism status	IUCN Status (Global)	Remarks
529	<i>Tinospora cordifolia</i> (Willd.) Hook.f. & Thomson	Giloy	Menispermaceae	Climber		-	
530	<i>Toona ciliata</i> M.Roem.	Toon / Red cedar	Meliaceae	Tree		LC	
531	<i>Tragia involucrata</i> L.	Indian Climbing Nettle	Euphorbiaceae	Climber		-	
532	<i>Trema orientalis</i> (L.) Blume	Charcoal tree	Cannabaceae	Tree		LC	
533	<i>Tridax procumbens</i> L.	Tridax Daisy	Asteraceae	Herb		-	
534	<i>Triumfetta pilosa</i> Roth	Hairy Burr-Bush	Malvaceae	Herb		-	
535	<i>Turnera ulmifolia</i> L.	Yellow alder	Passifloraceae	Herb		LC	
536	<i>Tylophora indica</i> (Burm.f.) Merr.	Indian Ipecac	Apocynaceae	Climber		-	
537	<i>Typha angustifolia</i> L.	Lesser Indian Reedmace	Typhaceae	Herb		LC	
538	<i>Urena lobata</i> L.	Caesarweed	Malvaceae	Shrub		LC	
539	<i>Vanda tessellata</i> (Roxb.) Hook. ex G.Don	Checkered Vanda	Orchidaceae	Herb		LC	
540	<i>Vanda testacea</i> (Lindl.) Rchb.f.	Small Flowered Vanda	Orchidaceae	Herb		-	
541	<i>Vateria indica</i> L.	Indian copal tree	Dipterocarpaceae	Tree		-	
542	<i>Vattakaka volubilis</i> (L.f.) Kuntze	Dudhi / Wax-leaved climber	Apocynaceae	Climber		-	
543	<i>Ventilago denticulata</i> Willd.	Ventilago	Rhamnaceae	Climber		-	
544	<i>Verbascum chinense</i> (L.) Santapau	Coromandel Mullein	Scrophulariaceae	Herb		-	
545	<i>Verbesina encelioides</i> (Cav.) Benth. & Hook.f.	Golden Crownbeard	Asteraceae	Herb		-	
546	<i>Vernonia arborea</i> Buch.-Ham	Tree Vernonia	Asteraceae	Tree		LC	
547	<i>Viscum articulatum</i> Burm.f.	Leafless Mistletoe	Santalaceae	Shrub		-	
548	<i>Vitex altissima</i> L.f.	Peacock chaste tree	Lamiaceae	Tree		LC	
549	<i>Vitex negundo</i> L.	Nirgundi	Lamiaceae	Shrub		LC	
550	<i>Vitex trifolia</i> L.	Three-leaved chaste tree	Lamiaceae	Shrub		LC	

Sr. No.	Botanical Name	Common Name	Family	Habit	Endemism status	IUCN Status (Global)	Remarks
551	<i>Wodyetia bifurcata</i> A.K.Irvine	Foxtail palm	Arecaceae	Palm		CD	
552	<i>Woodfordia fruticosa</i> (L.) Kurz	Fire Flame Bush	Lythraceae	Shrub		LC	
553	<i>Wrightia tinctoria</i> (Roxb.) R. Br.	Sweet Indrajao	Annonaceae	Tree		LC	
554	<i>Xanthium strumarium</i> L.	Cocklebur	Asteraceae	Herb		-	
555	<i>Xylia xylocarpa</i> (Roxb.) Taub.		Fabaceae	Tree		LC	
556	<i>Zanthoxylum rhetsa</i> (Roxb.) DC.	Indian prickly ash	Rutaceae	Tree		LC	
557	<i>Ziziphus mauritiana</i> Lam.	Ber	Rhamnaceae	Tree		LC	
558	<i>Ziziphus nummularia</i> (Burm.f.) Wight & Arn.,	Roundleaf Jujube	Rhamnaceae	Tree		LC	
559	<i>Ziziphus oenoplia</i> (L.) Mill.	Jackal jujube	Rhamnaceae	Climber		-	
560	<i>Ziziphus rugosa</i> Lam.	Wild jujube	Rhamnaceae	Shrub		LC	
561	<i>Zornia gibbosa</i> Span.	Grasslike Zornia	Fabaceae	Herb		-	

4. Fauna

a. Terrestrial and Aquatic Biodiversity

381. **Avifauna.** A total of 483 avifaunal species were recorded from the state of Karnataka, indicating high avian diversity comprising resident, migratory, and endemic species associated with terrestrial and aquatic ecosystems. As per the IUCN (2025-2) conservation status, the majority of species fall under Least Concern, reflecting relatively stable populations. However, the assemblage also includes 5 Critically Endangered species, 5 Endangered, and 13 Vulnerable highlighting the ecological sensitivity of the area. Additionally, 79 species are listed under Schedule-I of the Wild Life (Protection) Act, 1972 (amended 2022), indicating the presence of legally protected and conservation-priority avifauna.

382. The occurrence of threatened and Schedule-I species, along with diverse guilds such as raptors, waterbirds, grassland birds, and forest species, underscores the ecological importance of the project corridor and necessitates appropriate mitigation and conservation planning (refer Table IV-19).

Table IV-19 List of Avifauna species in Karnataka

SN	Common Name	Scientific Name	IUCN v.2025-2	WPAA 2022
1.	Alexandrine Parakeet	<i>Psittacula eupatria</i>	Least concern	II
2.	Alpine Swift	<i>Tachymarptis melba</i>	Least concern	II
3.	Amur Falcon	<i>Falco amurensis</i>	Least concern	I
4.	Ashy Drongo	<i>Dicrurus leucophaeus</i>	Least concern	II
5.	Ashy Prinia	<i>Prinia socialis</i>	Least concern	II
6.	Ashy Woodswallow	<i>Artamus fuscus</i>	Least concern	II
7.	Ashy-crowned Sparrow-Lark	<i>Eremopterix griseus</i>	Least concern	II
8.	Asian Barn Owl	<i>Tyto alba</i>	Least Concern	I
9.	Asian Brown Flycatcher	<i>Muscicapa dauurica</i>	Least Concern	II
10.	Asian Emerald Dove	<i>Chalcophaps indica</i>	Least concern	II
11.	Asian Fairy-bluebird	<i>Irena puella</i>	Least Concern	II
12.	Asian Green Bee-eater	<i>Merops orientalis</i>	Least concern	II
13.	Asian Koel	<i>Eudynamis scolopaceus</i>	Least Concern	II
14.	Asian Openbill	<i>Anastomus oscitans</i>	Least Concern	II
15.	Asian Palm Swift	<i>Cypsiurus balasiensis</i>	Least Concern	II
16.	Asian Woolly-necked Stork	<i>Ciconia episcopus</i>	Near Threatened	II
17.	Baillon's Crane	<i>Zapornia pusilla</i>	Least Concern	II
18.	Banded-Bay Cuckoo	<i>Cacomantis sonneratii</i>	Least Concern	II
19.	Bank Myna	<i>Acridotheres ginginianus</i>	Least concern	II
20.	Bank Swallow	<i>Riparia riparia</i>	Least concern	II
21.	Bar-headed Goose	<i>Anser indicus</i>	Least concern	II
22.	Barn Swallow	<i>Hirundo rustica</i>	Least concern	II
23.	Barred Buttonquail	<i>Turnix suscitator</i>	Least concern	II
24.	Bar-tailed Godwit	<i>Limosa lapponica</i>	Near Threatened	II
25.	Bar-winged Flycatcher-shrike	<i>Hemipus picatus</i>	Least Concern	II
26.	Baya Weaver	<i>Ploceus philippinus</i>	Least concern	II
27.	Bay-backed Shrike	<i>Lanius vittatus</i>	Least concern	II

SN	Common Name	Scientific Name	IUCN v.2025-2	WPAA 2022
28.	Besra	<i>Accipiter virgatus</i>	Least Concern	I
29.	Black Baza	<i>Aviceda leuphotes</i>	Least Concern	I
30.	Black Bittern	<i>Ixobrychus flavicollis</i>	Least concern	II
31.	Black Drongo	<i>Dicrurus macrocercus</i>	Least concern	II
32.	Black Eagle	<i>Ictinaetus malaiensis</i>	Least concern	I
33.	Black Kite	<i>Milvus migrans</i>	Least Concern	II
34.	Black Redstart	<i>Phoenicurus ochruros</i>	Least concern	II
35.	Black Stork	<i>Ciconia nigra</i>	Least concern	II
36.	Black-and-orange Flycatcher	<i>Ficedula nigrorufa</i>	Least Concern	II
37.	Oriental Dwarf Kingfisher	<i>Ceyx erithaca</i>	Near Threatened	II
38.	Black-bellied Tern	<i>Sterna acuticauda</i>	Endangered	I
39.	Black-breasted Weaver	<i>Ploceus benghalensis</i>	Least concern	II
40.	Black-capped Kingfisher	<i>Halcyon pileata</i>	Vulnerable	II
41.	Black-crowned Night Heron	<i>Nycticorax nycticorax</i>	Least Concern	II
42.	Black-headed Bunting	<i>Emberiza melanocephala</i>	Least concern	II
43.	Black-headed Cuckooshrike	<i>Lalage melanoptera</i>	Least concern	-
44.	Black-headed Gull	<i>Chroicocephalus ridibundus</i>	Least concern	II
45.	Black-headed Ibis	<i>Threskiornis melanocephalus</i>	Near Threatened	II
46.	Black-hooded Oriole	<i>Oriolus xanthornus</i>	Least concern	II
47.	Black-naped Monarch	<i>Hypothymis azurea</i>	Least concern	II
48.	Black-naped Oriole	<i>Oriolus chinensis</i>	Least Concern	II
49.	Black-tailed Godwit	<i>Limosa limosa</i>	Near Threatened	II
50.	Black-throated Munia	<i>Lonchura kelaarti</i>	Least Concern	II
51.	Black-winged Cuckooshrike	<i>Lalage melaschistos</i>	Least Concern	II
52.	Black-winged Kite	<i>Elanus caeruleus</i>	Least concern	II
53.	Black-winged Stilt	<i>Himantopus himantopus</i>	Least concern	II
54.	Blue Rock-Thrush	<i>Monticola solitarius</i>	Least concern	II
55.	Blue-bearded Bee-eater	<i>Nyctornis athertoni</i>	Least Concern	II
56.	Blue-breasted Quail	<i>Synois chinensis</i>	Least concern	-
57.	Blue-capped Rock-Thrush	<i>Monticola cinclorhyncha</i>	Least concern	II
58.	Blue-cheeked Bee-eater	<i>Merops persicus</i>	Least concern	II
59.	Blue-eared Kingfisher	<i>Alcedo meninting</i>	Least Concern	II
60.	Blue-faced Malkoha	<i>Phaenicophaeus viridirostris</i>	Least concern	II
61.	Blue-tailed Bee-eater	<i>Merops philippinus</i>	Least concern	II
62.	Bluethroat	<i>Luscinia svecica</i>	Least concern	II
63.	Blue-throated Flycatcher	<i>Cyornis rubeculoides</i>	Least concern	II
64.	Blyth's Pipit	<i>Anthus godlewskii</i>	Least concern	II
65.	Blyth's Reed Warbler	<i>Acrocephalus dumetorum</i>	Least Concern	II
66.	Bonelli's Eagle	<i>Aquila fasciata</i>	Least Concern	I
67.	Booted Eagle	<i>Hieraaetus pennatus</i>	Least concern	I
68.	Booted Warbler	<i>Iduna caligata</i>	Least Concern	II
69.	Brahminy Kite	<i>Haliastur indus</i>	Least Concern	I

SN	Common Name	Scientific Name	IUCN v.2025-2	WPAA 2022
70.	Brahminy Starling	<i>Sturnus pagodarum</i>	Least concern	II
71.	Bristled Grassbird	<i>Schoenicola striatus</i>	Vulnerable	I
72.	Broad-billed Sandpiper	<i>Calidris falcinellus</i>	Least concern	II
73.	Bronzed Drongo	<i>Dicrurus aeneus</i>	Least concern	0
74.	Bronze-winged Jacana	<i>Metopidius indicus</i>	Least concern	II
75.	Brown Boobook	<i>Ninox scutulata</i>	Least concern	II
76.	Brown Crake	<i>Zapornia akool</i>	Least concern	II
77.	Brown Fish-Owl	<i>Ketupa zeylonensis</i>	Least Concern	I
78.	Brown Rock Chat	<i>Oenanthe fusca</i>	Least concern	II
79.	Brown Shrike	<i>Lanius cristatus</i>	Least concern	II
80.	Brown Wood-Owl	<i>Strix leptogrammica</i>	Least Concern	I
81.	Brown-backed Needletail	<i>Hirundapus giganteus</i>	Least Concern	II
82.	Brown-breasted Flycatcher	<i>Muscicapa muttui</i>	Least concern	-
83.	Brown-capped Pygmy Woodpecker	<i>Yungipicus nanus</i>	Least concern	II
84.	Brown-cheeked Fulvetta	<i>Alcippe poioicephala</i>	Least concern	II
85.	Brown-headed Barbet	<i>Psilopogon zeylanicus</i>	Least concern	II
86.	Brown-headed Gull	<i>Chroicocephalus brunnicephalus</i>	Least Concern	II
87.	Caspian Tern	<i>Hydroprogne caspia</i>	Least concern	II
88.	Changeable Hawk-Eagle	<i>Nisaetus cirrhatus</i>	Least concern	I
89.	Chestnut-bellied Sandgrouse	<i>Pterocles exustus</i>	Least concern	II
90.	Chestnut-headed Bee-eater	<i>Merops leschenaulti</i>	Least concern	II
91.	Chestnut-tailed Starling	<i>Sturnia malabarica</i>	Least concern	II
92.	Chestnut-winged Cuckoo	<i>Clamator coromandus</i>	Least concern	II
93.	Cinereous Tit	<i>Parus cinereus</i>	Least concern	II
94.	Cinnamon Bittern	<i>Ixobrychus cinnamomeus</i>	Least concern	I
95.	Citrine Wagtail	<i>Motacilla citreola</i>	Least Concern	II
96.	Collared Pratincole	<i>Glareola pratincola</i>	Least concern	II
97.	Common Babbler	<i>Argya caudata</i>	Least concern	II
98.	Common Buzzard	<i>Buteo buteo</i>	Least concern	I
99.	Common Cuckoo	<i>Cuculus canorus</i>	Least concern	II
100.	Common Flameback	<i>Dinopium javanense</i>	Least Concern	II
101.	Common Grasshopper Warbler	<i>Locustella naevia</i>	Least Concern	II
102.	Common Greenshank	<i>Tringa nebularia</i>	Least concern	I
103.	Common Hawk-Cuckoo	<i>Hierococcyx varius</i>	Least concern	II
104.	Common Hoopoe	<i>Upupa epops</i>	Least concern	II
105.	Common Iora	<i>Aegithina tiphia</i>	Least concern	II
106.	Common Kingfisher	<i>Alcedo atthis</i>	Least Concern	II
107.	Common Moorhen	<i>Gallinula chloropus</i>	Least Concern	II
108.	Common Myna	<i>Acridotheres tristis</i>	Least concern	II
109.	Common Pochard	<i>Aythya ferina</i>	Vulnerable	I
110.	Common Redshank	<i>Tringa totanus</i>	Least concern	II
111.	Common Rosefinch	<i>Carpodacus erythrinus</i>	Least concern	II

SN	Common Name	Scientific Name	IUCN v.2025-2	WPAA 2022
112.	Common Sandpiper	<i>Actitis hypoleucos</i>	Least concern	I
113.	Common Snipe	<i>Gallinago gallinago</i>	Least concern	II
114.	Common Tailorbird	<i>Orthotomus sutorius</i>	Least concern	II
115.	Common Teal	<i>Anas crecca</i>	Least concern	II
116.	Common Tern	<i>Sterna hirundo</i>	Least concern	-
117.	Common Woodshrike	<i>Tephrodornis pondicerianus</i>	Least concern	II
118.	Coppersmith Barbet	<i>Psilopogon haemacephalus</i>	Least Concern	II
119.	Cotton Pygmy-Goose	<i>Nettapus coromandelianus</i>	Least concern	I
120.	Crab-Plover	<i>Dromas ardeola</i>	Least concern	II
121.	Crested Goshawk	<i>Accipiter trivirgatus</i>	Least Concern	I
122.	Crested Serpent-Eagle	<i>Spilornis cheela</i>	Least concern	I
123.	Crested Treeswift	<i>Hemiprocne coronata</i>	Least concern	I
124.	Crimson-backed Sunbird	<i>Leptocoma minima</i>	Least Concern	II
125.	Curlew Sandpiper	<i>Calidris ferruginea</i>	Near Threatened	II
126.	Dalmatian Pelican	<i>Pelecanus crispus</i>	Near Threatened	II
127.	Dark-fronted Babbler	<i>Dumetia atriceps</i>	Least concern	II
128.	Demoiselle Crane	<i>Grus virgo</i>	Least concern	I
129.	Desert Wheatear	<i>Oenanthe deserti</i>	Least concern	II
130.	Dunlin	<i>Calidris alpina</i>	Least concern	II
131.	Dusky Crag-Martin	<i>Ptyonoprogne concolor</i>	Least concern	II
132.	Eastern Cattle-Egret	<i>Bubulcus ibis</i>	Least concern	II
133.	Eastern Orphean Warbler	<i>Curruca crassirostris</i>	Least concern	II
134.	Eastern Red-rumped Swallow	<i>Cecropis daurica</i>	Least concern	II
135.	Eastern Yellow Wagtail	<i>Motacilla tschutschensis</i>	Least concern	II
136.	Egyptian Vulture	<i>Neophron percnopterus</i>	Endangered	I
137.	Eurasian Collared-Dove	<i>Streptopelia decaocto</i>	Least concern	II
138.	Eurasian Coot	<i>Fulica atra</i>	Least concern	II
139.	Eurasian Crag-Martin	<i>Ptyonoprogne rupestris</i>	Least concern	II
140.	Eurasian Curlew	<i>Numenius arquata</i>	Near Threatened	II
141.	Eurasian Hobby	<i>Falco subbuteo</i>	Least concern	II
142.	Eurasian Kestrel	<i>Falco tinnunculus</i>	Least Concern	II
143.	Eurasian Oystercatcher	<i>Haematopus ostralegus</i>	Near Threatened	II
144.	Eurasian Sparrowhawk	<i>Accipiter nisus</i>	Least Concern	I
145.	Eurasian Spoonbill	<i>Platalea leucorodia</i>	Least Concern	I
146.	Eurasian Whimbrel	<i>Numenius phaeopus</i>	Least concern	II
147.	Eurasian Wigeon	<i>Mareca penelope</i>	Least Concern	II
148.	Eurasian Wryneck	<i>Jynx torquilla</i>	Least concern	II
149.	European Honey-buzzard	<i>Pernis apivorus</i>	Least concern	-
150.	European Roller	<i>Coracias garrulus</i>	Least concern	II
151.	Ferruginous Duck	<i>Aythya nyroca</i>	Near Threatened	II
152.	Flame-throated Bulbul	<i>Rubigula gularis</i>	Least concern	II

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153.	Flesh-footed Shearwater	<i>Ardenna carneipes</i>	Near Threatened	II
154.	Forest Wagtail	<i>Dendronanthus indicus</i>	Least concern	I
155.	Fork-tailed Drongo-Cuckoo	<i>Surniculus dicruroides</i>	Least concern	II
156.	Fulvous Whistling-Duck	<i>Dendrocygna bicolor</i>	Least concern	-
157.	Gadwall	<i>Mareca strepera</i>	Least Concern	II
158.	Garganey	<i>Spatula querquedula</i>	Least concern	II
159.	Glossy Ibis	<i>Plegadis falcinellus</i>	Least Concern	II
160.	Golden-fronted Leafbird	<i>Chloropsis aurifrons</i>	Least concern	II
161.	Golden-headed Cisticola	<i>Cisticola exilis</i>	Least Concern	II
162.	Gray-fronted Green-Pigeon	<i>Treron affinis</i>	Least concern	II
163.	Great Cormorant	<i>Phalacrocorax carbo</i>	Least Concern	II
164.	Great Crested Tern	<i>Thalasseus bergii</i>	Least concern	-
165.	Great Egret	<i>Ardea alba</i>	Least Concern	II
166.	Great Grey Shrike	<i>Lanius excubitor</i>	Least concern	II
167.	Great Hornbill	<i>Buceros bicornis</i>	Vulnerable	I
168.	Great Indian Bustard	<i>Ardeotis nigriceps</i>	Critically Endangered	I
169.	Great Knot	<i>Calidris tenuirostris</i>	Endangered	I
170.	Great Thick-knee	<i>Esacus recurvirostris</i>	Near Threatened	II
171.	Greater Coucal	<i>Centropus sinensis</i>	Least concern	II
172.	Greater Flamingo	<i>Phoenicopterus roseus</i>	Least concern	II
173.	Greater Painted-Snipe	<i>Rostratula benghalensis</i>	Least concern	II
174.	Greater Racket-tailed Drongo	<i>Dicrurus paradiseus</i>	Least concern	II
175.	Greater Sand-Plover	<i>Charadrius leschenaultii</i>	Least concern	II
176.	Greater Short-toed Lark	<i>Calandrella brachydactyla</i>	Least concern	II
177.	Greater Spotted Eagle	<i>Clanga clanga</i>	Vulnerable	I
178.	Greater White-fronted Goose	<i>Anser albifrons</i>	Least Concern	II
179.	Green Imperial Pigeon	<i>Ducula aenea</i>	Near Threatened	II
180.	Green Sandpiper	<i>Tringa ochropus</i>	Least Concern	II
181.	Green Warbler	<i>Phylloscopus nitidus</i>	Least concern	-
182.	Greenish Warbler	<i>Phylloscopus trochiloides</i>	Least concern	II
183.	Grey Francolin	<i>Ortygornis pondicerianus</i>	Least concern	II
184.	Grey Heron	<i>Ardea cinerea</i>	Least Concern	II
185.	Grey Junglefowl	<i>Gallus sonneratii</i>	Least concern	I
186.	Grey Plover	<i>Pluvialis squatarola</i>	Vulnerable	II
187.	Grey Wagtail	<i>Motacilla cinerea</i>	Least concern	II
188.	Grey-bellied Cuckoo	<i>Cacomantis passerinus</i>	Least concern	II
189.	Grey-breasted Prinia	<i>Prinia hodgsonii</i>	Least Concern	II
190.	Grey-headed Bulbul	<i>Brachypodius priocephalus</i>	Near Threatened	II
191.	Grey-headed Canary-Flycatcher	<i>Culicicapa ceylonensis</i>	Least concern	II
192.	Grey-headed Fish-Eagle	<i>Ichthyophaga ichthyaetus</i>	Near Threatened	-
193.	Grey-headed Lapwing	<i>Vanellus cinereus</i>	Least concern	-
194.	Grey-headed Swamphen	<i>Porphyrio poliocephalus</i>	Not Recognised	II

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195.	Greylag Goose	<i>Anser anser</i>	Least concern	II
196.	Grey-necked Bunting	<i>Emberiza buchanani</i>	Least concern	II
197.	Grey-throated Martin	<i>Riparia chinensis</i>	Least concern	II
198.	Gull-billed Tern	<i>Gelochelidon nilotica</i>	Least concern	I
199.	Hair-crested Drongo	<i>Dicrurus hottentottus</i>	Least concern	II
200.	Heart-spotted Woodpecker	<i>Hemicircus canente</i>	Least Concern	I
201.	Hill Swallow	<i>Hirundo domicola</i>	Not Recognised	II
202.	House Crow	<i>Corvus splendens</i>	Least concern	II
203.	House Sparrow	<i>Passer domesticus</i>	Least concern	II
204.	Hume's Leaf Warbler	<i>Phylloscopus humei</i>	Least concern	II
205.	Indian Blackbird	<i>Turdus simillimus</i>	Least concern	II
206.	Indian Blue Robin	<i>Larvivora brunnea</i>	Least concern	II
207.	Indian Bushlark	<i>Mirafra erythroptera</i>	Least concern	II
208.	Indian Courser	<i>Cursorius coromandelicus</i>	Least concern	I
209.	Indian Cuckoo	<i>Cuculus micropterus</i>	Least concern	II
210.	Indian Cuckooshrike	<i>Coracina macei</i>	Least concern	II
211.	Indian Eagle-Owl	<i>Bubo bengalensis</i>	Least concern	I
212.	Indian Golden Oriole	<i>Oriolus kundoo</i>	Least Concern	II
213.	Indian Grey Hornbill	<i>Ocyrceros birostris</i>	Least concern	II
214.	Indian Nightjar	<i>Caprimulgus asiaticus</i>	Least Concern	II
215.	Indian Nuthatch	<i>Sitta castanea</i>	Least Concern	II
216.	Indian Paradise-Flycatcher	<i>Terpsiphone paradisi</i>	Least concern	II
217.	Indian Peafowl	<i>Pavo cristatus</i>	Least concern	I
218.	Indian Pied Starling	<i>Gracupica contra</i>	Least concern	II
219.	Indian Pitta	<i>Pitta brachyura</i>	Least concern	II
220.	Indian Pond-Heron	<i>Ardeola grayii</i>	Least concern	II
221.	Indian Robin	<i>Saxicoloides fulicatus</i>	Least concern	II
222.	Indian Roller	<i>Coracias benghalensis</i>	Near Threatened	II
223.	Indian Scimitar-Babbler	<i>Pomatorhinus horsfieldii</i>	Least concern	II
224.	Indian Scops-Owl	<i>Otus bakkamoena</i>	Least concern	II
225.	Indian Silverbill	<i>Euodice malabarica</i>	Least concern	II
226.	Indian Spot-billed Duck	<i>Anas poecilorhyncha</i>	Least Concern	II
227.	Indian Spotted Eagle	<i>Clanga hastata</i>	Vulnerable	I
228.	Indian Swiftlet	<i>Aerodramus unicolor</i>	Least Concern	II
229.	Indian thick-knee	<i>Burhinus indicus</i>	Least concern	II
230.	Indian Vulture	<i>Gyps indicus</i>	Critically Endangered	I
231.	Indian White-eye	<i>Zosterops palpebrosus</i>	Least Concern	II
232.	Isabelline Shrike	<i>Lanius isabellinus</i>	Least concern	II
233.	Isabelline Wheatear	<i>Oenanthe isabellina</i>	Least concern	II
234.	Java Sparrow	<i>Lonchura oryzivora</i>	Endangered	-
235.	Jerdon's Baza	<i>Aviceda jerdoni</i>	Least Concern	I
236.	Jerdon's Bushlark	<i>Plocealauda affinis</i>	Least concern	II
237.	Jerdon's Leafbird	<i>Chloropsis jerdoni</i>	Least concern	II

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238.	Jerdon's Nightjar	<i>Caprimulgus atripennis</i>	Least concern	II
239.	Jungle Babbler	<i>Turdoides striata</i>	Least concern	II
240.	Jungle Bush-Quail	<i>Perdica asiatica</i>	Least concern	II
241.	Jungle Myna	<i>Acridotheres fuscus</i>	Least concern	II
242.	Jungle Nightjar	<i>Caprimulgus indicus</i>	Least Concern	
243.	Jungle Owlet	<i>Glaucidium radiatum</i>	Least concern	II
244.	Jungle Prinia	<i>Argya striata</i>	Least Concern	II
245.	Kashmir Flycatcher	<i>Ficedula subrubra</i>	Vulnerable	I
246.	Kentish Plover	<i>Charadrius alexandrinus</i>	Least Concern	II
247.	Knob-billed Duck	<i>Sarkidiornis melanotos</i>	Least concern	II
248.	Laggar Falcon	<i>Falco jugger</i>	Near Threatened	I
249.	Large Grey Babbler	<i>Argya malcolmi</i>	Least concern	II
250.	Large Hawk-Cuckoo	<i>Hierococcyx sparveroides</i>	Least Concern	
251.	Large-billed Crow	<i>Corvus macrorhynchos</i>	Least concern	II
252.	Large-billed Leaf Warbler	<i>Phylloscopus magnirostris</i>	Least concern	II
253.	Laughing Dove	<i>Spilopelia senegalensis</i>	Least concern	II
254.	Legge's Hawk-Eagle	<i>Nisaetus kelaarti</i>	Least Concern	-
255.	Lesser Adjutant	<i>Leptoptilos javanicus</i>	Near Threatened	I
256.	Lesser Black-backed Gull	<i>Larus fuscus</i>	Least concern	II
257.	Lesser Coucal	<i>Centropus bengalensis</i>	Least Concern	II
258.	Lesser Crested Tern	<i>Thalasseus bengalensis</i>	Least concern	II
259.	Lesser Cuckoo	<i>Cuculus poliocephalus</i>	Least concern	II
260.	Lesser Fish-Eagle	<i>Ichthyophaga humilis</i>	Near Threatened	I
261.	Lesser Flamingo	<i>Phoeniconaias minor</i>	Near Threatened	II
262.	Lesser Florican	<i>Sypheotides indicus</i>	Critically Endangered	I
263.	Lesser Golden-backed Woodpecker	<i>Dinopium benghalense</i>	Least Concern	II
264.	Lesser Kestrel	<i>Falco naumanni</i>	Least Concern	II
265.	Lesser Whistling-Duck	<i>Dendrocygna javanica</i>	Least concern	II
266.	Lesser White-fronted Goose	<i>Anser erythropus</i>	Vulnerable	II
267.	Lesser Whitethroat	<i>Curruca curruca</i>	Least concern	II
268.	Lesser Yellownape	<i>Picus chlorolophus</i>	Least Concern	II
269.	Little Bunting	<i>Emberiza pusilla</i>	Least Concern	II
270.	Little Cormorant	<i>Microcarbo niger</i>	Least concern	II
271.	Little Egret	<i>Egretta garzetta</i>	Least concern	II
272.	Little Grebe	<i>Tachybaptus ruficollis</i>	Least concern	II
273.	Little Ringed Plover	<i>Charadrius dubius</i>	Least concern	II
274.	Little Spiderhunter	<i>Arachnothera longirostra</i>	Least Concern	II
275.	Little Stint	<i>Calidris minuta</i>	Least concern	II
276.	Little Swift	<i>Apus affinis</i>	Least concern	II
277.	Little Tern	<i>Sternula albifrons</i>	Least concern	II
278.	Long-billed Pipit	<i>Anthus similis</i>	Least concern	II

SN	Common Name	Scientific Name	IUCN v.2025-2	WPAA 2022
279.	Long-legged Buzzard	<i>Buteo rufinus</i>	Least Concern	I
280.	Long-tailed Shrike	<i>Lanius schach</i>	Least concern	II
281.	Long-toed Stint	<i>Calidris subminuta</i>	Least Concern	II
282.	Loten's Sunbird	<i>Cinnyris lotenius</i>	Least concern	II
283.	Malabar Barbet	<i>Psilopogon malabaricus</i>	Least Concern	II
284.	Malabar Grey Hornbill	<i>Ocyrceros griseus</i>	Vulnerable	I
285.	Malabar Imperial Pigeon	<i>Ducula cuprea</i>	Least Concern	II
286.	Malabar Lark	<i>Galerida malabarica</i>	Least Concern	II
287.	Malabar Parakeet	<i>Psittacula columboides</i>	Least concern	II
288.	Malabar Pied Hornbill	<i>Anthraceroceros coronatus</i>	Near Threatened	I
289.	Malabar Starling	<i>Sturnia blythii</i>	Not Recognized	II
290.	Malabar trogon	<i>Harpactes fasciatus</i>	Least Concern	II
291.	Malabar Whistling-Thrush	<i>Myophonus horsfieldii</i>	Least concern	II
292.	Malabar Woodshrike	<i>Tephrodornis sylvicola</i>	Least Concern	II
293.	Malayan Night Heron	<i>Gorsachius melanolophus</i>	Least Concern	II
294.	Mallard	<i>Anas platyrhynchos</i>	Least concern	II
295.	Marsh Sandpiper	<i>Tringa stagnatilis</i>	Least concern	II
296.	Masked Booby	<i>Sula dactylatra</i>	Least concern	II
297.	Medium Egret	<i>Ardea intermedia</i>	Least Concern	II
298.	Mongolian Short-toed Lark	<i>Calandrella dukhunensis</i>	Least concern	-
299.	Montagu's Harrier	<i>Circus pygargus</i>	Least concern	I
300.	Mottled Wood-Owl	<i>Strix ocellata</i>	Least concern	I
301.	Nilgiri Flowerpecker	<i>Dicaeum concolor</i>	Least Concern	II
302.	Nilgiri Flycatcher	<i>Eumyias albicaudatus</i>	Least Concern	II
303.	Nilgiri Laughingthrush	<i>Montecincla cachinnans</i>	Near Threatened	I
304.	Nilgiri Sholakili	<i>Sholicola major</i>	Near Threatened	I
305.	Nilgiri Wood-Pigeon	<i>Columba elphinstonii</i>	Least Concern	I
306.	Northern Pintail	<i>Anas acuta</i>	Least concern	II
307.	Northern Shoveler	<i>Spatula clypeata</i>	Least concern	II
308.	Northern Wheatear	<i>Oenanthe oenanthe</i>	Least Concern	II
309.	Olive-backed Pipit	<i>Anthus hodgsoni</i>	Least concern	II
310.	Orange Minivet	<i>Pericrocotus flammeus</i>	NA	II
311.	Orange-breasted Green-Pigeon	<i>Treron bicinctus</i>	Least Concern	II
312.	Orange-headed Thrush	<i>Geokichla citrina</i>	Least concern	II
313.	Oriental Darter	<i>Anhinga melanogaster</i>	Near Threatened	II
314.	Oriental Honey-buzzard	<i>Pernis ptilorhynchus</i>	Least concern	I
315.	Oriental Magpie-Robin	<i>Copsychus saularis</i>	Least Concern	II
316.	Oriental Pratincole	<i>Glareola maldivarum</i>	Least concern	II
317.	Oriental Scops-Owl	<i>Otus sunia</i>	Least Concern	II
318.	Oriental Skylark	<i>Alauda gulgula</i>	Least Concern	II
319.	Oriental Turtle-Dove	<i>Streptopelia orientalis</i>	Least concern	II
320.	Osprey	<i>Pandion haliaetus</i>	Least concern	I
321.	Pacific Golden-Plover	<i>Pluvialis fulva</i>	Least concern	I

SN	Common Name	Scientific Name	IUCN v.2025-2	WPAA 2022
322.	Paddyfield Pipit	<i>Anthus rufulus</i>	Least Concern	II
323.	Paddyfield Warbler	<i>Acrocephalus agricola</i>	Least concern	II
324.	Painted Bush-Quail	<i>Perdica erythrorhyncha</i>	Least Concern	II
325.	Painted Francolin	<i>Francolinus pictus</i>	Least concern	II
326.	Painted Sandgrouse	<i>Pterocles indicus</i>	Least concern	II
327.	Painted Spurfowl	<i>Galloperdix lunulata</i>	Least Concern	II
328.	Painted Stork	<i>Mycteria leucocephala</i>	Least Concern	II
329.	Pale-billed Flowerpecker	<i>Dicaeum erythrorhynchos</i>	Least concern	II
330.	Pallas's Grasshopper Warbler	<i>Helopsaltes certhiola</i>	Least concern	II
331.	Pallas's Gull	<i>Ichthyaeetus ichthyaeetus</i>	Least concern	II
332.	Pallid Harrier	<i>Circus macrourus</i>	Near Threatened	I
333.	Peregrine Falcon	<i>Falco peregrinus</i>	Least Concern	I
334.	Pheasant-tailed Jacana	<i>Hydrophasianus chirurgus</i>	Least concern	II
335.	Pied Avocet	<i>Recurvirostra avosetta</i>	Least concern	II
336.	Pied Bushchat	<i>Saxicola caprata</i>	Least concern	II
337.	Pied Cuckoo	<i>Clamator jacobinus</i>	Least concern	II
338.	Pied Kingfisher	<i>Ceryle rudis</i>	Least Concern	II
339.	Pied Thrush	<i>Geokichla wardii</i>	Least Concern	II
340.	Pied Wheatear	<i>Oenanthe pleschanka</i>	Least Concern	II
341.	Pin-tailed Snipe	<i>Gallinago stenura</i>	Least concern	II
342.	Plain Prinia	<i>Prinia inornata</i>	Least concern	II
343.	Plaintive Cuckoo	<i>Cacomantis merulinus</i>	Least Concern	II
344.	Plum-headed Parakeet	<i>Psittacula cyanocephala</i>	Least concern	II
345.	Puff-throated Babbler	<i>Pellorneum ruficeps</i>	Least concern	II
346.	Purple Heron	<i>Ardea purpurea</i>	Least concern	II
347.	Purple Sunbird	<i>Cinnyris asiaticus</i>	Least concern	II
348.	Purple-rumped Sunbird	<i>Leptocoma zeylonica</i>	Least concern	II
349.	Rain Quail	<i>Coturnix coromandelica</i>	Least concern	II
350.	Red Avadavat	<i>Amandava amandava</i>	Least concern	II
351.	Red Collared-Dove	<i>Streptopelia tranquebarica</i>	Least concern	II
352.	Red Junglefowl	<i>Gallus gallus</i>	Least concern	II
353.	Red Phalarope	<i>Phalaropus fulicarius</i>	Least Concern	II
354.	Red Spurfowl	<i>Galloperdix spadicea</i>	Least concern	II
355.	Red-breasted Flycatcher	<i>Ficedula parva</i>	Least concern	II
356.	Red-crested Pochard	<i>Netta rufina</i>	Least concern	II
357.	Red-headed Bunting	<i>Emberiza bruniceps</i>	Least concern	II
358.	Red-headed Vulture	<i>Sarcogyps calvus</i>	Critically Endangered	I
359.	Red-naped Ibis	<i>Pseudibis papillosa</i>	Least concern	II
360.	Red-necked Falcon	<i>Falco chicquera</i>	Near Threatened	I
361.	Red-necked Phalarope	<i>Phalaropus lobatus</i>	Least concern	II
362.	Red-throated Pipit	<i>Red-throated Pipit</i>	Least Concern	II

SN	Common Name	Scientific Name	IUCN v.2025-2	WPAA 2022
363.	Red-vented Bulbul	<i>Pycnonotus cafer</i>	Least Concern	II
364.	Red-wattled Lapwing	<i>Vanellus indicus</i>	Least concern	II
365.	Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>	Least concern	II
366.	Richard's Pipit	<i>Anthus richardi</i>	Least concern	II
367.	River Tern	<i>Sterna aurantia</i>	Vulnerable	I
368.	Rock Bush-Quail	<i>Perdica argoondah</i>	Least concern	II
369.	Rock Pigeon	<i>Columba livia</i>	Least concern	II
370.	Rose-ringed Parakeet	<i>Psittacula krameri</i>	Least concern	II
371.	Rosy Starling	<i>Pastor roseus</i>	Least concern	II
372.	Ruddy Shelduck	<i>Tadorna ferruginea</i>	Least concern	II
373.	Ruddy Turnstone	<i>Arenaria interpres</i>	Near Threatened	II
374.	Ruddy-breasted Crake	<i>Zapornia fusca</i>	Least concern	II
375.	Ruff	<i>Calidris pugnax</i>	Least concern	II
376.	Rufous Babbler	<i>Turdoides subrufa</i>	Least Concern	II
377.	Rufous Treepie	<i>Dendrocitta vagabunda</i>	Least Concern	II
378.	Rufous Woodpecker	<i>Micropternus brachyurus</i>	Least concern	II
379.	Rufous-bellied Eagle	<i>Lophotriorchis kienerii</i>	Near Threatened	I
380.	Rufous-fronted Prinia	<i>Prinia buchanani</i>	Least concern	I
381.	Rufous-tailed Lark	<i>Ammomanes phoenicura</i>	Near Threatened	II
382.	Rusty-tailed Flycatcher	<i>Ficedula ruficauda</i>	Least concern	II
383.	Sanderling	<i>Calidris alba</i>	Least concern	-
384.	Sandwich Tern	<i>Thalasseus sandvicensis</i>	Least Concern	II
385.	Savanna Nightjar	<i>Caprimulgus affinis</i>	Least concern	II
386.	Scaly-breasted Munia	<i>Lonchura punctulata</i>	Least concern	II
387.	shikra	<i>Tachyspiza badia</i>	Least concern	I
388.	Short-eared Owl	<i>Asio flammeus</i>	Least Concern	I
389.	Short-toed Snake-Eagle	<i>Circaetus gallicus</i>	Least Concern	I
390.	Siberian Stonechat	<i>Saxicola maurus</i>	Least concern	II
391.	Singing Bushlark	<i>Mirafra javanica</i>	Least Concern	II
392.	Sirkeer Malkoha	<i>Taccocua leschenaultii</i>	Least concern	II
393.	Slaty-breasted Rail	<i>Lewinia striata</i>	Least concern	II
394.	Slaty-legged Crake	<i>Rallina eurizonoides</i>	Least Concern	II
395.	Slender-billed Gull	<i>Chroicocephalus genei</i>	Least concern	II
396.	Small Buttonquail	<i>Turnix sylvaticus</i>	Least concern	II
397.	Small Minivet	<i>Pericrocotus cinnamomeus</i>	Least concern	II
398.	Small Pratincole	<i>Glareola lactea</i>	Least Concern	II
399.	Speckled Piculet	<i>Picumnus innominatus</i>	Least Concern	II
400.	Spot-bellied Eagle-Owl	<i>Bubo nipalensis</i>	Least Concern	I
401.	Spot-billed Pelican	<i>Pelecanus philippensis</i>	Near Threatened	II
402.	Spot-breasted Fantail	<i>Rhipidura albogularis</i>	Least concern	II
403.	Spotted Crake	<i>Porzana porzana</i>	Least concern	II
404.	Spotted Dove	<i>Spilopelia chinensis</i>	Least Concern	II
405.	Spotted Owlet	<i>Athene brama</i>	Least Concern	II
406.	Spotted Redshank	<i>Tringa erythropus</i>	Least concern	I

SN	Common Name	Scientific Name	IUCN v.2025-2	WPAA 2022
407.	Square-tailed Bulbul	<i>Hypsipetes ganeesa</i>	Least Concern	II
408.	Sri Lanka Bay Owl	<i>Phodilus assimilis</i>	Least Concern	II
409.	Sri Lanka Frogmouth	<i>Batrachostomus moniliger</i>	Least Concern	I
410.	Steppe Buzzard	<i>Buteo buteo</i>	Least Concern	I
411.	Steppe Eagle	<i>Aquila nipalensis</i>	Endangered	I
412.	Stork-billed Kingfisher	<i>Pelargopsis capensis</i>	Least concern	II
413.	Streaked Weaver	<i>Ploceus manyar</i>	Least concern	II
414.	Streak-throated Swallow	<i>Petrochelidon fluvicola</i>	Least concern	II
415.	Streak-throated Woodpecker	<i>Picus xanthopygaeus</i>	Least concern	II
416.	Sulphur-bellied Warbler	<i>Phylloscopus griseolus</i>	Least concern	II
417.	Sykes's Warbler	<i>Iduna rama</i>	Least Concern	II
418.	Taiga Flycatcher	<i>Ficedula albicilla</i>	Least concern	II
419.	Tawny Eagle	<i>Aquila rapax</i>	Vulnerable	I
420.	Tawny Lark	<i>Galerida deva</i>	Least concern	II
421.	Tawny Pipit	<i>Anthus campestris</i>	Least concern	II
422.	Tawny-bellied Babbler	<i>Dumetia hyperythra</i>	Least concern	II
423.	Temminck's Stint	<i>Calidris temminckii</i>	Least concern	II
424.	Terek Sandpiper	<i>Xenus cinereus</i>	Least concern	II
425.	Thick-billed Flowerpecker	<i>Dicaeum agile</i>	Least concern	II
426.	Thick-billed Warbler	<i>Arundinax aedon</i>	Least concern	-
427.	Tibetan Sand-Plover	<i>Anarhynchus atrifrons</i>	Least concern	-
428.	Tickell's Blue Flycatcher	<i>Cyornis tickelliae</i>	Least Concern	II
429.	Tickell's Leaf Warbler	<i>Phylloscopus affinis</i>	Least concern	II
430.	Tickell's Thrush	<i>Turdus unicolor</i>	Least Concern	II
431.	Tree Pipit	<i>Anthus trivialis</i>	Least concern	II
432.	Tricolored Munia	<i>Lonchura malacca</i>	Least concern	II
433.	Tufted Duck	<i>Aythya fuligula</i>	Least concern	II
434.	Tytlar's Leaf Warbler	<i>Phylloscopus tytleri</i>	Least Concern	II
435.	Ultramarine Flycatcher	<i>Ficedula supercilialis</i>	Least concern	II
436.	Velvet-fronted Nuthatch	<i>Sitta frontalis</i>	Least concern	II
437.	Verditer Flycatcher	<i>Eumyias thalassinus</i>	Least concern	II
438.	Vernal Hanging-Parrot	<i>Loriculus vernalis</i>	Least Concern	II
439.	Vigors's Sunbird	<i>Aethopyga vigorsii</i>	Least concern	II
440.	Watercock	<i>Gallicrex cinerea</i>	Least concern	II
441.	Wayanad Laughingthrush	<i>Pterorhinus delesserti</i>	Least Concern	II
442.	Western Crowned Warbler	<i>Phylloscopus occipitalis</i>	Least concern	II
443.	Western Marsh Harrier	<i>Circus aeruginosus</i>	Least Concern	I
444.	Western Reef Heron	<i>Egretta gularis</i>	Least Concern	II
445.	Western Yellow Wagtail	<i>Motacilla flava</i>	Least concern	II
446.	Whiskered Tern	<i>Chlidonias hybrida</i>	Least concern	II
447.	White Stork	<i>Ciconia ciconia</i>	Least concern	I
448.	White Wagtail	<i>Motacilla alba</i>	Least concern	II
449.	White-bellied Blue Flycatcher	<i>Cyornis pallidipes</i>	Least concern	II
450.	White-bellied Drongo	<i>Dicrurus caeruleus</i>	Least concern	II

SN	Common Name	Scientific Name	IUCN v.2025-2	WPAA 2022
451.	White-bellied Minivet	<i>Pericrocotus erythropygius</i>	Least Concern	II
452.	White-bellied Sea-Eagle	<i>Ichthyophaga leucogaster</i>	Least concern	-
453.	White-bellied Treepie	<i>Dendrocitta leucogastra</i>	Least Concern	II
454.	White-bellied Woodpecker	<i>Dryocopus javensis</i>	Least concern	II
455.	White-breasted Waterhen	<i>Amaurornis phoenicurus</i>	Least concern	II
456.	White-browed Bulbul	<i>Pycnonotus luteolus</i>	Least concern	II
457.	White-browed Fantail	<i>Rhipidura aureola</i>	Least concern	II
458.	White-browed Wagtail	<i>Motacilla maderaspatensis</i>	Least Concern	II
459.	White-cheeked Barbet	<i>Psilopogon viridis</i>	Least Concern	II
460.	White-eyed Buzzard	<i>Butastur teesa</i>	Least concern	I
461.	White-naped Tit	<i>Machlolophus nuchalis</i>	Vulnerable	II
462.	White-naped Woodpecker	<i>Chrysocolaptes festivus</i>	Least concern	II
463.	White-rumped Munia	<i>Lonchura striata</i>	Least concern	II
464.	White-rumped Shama	<i>Copsychus malabaricus</i>	Least concern	II
465.	White-rumped Spinetail	<i>Zonavena sylvatica</i>	Least Concern	II
466.	White-rumped Vulture	<i>Gyps bengalensis</i>	Critically Endangered	I
467.	White-tailed Iora	<i>Aegithina nigrolutea</i>	Least Concern	I
468.	White-throated Kingfisher	<i>Halcyon smyrnensis</i>	Least Concern	II
469.	Wire-tailed Swallow	<i>Hirundo smithii</i>	Least concern	II
470.	Wood Sandpiper	<i>Tringa glareola</i>	Least concern	II
471.	Yellow Bittern	<i>Ixobrychus sinensis</i>	Least concern	II
472.	Yellow-billed Babbler	<i>Argya affinis</i>	Least concern	II
473.	Yellow-browed Bulbul	<i>Acritillas indica</i>	Least concern	II
474.	Yellow-browed Warbler	<i>Phylloscopus inornatus</i>	Least Concern	II
475.	Yellow-crowned Woodpecker	<i>Leiopicus mahrattensis</i>	Least concern	I
476.	Yellow-eyed Babbler	<i>Chrysomma sinense</i>	Least concern	II
477.	Yellow-footed Green Pigeon	<i>Treron phoenicopterus</i>	Least concern	II
478.	Yellow-legged Buttonquail	<i>Turnix tanki</i>	Least concern	I
479.	Yellow-throated Bulbul	<i>Pycnonotus xantholaemus</i>	Least concern	II
480.	Yellow-throated Sparrow	<i>Gymnoris xanthocollis</i>	Least concern	II
481.	Yellow-wattled Lapwing	<i>Vanellus malabaricus</i>	Least Concern	II
482.	Zebra Finch	<i>Taeniopygia guttata</i>	Least Concern	-
483.	Zitting Cisticola	<i>Cisticola juncidis</i>	Least concern	II

Source: ebird.org, primary observations, State of India's Birds

383. **Mammals.** A total of 90 mammalian species were recorded from the state of Karnataka, representing a diverse assemblage of terrestrial and aquatic fauna, including carnivores, herbivores, primates, bats, and marine mammals. As per the IUCN (2025-2) status, most species are categorized as Least Concern, indicating relatively stable populations within the region. However, the list includes no Critically Endangered species, while 5 species are Endangered and 15 species are Vulnerable, highlighting certain conservation concerns.

384. Additionally, 36 species are listed under Schedule-I of the Wildlife (Protection) Act, 1972 (amended 2022), indicating high conservation and legal protection status. The presence of flagship species (e.g., Asian Elephant, Tiger) and endemic species further emphasizes the ecological significance of the project area and the need for careful planning and mitigation to minimize impacts on sensitive wildlife populations (refer Table IV-20).

Table IV-20 List of mammalian species in Karnataka

SN	Common Name	Scientific Name	IUCN v.2025-2	WPAA 2022
1.	Asian Elephant	<i>Elephas maximus</i>	Least Concern	II
2.	Asian House Shrew	<i>Suncus murinus</i>	Least Concern	Not Listed
3.	Asian Small-clawed Otter	<i>Lutra cinerea</i>	Least Concern	Not Listed
4.	Bare-rumped Pouched Bat	<i>Saccolaimus saccolaimus</i>	Least Concern	Not Listed
5.	Beddome's Horseshoe Bat	<i>Rhinolophus beddomei</i>	Endangered	Not Listed
6.	Bengal Tiger	<i>Panthera tigris</i>	Endangered	I
7.	Black-bearded Tomb Bat	<i>Taphozous melanopogon</i>	Least Concern	Not Listed
8.	Blackbuck	<i>Antelope cervicapra</i>	Least Concern	I
9.	Black-footed Gray Langur	<i>Semnopithecus hypoleucos</i>	Least Concern	I
10.	Blyth's Horseshoe Bat	<i>Rhinolophus lepidus</i>	Vulnerable	Not Listed
11.	Bonnet Macaque	<i>Macaca radiata</i>	Least Concern	I
12.	Brown Palm Civet	<i>Paradoxurus jerdoni</i>	Least Concern	I
13.	Chital/Spotted Deer	<i>Axis axis</i>	Least Concern	II
14.	Common Giant Flying Squirrel	<i>Petaurista philippensis</i>	Least Concern	Not Listed
15.	Common Indian Field Mouse	<i>Mus booduga</i>	Least Concern	Not Listed
16.	Cutch Rock Rat	<i>Cremnomys cutchicus</i>	Least Concern	II
17.	Dhole	<i>Cuon alpinus</i>	Endangered	I
18.	Five-striped Palm Squirrel	<i>Funambulus pennantii</i>	Least Concern	Not Listed
19.	Four-horned Antelope	<i>Tetracerus quadricornis</i>	Vulnerable	I
20.	Gaur	<i>Bos gaurus</i>	Vulnerable	I
21.	Golden Jackal	<i>Canis aureus</i>	Least Concern	I
22.	Greater Asian Yellow Bat	<i>Scotophilus heathii</i>	Least Concern	Not Listed
23.	Greater Bandicoot-rat	<i>Bandicota indica</i>	Least Concern	Not Listed
24.	Greater False Vampire Bat	<i>Lyroderma lyra</i>	Least Concern	Not Listed
25.	Greater Short-nosed Fruit Bat	<i>Cynopterus sphinx</i>	Near Threatened	Not Listed
26.	Grey Slender Loris	<i>Loris lydekkerianus</i>	Least Concern	I
27.	Grizzled Giant Squirrel	<i>Ratufa macroura</i>	Least Concern	I
28.	Hairy-winged Bat	<i>Harpiocephalus harpia</i>	Near Threatened	Not Listed
29.	Hodgson's Bat	<i>Myotis formosus</i>	Data Deficient	Not Listed
30.	Horseshoe Bat	<i>Rhinolophus sp</i>	-	-
31.	Horsfield's Shrew	<i>Crocidura horsfieldii</i>	Least Concern	Not Listed
32.	Indian Bush Rat	<i>Golunda ellioti</i>	Least Concern	Not Listed
33.	Indian Chevrotain	<i>Moschiola indica</i>	Least Concern	I
34.	Indian Crested Porcupine	<i>Hystrix indica</i>	Least Concern	I

SN	Common Name	Scientific Name	IUCN v.2025-2	WPAA 2022
35.	Indian Flying Fox	<i>Pteropus medius</i>	Near Threatened	Not Listed
36.	Indian Fox	<i>Vulpes bengalensis</i>	Least Concern	I
37.	Indian Gazelle	<i>Gazella bennettii</i>	Least Concern	I
38.	Indian Gerbil	<i>Tatera indica</i>	Least Concern	Not Listed
39.	Indian Giant Squirrel	<i>Ratufa indica</i>	Least Concern	I
40.	Indian Grey Mongoose	<i>Urva edwardsii</i>	Least Concern	I
41.	Indian Hare	<i>Lepus nigricollis</i>	Least Concern	II
42.	Indian Leopard	<i>Panthera pardus</i>	Vulnerable	I
43.	Indian Palm Civet	<i>Paradoxurus hermaphroditus</i>	Least Concern	I
44.	Indian Pangolin	<i>Manis crassicaudata</i>	Endangered	I
45.	Indian Pipistrelle	<i>Pipistrellus coromandra</i>	Least Concern	Not Listed
46.	Indian Roundleaf bat	<i>Hipposideros lankadiva</i>	Least Concern	Not Listed
47.	Indian Ruddy Mongoose	<i>Urva smithii</i>	Least Concern	I
48.	Indian Striped Hyaena	<i>Hyaena hyaena</i>	Near Threatened	I
49.	Jungle Cat	<i>Felis chaus</i>	Least Concern	I
50.	Jungle Palm Squirrel	<i>Funambulus tristriatus</i>	Least Concern	II
51.	Kolar Leaf-nosed Bat	<i>Hipposideros hypophyllus</i>	Critically Endangered	I
52.	Least Pipistrelle	<i>Pipistrellus tenuis</i>	Least Concern	Not Listed
53.	Leschenaultae's Rousette	<i>Rousettus leschenaultii</i>	Least Concern	Not Listed
54.	Lesser Bandicoot-rat	<i>Bandicota bengalensis</i>	Least Concern	Not Listed
55.	Lesser False Vampire Bat	<i>Megaderma spasma</i>	Least Concern	Not Listed
56.	Lesser Mouse-tailed Bat	<i>Rhinopoma hardwickii</i>	Least Concern	Not Listed
57.	Lesser Short-nosed Fruit Bat	<i>Cynopterus brachyotis</i>	Least Concern	Not Listed
58.	Lion-tailed Macaque	<i>Macaca silenus</i>	Endangered	I
59.	Madras Treeshrew	<i>Anathana ellioti</i>	Least Concern	Not Listed
60.	Mainland Leopard Cat	<i>Prionailurus bengalensis</i>	Least Concern	I
61.	Mainland Rusty-spotted Cat	<i>Prionailurus rubiginosus</i>	Vulnerable	I
62.	Malabar Spiny Dormouse	<i>Platacanthomys lasiurus</i>	Vulnerable	II
63.	Nilgiri Langur	<i>Semnopithecus johnii</i>	Vulnerable	I
64.	Nilgiri Long-tailed Tree Mouse	<i>Vandeleuria nilagirica</i>	Endangered	I
65.	Nilgiri Marten	<i>Martes gwatkinsii</i>	Vulnerable	I
66.	Nilgiri Palm Squirrel	<i>Funambulus sublineatus</i>	Vulnerable	Not Listed
67.	Northern Plains Gray Langur	<i>Semnopithecus entellus</i>	Least Concern	II
68.	Northern Red Muntjac	<i>Muntiacus vaginalis</i>	Data Deficient	I
69.	Painted Bat	<i>Kerivoula picta</i>	Least Concern	Not Listed
70.	Pygmy White-toothed Shrew	<i>Suncus etruscus</i>	Least Concern	Not Listed
71.	Rhesus Macaque	<i>Macaca mulatta</i>	Least Concern	Not Listed
72.	Rufous Horseshoe Bat	<i>Rhinolophus rouxii</i>	Least Concern	Not Listed
73.	Sahyadris Forest Rat	<i>Rattus satarae</i>	Vulnerable	II
74.	Sambar	<i>Rusa unicolor</i>	Vulnerable	I
75.	Schneider's roundleaf bat	<i>Hipposideros speoris</i>	Least Concern	Not Listed
76.	Sloth Bear	<i>Melursus ursinus</i>	Vulnerable	I

SN	Common Name	Scientific Name	IUCN v.2025-2	WPAA 2022
77.	Small Indian Civet	<i>Viverricula indica</i>	Least Concern	I
78.	Smooth-coated Otter	<i>Lutra perspicillata</i>	Vulnerable	Not Listed
79.	Stripe-necked Mongoose	<i>Urva vitticollis</i>	Least Concern	Not Listed
80.	Three-striped Palm Squirrel	<i>Funambulus palmarum</i>	Data Deficient	Not Listed
81.	Tomb Bat	<i>Taphozous</i> sp.	-	-
82.	Tufted Gray Langur	<i>Semnopithecus priam</i>	Least Concern	I
83.	Wild Pig	<i>Sus scrofa</i>	Data Deficient	II
84.	Wroughton's free-tailed bat	<i>Otomops wroughtoni</i>	Data Deficient	I

385. **Herpetofauna.** A total of approximately 240 herpetofaunal species were recorded from the state of Karnataka, comprising 148 reptile species and 96 amphibian species, reflecting a rich and ecologically diverse assemblage typical of Western Ghats and associated habitats. As per the IUCN (2025-2) status, most species fall under Least Concern, indicating relatively stable populations. However, the dataset includes 5 Critically Endangered and 15 Endangered species highlighting significant conservation concerns, especially among restricted range taxa.

386. Further, 27 species are listed under Schedule-I of the Wildlife (Protection) Act, 1972 (amended 2022), while 64 species are included under Schedule-II. The fauna is characterized by a high proportion of Western Ghats endemics, habitat specialists, and data-deficient species, reflecting both ecological sensitivity and gaps in knowledge. Overall, the presence of threatened, endemic, and legally protected herpetofauna underscores the high conservation value of the project area and necessitates careful mitigation planning to minimize impacts on sensitive habitats and species (Table IV-21).

Table IV-21 List of herpetofauna species in Karnataka

SN	Common Name	Scientific Name	IUCN v2025-2	WLPA 2023
Reptiles and Lizards				
1.	Adi's Day Gecko	<i>Cnemaspis adii</i>	CR	NA
2.	Asian Chameleon	<i>Chamaeleo zeylanicus</i>	LC	I
3.	Banded Racer	<i>Argyrogena fasciolata</i>	LC	II
4.	Bangalore Geckoella	<i>Cyrtodactylus srilekhae</i>	NT	I
5.	Barred Wolf Snake	<i>Lycodon striatus</i>	LC	II
6.	Beaked Worm Snake	<i>Grypotyphlops acutus</i>	LC	II
7.	Beddome's Black Earth Snake	<i>Melanophidium punctatum</i>	VU	II
8.	Beddome's Cat Skink	<i>Ristella beddomii</i>	LC	NA
9.	Beddome's Cat Snake	<i>Boiga beddomei</i>	LC	II
10.	Beddome's Coral Snake	<i>Calliophis beddomei</i>	DD	II
11.	Beddome's Ground Skink	<i>Kaestlea beddomii</i>	LC	NA
12.	Beddome's Mabuya	<i>Eutropis beddomei</i>	LC	NA
13.	Beddome's Snake-Eye	<i>Ophisops beddomei</i>	LC	NA
14.	Belgaum Worm Snake	<i>Indotyphlops exiguus</i>	DD	II
15.	Bengal Monitor Lizard	<i>Varanus bengalensis</i>	NT	I
16.	Black Coral Snake	<i>Calliophis nigrescens</i>	LC	II
17.	Blanford's Rock Agama	<i>Psammophilus blanfordianus</i>	LC	NA
18.	Bombay Leaf-toed Gecko	<i>Hemidactylus prashadi</i>	LC	NA

SN	Common Name	Scientific Name	IUCN v2025-2	WLPAA 2023
19.	Boulenger's Indian Gecko	<i>Cyrtodactylus albofasciatus</i>	LC	II
20.	Boulenger's Bronzeback	<i>Dendrelaphis bifrenalis</i>	LC	II
21.	Boulenger's Dasia	<i>Dasia subcaerulea</i>	EN	NA
22.	Brahminy Blind Snake	<i>Indotyphlops braminus</i>	LC	II
23.	Broad-headed Fan-throated Lizard	<i>Sitana laticeps</i>	LC	NA
24.	Bronze Mabuya	<i>Eutropis macularia</i>	LC	NA
25.	Brooke's House Gecko	<i>Hemidactylus brookii</i>	LC	NA
26.	Brown Vine Snake	<i>Ahaetulla pulverulenta</i>	LC	II
27.	Buff Striped Keelback	<i>Amphiesma stolatum</i>	LC	NA
28.	Calamaria Reed Snake	<i>Liopeltis calamaria</i>	LC	II
29.	Castoe's Coralsnake	<i>Calliophis castoe</i>	EN	II
30.	Changeable Lizard	<i>Calotes versicolor</i>	LC	NA
31.	Chequered Keelback	<i>Xenochrophis piscator</i>	LC	I
32.	Coastal Day Gecko	<i>Cnemaspis littoralis</i>	DD	NA
33.	Cochin Forest Cane Turtle	<i>Vijayachelys silvatica</i>	EN	I
34.	Collared Cat Snake	<i>Boiga nuchalis</i>	LC	II
35.	Common Bamboo Viper	<i>Trimeresurus gramineus</i>	LC	II
36.	Common Dotted Garden Skink	<i>Lygosoma punctata</i>	LC	NA
37.	Common Green Forest Lizard	<i>Calotes calotes</i>	LC	NA
38.	Common Krait	<i>Bungarus caeruleus</i>	LC	II
39.	Common Kukri Snake	<i>Oligodon arnensis</i>	LC	II
40.	Common Wolf Snake	<i>Lycodon aulicus</i>	LC	II
41.	Copper-head Trinket Snake	<i>Coelognathus radiatus</i>	LC	II
42.	Cuvier's Shieldtail	<i>Uropeltis ceylanica</i>	DD	II
43.	Dakota's Leaf-toed Gecko	<i>Hemidactylus triedrus</i>	LC	NA
44.	Darwin's Large Fan-throated Lizard	<i>Sarada darwini</i>	LC	NA
45.	Das's Day Gecko	<i>Cnemaspis indraneildasii</i>	VU	NA
46.	Daudin's Bronzeback	<i>Dendrelaphis tristis</i>	LC	II
47.	Deccan Fan-throated Lizard	<i>Sarada deccanensis</i>	LC	NA
48.	Dog-faced Water Snake	<i>Cerberus rynchops</i>	LC	I
49.	Dumeril's Black-headed Snake	<i>Sibynophis subpunctatus</i>	LC	II
50.	Dussumier's Forest Skink	<i>Sphenomorphus dussumieri</i>	LC	NA
51.	Elliot's Earth Snake	<i>Uropeltis ellioti</i>	LC	II
52.	Elliot's Forest Lizard	<i>Monilesaurus ellioti</i>	LC	NA
53.	Forest Spotted Gecko	<i>Cyrtodactylus collegalensis</i>	LC	I
54.	Gerard's Water Snake	<i>Gerarda prevostiana</i>	LC	NA
55.	Giant Gecko	<i>Hemidactylus giganteus</i>	LC	NA
56.	Giri's Bronzeback Tree Snake	<i>Dendrelaphis giri</i>	LC	II
57.	Gleadow's House Gecko	<i>Hemidactylus gleadowi</i>	DD	NA

SN	Common Name	Scientific Name	IUCN v2025-2	WLPAA 2023
58.	Goan Day Gecko	<i>Cnemaspis goaensis</i>	EN	NA
59.	Gokak Fan-throated Lizard	<i>Sitana gokakensis</i>	DD	NA
60.	Graceful Leaf-toed Gecko	<i>Hemidactylus gracilis</i>	LC	NA
61.	Green Keelback	<i>Rhabdophis plumbicolor</i>	LC	NA
62.	Gund Day Gecko	<i>Cnemaspis heteropholis</i>	NT	NA
63.	Günther's Writhing Snake	<i>Lygosoma guentheri</i>	LC	NA
64.	Günther's Earth Snake	<i>Uropeltis liura</i>	DD	II
65.	Gunther's Indian Gecko	<i>Cyrtodactylus deccanensis</i>	LC	II
66.	Günther's Mountain Snake	<i>Xylophis stenorhynchus</i>	DD	NA
67.	Günther's Vine Snake	<i>Ahaetulla dispar</i>	NT	II
68.	Hampi Rock Gecko	<i>Hemidactylus siva</i>	EN	NA
69.	Hill Keelback	<i>Hebius monticola</i>	LC	NA
70.	Horseshoe Pit-viper	<i>Trimeresurus strigatus</i>	LC	II
71.	Hump-nosed Moccasin	<i>Hypnale hypnale</i>	LC	II
72.	Indian Black Earth Snake	<i>Melanophidium wynaudente</i>	LC	II
73.	Indian Black Turtle	<i>Melanocheilus trijuga</i>	LC	I
74.	Indian Cobra	<i>Naja naja</i>	LC	I
75.	Indian Egg-eater	<i>Boiga westermanni</i>	LC	I
76.	Indian Gamma Snake	<i>Boiga trigonata</i>	LC	II
77.	Indian Golden Gecko	<i>Calodactylodes aureus</i>	LC	I
78.	Indian Narrow-headed Softshell Turtle	<i>Chitra indica</i>	EN	I
79.	Indian Rock Python	<i>Python molurus</i>	NT	I
80.	Indian Smooth Snake	<i>Coronella brachyura</i>	LC	II
81.	Indian Star Tortoise	<i>Geochelone elegans</i>	VU	I
82.	Jerdon's Day Gecko	<i>Cnemaspis jerdonii</i>	VU	NA
83.	Jerdon's Kukri Snake	<i>Oligodon venustus</i>	LC	II
84.	Karnataka Burrowing Snake	<i>Pseudoplectrurus canarius</i>	DD	II
85.	Keeled Indian Mabuya	<i>Eutropis carinata</i>	LC	NA
86.	Kerala Burrowing Snake	<i>Plectrurus aureus</i>	DD	II
87.	King Cobra	<i>Ophiophagus hannah</i>	LC	I
88.	Large-scaled Forest Lizard	<i>Calotes grandisquamis</i>	LC	NA
89.	Large-scaled Pit Viper	<i>Trimeresurus macrolepis</i>	NT	II
90.	Leith's Sand Snake	<i>Psammophis leithii</i>	LC	NA
91.	Leith's Softshell Turtle	<i>Nilssonia leithii</i>	CR	I
92.	Leschenault's Gecko	<i>Hemidactylus leschenaultii</i>	LC	NA
93.	Leschenault's Snake Eye	<i>Ophisops leschenaultii</i>	LC	NA
94.	Lesser Snake-eyed Lacerta	<i>Ophisops minor</i>	LC	NA
95.	Lined Supple Skink	<i>Lygosoma lineata</i>	LC	NA
96.	Long-nosed Tree Snake	<i>Ahaetulla nasuta</i>	LC	II
97.	Malabar Pit Viper	<i>Trimeresurus malabaricus</i>	LC	II
98.	Mugger	<i>Crocodylus palustris</i>	VU	I
99.	Mysore Day Gecko	<i>Cnemaspis mysoriensis</i>	LC	NA
100.	Nilgiri Burrowing Snake	<i>Plectrurus perroteti</i>	LC	II
101.	Nilgiri Dwarf Gecko	<i>Cnemaspis indica</i>	VU	NA

SN	Common Name	Scientific Name	IUCN v2025-2	WLPAA 2023
102.	Nilgiri Forest Lizard	<i>Calotes nemoricola</i>	LC	NA
103.	Nilgiri Keelback	<i>Hebius beddomei</i>	LC	NA
104.	Olive Forest Snake	<i>Rhabdops olivaceus</i>	NT	II
105.	Olive Keelback Water Snake	<i>Atretium schistosum</i>	LC	I
106.	Oriental Rat Snake	<i>Ptyas mucosa</i>	LC	I
107.	Ornate Flying Snake	<i>Chrysopelea ornata</i>	LC	II
108.	Punjab-snake-eyed Lacerta	<i>Ophisops jerdonii</i>	LC	NA
109.	Red Sand Boa	<i>Eryx johnii</i>	NT	I
110.	Red-spotted Earth Snake	<i>Uropeltis rubromaculata</i>	LC	II
111.	Reticulate Leaf-toed Gecko	<i>Hemidactylus reticulatus</i>	LC	NA
112.	Rough-tailed Sand Boa	<i>Eryx conicus</i>	LC	II
113.	Roux's Forest Calotes	<i>Monilesaurus rouxii</i>	LC	NA
114.	Salty Earth Snake	<i>Rhinophis sanguineus</i>	LC	II
115.	Sand Snake	<i>Psammophis condanarus</i>	LC	II
116.	Scarce Bridal Snake	<i>Lycodon gracilis</i>	DD	II
117.	Schmidt's Mabuya	<i>Eutropis allapallensis</i>	LC	NA
118.	Sharma's Racer	<i>Platycephalus bholanathi</i>	DD	II
119.	Sind Krait	<i>Bungarus walli</i>	LC	II
120.	Slender Coral Snake	<i>Calliophis melanurus</i>	LC	II
121.	South Indian Rock Agama	<i>Psammophilus dorsalis</i>	LC	NA
122.	Southern Flying Lizard	<i>Draco dussumieri</i>	LC	I
123.	Spiny-headed Fan-throated Lizard	<i>Sitana spinaecephalus</i>	LC	NA
124.	Spotted Leaf-toed Gecko	<i>Hemidactylus maculatus</i>	LC	NA
125.	Sri Lanka Cat Snake	<i>Boiga ceylonensis</i>	LC	II
126.	Stoliczka's Slender Blind Snake	<i>Indotyphlops porrectus</i>	LC	II
127.	Stout Sand Snake	<i>Psammophis longifrons</i>	LC	NA
128.	Striped Narrow-headed Snake	<i>Xylophis perroteti</i>	LC	NA
129.	Three-banded Mabuya	<i>Eutropis trivittata</i>	LC	NA
130.	Travancore Tortoise	<i>Indotestudo travancorica</i>	VU	NA
131.	Travancore Wolf Snake	<i>Lycodon travancoricus</i>	LC	II
132.	Trinket Snake	<i>Coelognathus helena</i>	LC	II
133.	Two-lined Ground Skink	<i>Kaestlea bilineata</i>	LC	NA
134.	Vellore Bridal Snake	<i>Lycodon nympha</i>	LC	II
135.	Water Rhabdops	<i>Rhabdops aquaticus</i>	LC	II
136.	Western Kukri Snake	<i>Oligodon affinis</i>	LC	II
137.	Western Russel's Viper	<i>Daboia russelii</i>	LC	I
138.	Whitaker's Termite Hill Gecko	<i>Hemidactylus whitakeri</i>	LC	NA
139.	Whitaker's Boa	<i>Eryx whitakeri</i>	NT	I
140.	Yellow-bellied House Gecko	<i>Hemidactylus flaviviridis</i>	LC	NA
141.	Yellow-collared Wolf Snake	<i>Lycodon flavicollis</i>	LC	II
142.	Yellow-green Cat Snake	<i>Boiga flaviviridis</i>	LC	II
143.	Yellow-spotted Wolf Snake	<i>Lycodon flavomaculatus</i>	LC	II

SN	Common Name	Scientific Name	IUCN v2025-2	WLPAA 2023
144.	Yercaud Slender Gecko	<i>Hemiphyllodactylus aurantiacus</i>	CR	NA
145.	Leith's Softshell Turtle	<i>Nilssonia leithii</i>	CR	I
146.	Cochin Forest Cane Turtle	<i>Vijayachelys silvatica</i>	EN	I
147.	Green Turtle	<i>Chelonia mydas</i>	LC	I
148.	Hawksbill Turtle	<i>Eretmochelys imbricata</i>	CR	I
Amphibians				
1.	Bicolored Frog	<i>Clinotarsus curtipes</i>	Least Concern	NA
2.	Malabar Tree Toad	<i>Pedostibes tuberculosus</i>	Least Concern	NA
3.	Beddome's Caecilian	<i>Ichthyophis beddomei</i>	Least Concern	NA
4.	Malabar Gliding Frog	<i>Rhacophorus malabaricus</i>	Least Concern	NA
5.	Coorg Yellow Bush Frog	<i>Raorchestes luteolus</i>	Least Concern	NA
6.	South Indian Frog	<i>Indirana semipalmata</i>	Least Concern	NA
7.	Castle Rock night frog	<i>Nyctibatrachus petraeus</i>	Near Threatened	NA
8.	Small Wood frog	<i>Hylarana aurantiaca</i>	Endangered	NA
9.	Asian Common Toad	<i>Duttaphrynus melanostictus</i>	Least Concern	NA
10.	Indian Bullfrog	<i>Hoplobatrachus tigerinus</i>	Least Concern	II
11.	Malabar Wart Frog	<i>Minervarya rufescens</i>	Near Threatened	NA
12.	Western Tree Frog	<i>Polypedates occidentalis</i>	Least Concern	NA
13.	Aloysi Skittering Frog	<i>Phrynoderma aloysii</i>	Least Concern	II
14.	Common skittering frog	<i>Euphylyctis cyanophlyctis</i>	Least Concern	II
15.	Large Ponmudi Bush Frog	<i>Raorchestes ponmudi</i>	Least Concern	NA
16.	winged gliding frog	<i>Rhacophorus lateralis</i>	Vulnerable	NA
17.	Beddomes Leaping Frog	<i>Indirana beddomii</i>	Endangered	NA
18.	Indian Dot Frog	<i>Uperodon mormoratus</i>	Least Concern	NA
19.	Waynad bush frog	<i>Pseudophilautus wynaadensis</i>	Least Concern	NA
20.	Kempholey Night Frog	<i>Nyctibatrachus kempholeyensis</i>	Least Concern	NA
21.	Short-webbed Frog	<i>Minervarya brevipalmata</i>	Data Deficient	NA
22.	Amboli bush frog	<i>Pseudophilautus amboli</i>	Least Concern	NA
23.	-	<i>Raorchestes chromasynchysi</i>	Vulnerable	NA
24.	Variable Bush Frog	<i>Raorchestes akroparallagi</i>	Least Concern	NA
25.	Southern Bubble-nest Frog	<i>Raorchestes glandulosus</i>	Vulnerable	NA
26.	Chunam Tree Frog	<i>Polypedates maculatus</i>	Least Concern	NA
27.	Painted Globular Frog	<i>Uperodon taprobanicus</i>	Least Concern	NA
28.	Kudremukh Bush Frog	<i>Raorchestes tuberochumerus</i>	Least Concern	NA
29.	Malabar Tropical Frog	<i>Micrixalus saxicola</i>	Least Concern	NA
30.	Ornate Narrow-mouthed Toad	<i>Microhyla ornata</i>	Least Concern	NA
31.	Hill Cricket Frog	<i>Minervarya syhadrensis</i>	Least Concern	NA
32.	Kudremukh Cricket Frog	<i>Minervarya mysorensis</i>	Least Concern	NA
33.	Malabar Toad	<i>Firouzophrynus hololius</i>	Least Concern	NA
34.	Chari's bush frog	<i>Raorchestes charius</i>	Least Concern	NA
35.	Mangalore Burrowing Frog	<i>Sphaerotheca dobsonii</i>	Least Concern	NA
36.	Kalpetta Yellow Bush Frog	<i>Raorchestes nerostagona</i>	Vulnerable	NA

SN	Common Name	Scientific Name	IUCN v2025-2	WLPAA 2023
37.	Anil's Bush Frog	<i>Raorchestes anili</i>	Least Concern	NA
38.	Kannan Caecilian	<i>Uraeotyphlus narayani</i>	Least Concern	NA
39.	Malabar Torrent Toad	<i>Blaira ornata</i>	Vulnerable	NA
40.	White-bellied pug-snout frog	<i>Uperodon variegatus</i>	Least Concern	NA
41.	Marbled balloon frog	<i>Uperodon systoma</i>	Least Concern	NA
42.	Indian golden-backed frog	<i>Hylarana indica</i>	Least Concern	NA
43.	Indigo Bush Frog	<i>Raorchestes indigo</i>	Vulnerable	NA
44.	Rao's Intermediate Golden-backed Frog	<i>Hylarana intermedia</i>	Least Concern	NA
45.	Laterite narrow-mouthed frog	<i>Microhyla laterite</i>	Endangered	NA
46.	Jog's night frog	<i>Nyctibatrachus jog</i>	Least Concern	NA
47.	Kottigehar Dancing Frog	<i>Micrixalus kottigeharensis</i>	Vulnerable	NA
48.	Asian Painted Frog	<i>Kaloula pulchra</i>	Vulnerable	NA
49.	Mangaluru narrow-mouthed frog	<i>Microhyla kodial</i>	Data Deficient	NA
50.	Niluvase Dancing Frog	<i>Micrixalus niluvasei</i>	Endangered	NA
51.	Wide-spread Fungoid Frog	<i>Hylarana bahuvistara</i>	Least Concern	NA
52.	Indian Toad	<i>Duttaphrynus parietalis</i>	Least Concern	NA
53.	Elegant Bubble-nest Frog	<i>Micrixalus elegans</i>	Vulnerable	NA
54.	Ochlandra shrub frog	<i>Raorchestes ochlandrae</i>	Least Concern	NA
55.	Paddy Field Frog	<i>Fejervarya limnocharis</i>	Least Concern	NA
56.	Marbled Sand Frog	<i>Sphaerotheca rolandae</i>	Least Concern	NA
57.	Kumbara night frog	<i>Nyctibatrachus kumbara</i>	Vulnerable	NA
58.	Bengaluru Burrowing Frog	<i>Sphaerotheca bengaluru</i>	NA	NA
59.	Indian Burrowing Frog	<i>Sphaerotheca breviceps</i>	Least Concern	NA
60.	Nilphamarai Narrow-mouthed Frog	<i>Microhyla nilphamariensis</i>	Least Concern	NA
61.	False Hourglass Tree Frog	<i>Polypedates pseudocruciger</i>	Least Concern	NA
62.	Red Narrow-mouthed Frog	<i>Microhyla rubra</i>	NA	NA
63.	Spinular Bush Frog	<i>Raorchestes echinatus</i>	Vulnerable	NA
64.	Schneider's Toad	<i>Duttaphrynus scaber</i>	NA	NA
65.	Honnametti bush frog	<i>Raorchestes honnametti</i>	Near Threatened	NA
66.	White-cheeked Dancing Frog	<i>Micrixalus candidus</i>	Endangered	NA
67.	Small Cricket Frog	<i>Minervarya sahyadris</i>	Least Concern	NA
68.	Burrowing Frogs	<i>Sphaerotheca</i>	Least Concern	NA
69.	Jerdon's Bullfrog	<i>Hoplobatrachus crassus</i>	Least Concern	NA
70.	Boulenger's Narrow-eyed Frog	<i>Nyctibatrachus major</i>	Endangered	NA
71.	Dutta's Bubble-nest Frog	<i>Raorchestes hassanensis</i>	Near Threatened	NA
72.	Common Paddy Field Frog	<i>Minervarya agricola</i>	Least Concern	NA
73.	Short-nosed Toad	<i>Duttaphrynus brevirostris</i>	Vulnerable	NA
74.	Bombay Bubble-nest Frog	<i>Raorchestes bombayensis</i>	Least Concern	NA
75.	Indian Five-fingered Frog	<i>Phrynoderma hexadactylum</i>	NA	II

SN	Common Name	Scientific Name	IUCN v2025-2	WLPAA 2023
76.	Netravali Leaping Frog	<i>Indirana salelkari</i>	Vulnerable	NA
77.	Kodagu Striped Caecilian	<i>Ichthyophis kodaguensis</i>	Least Concern	NA
78.	Gundia Leaping Frog	<i>Indirana gundia</i>	Near Threatened	NA
79.	Jerdon's Narrow-mouthed Frog	<i>Uperodon montanus</i>	Least Concern	NA
80.	Dubois's Leaping Frog	<i>Indirana duboisi</i>	Near Threatened	NA
81.	Mudduraja cricket frog	<i>Minervarya nilagirica</i>	Least Concern	NA
82.	Peninsular Caecilian	<i>Uraeotyphlus bombayensis</i>	Least Concern	NA
83.	Karnataka bubble-nest frog	<i>Raorchestes ravii</i>	Data Deficient	NA
84.	Striped Caecilians	<i>Ichthyophis</i>	Least Concern	NA
85.	Malabar Fungoid Frog	<i>Hylarana malabaricus</i>	Least Concern	NA
86.	Maharashtra Golden-backed Frog	<i>Hylarana caesari</i>	Vulnerable	NA
87.	Mountain Golden-backed frog	<i>Hylarana montana</i>	Least Concern	NA
88.	Sholigari Narrow-mouthed Frog	<i>Microhyla sholigari</i>	Least Concern	NA
89.	CEPF Burrowing Frog	<i>Minervarya cepfi</i>	Least Concern	NA
90.	Forest night frog	<i>Nyctibatrachus sylvaticus</i>	Endangered	NA
91.	GÃ¼nther's Golden-backed Frog	<i>Hylarana temporalis</i>	Vulnerable	NA
92.	Jaladhara Skittering Frog	<i>Euphyctis jaladhara</i>	NA	NA
93.	Karaavali skittering frog	<i>Euphyctis karaavali</i>	Least Concern	NA
94.	Indus Valley Toad	<i>Firouzophrynus stomaticus</i>	Least Concern	NA
95.	Peninsular Toad	<i>Firouzophrynus peninsularis</i>	Least Concern	NA
96.	Wrinkled frog	<i>Nyctibatrachus karnatakaensis</i>	Endangered	NA

Source: The Reptiles Database, Frogs of India Website, stakeholder consultations, literature review

Note: LC- Least Concern, NT- Near Threatened, VU- Vulnerable, EN- Endangered, CR- Critically Endangered, NA- Not assessed/listed, DD- Data Deficient

387. **Fishes.** A total of 74 fish species were recorded from the study area, representing a diverse assemblage of freshwater taxa including barbs, loaches, catfishes, snakeheads, gobies, and mahseers. As per the IUCN (2025-2) conservation status, the majority of species are classified as Least Concern, indicating relatively stable populations in the region. However, the ichthyofauna includes 1 Critically Endangered species, 7 Endangered species, and 3 Vulnerable species, reflecting moderate conservation concern. Additionally, several species fall under the Data Deficient category, highlighting gaps in ecological knowledge and the need for further research.

388. None of the recorded fish species are listed under Schedule-I of the Wildlife (Protection) Act, 1972 (amended 2023). The presence of endemic Western Ghats species, economically important fishes and threatened taxa underscores the ecological importance of aquatic habitats within the project area and the need for appropriate mitigation measures to conserve aquatic biodiversity (Table).

Table IV-22 List of Fish species in Karnataka

SN	Common Name	Scientific Name	IUCN v2025-2	WPAA 2023
1.	Amur Carp	<i>Cyprinus rubrofasciatus</i>	Least Concern	NA
2.	Bigmouth Stream Goby	<i>Pseudogobiopsis oligactis</i>	Least Concern	NA
3.	Blackspot Longtom	<i>Strongylura strongylura</i>	Least Concern	NA
4.	Blue Panchax	<i>Aplocheilichthys panchax</i>	Least Concern	NA
5.	Bullseye Snakehead	<i>Channa marulius</i>	Least Concern	NA
6.	Catla	<i>Labeo catla</i>	Least Concern	NA
7.	Commerson's Glassy	<i>Ambassis ambassis</i>	Least Concern	NA
8.	Common Spiny Loach	<i>Lepidocephalichthys thermalis</i>	Least Concern	NA
9.	Congaturi Halfbeak	<i>Hyporhamphus limbatus</i>	Least Concern	NA
10.	Curmuca Barb	<i>Hypsibarbus curmuca</i>	Endangered	NA
11.	Deccan Mahseer	<i>Tor khudree</i>	Least Concern	NA
12.	Dotted Loach	<i>Schistura semiarmata</i>	Least Concern	NA
13.	Dotted Sawfin Barb	<i>Pethia punctata</i>	Least Concern	NA
14.	Dwarf panchax	<i>Aplocheilichthys parvus</i>	Least Concern	NA
15.	Dwarf Snakehead	<i>Channa gachua</i>	Least Concern	NA
16.	Eastern Mosquitofish	<i>Gambusia holbrooki</i>	Least Concern	NA
17.	Ember Barb	<i>Haludaria fasciata</i>	Least Concern	NA
18.	Filament Barb	<i>Dawkinsia filamentosa</i>	Least Concern	NA
19.	Freshwater Catfish	<i>Tandanus tandanus</i>	Least Concern	NA
20.	Giant Danio	<i>Devario aequipinnatus</i>	Least Concern	NA
21.	Giant Gourami	<i>Osphronemus goramy</i>	Least Concern	NA
22.	Green Panchax	<i>Aplocheilichthys blockii</i>	Least Concern	NA
23.	Greenstripe Barb	<i>Bhava vittata</i>	Least Concern	NA
24.	Guppy	<i>Poecilia reticulata</i>	Least Concern	NA
25.	Indigo Barb	<i>Pethia setnai</i>	Vulnerable	NA
26.	Indo-Pacific Tarpon	<i>Megalops cyprinoides</i>	Data Deficient	NA
27.	Jerdon's Baril	<i>Opsarius canarensis</i>	Endangered	NA
28.	Jerdon's Mystus	<i>Mystus malabaricus</i>	Near Threatened	NA
29.	Kerala Mystus	<i>Mystus armatus</i>	Least Concern	NA
30.	Khavli Barb	<i>Waikhomia sahyadriensis</i>	NA	NA
31.	Mahecola Barb	<i>Puntius mahecola</i>	NA	NA
32.	Malabar Baril	<i>Opsarius gatensis</i>	Least Concern	NA
33.	Malabar Danio	<i>Devario malabaricus</i>	Least Concern	NA
34.	Malabar Mahseer	<i>Tor malabaricus</i>	Endangered	NA
35.	Malabar Silurus	<i>Pterocryptis wynadensis</i>	Endangered	NA
36.	Mozambique Tilapia	<i>Oreochromis mossambicus</i>	Vulnerable	NA
37.	Mullya Garra	<i>Garra mullya</i>	Least Concern	NA
38.	Nash's Barb	<i>Osteochilichthys nashii</i>	Least Concern	NA
39.	Nile Tilapia	<i>Oreochromis niloticus</i>	Least Concern	NA
40.	Olive Barb	<i>Systemus sarana</i>	Least Concern	NA
41.	Pangas catfish	<i>Pangasius pangasius</i>	Least Concern	NA
42.	Pleurophthalma Snakehead	<i>Channa pseudomarluius</i>	Least Concern	NA
43.	Redside Barb	<i>Plesiopuntius bimaculatus</i>	Endangered	NA

SN	Common Name	Scientific Name	IUCN v2025-2	WPAA 2023
44.	Rohu	<i>Labeo rohita</i>	Least Concern	NA
45.	Rosy Barb	<i>Pethia conchonius</i>	Least Concern	NA
46.	Sharptooth Catfish	<i>Clarias gariepinus</i>	Least Concern	NA
47.	Silver Arowana	<i>Osteoglossum bicirrhosum</i>	Least Concern	NA
48.	Slender Rasbora	<i>Rasbora daniconius</i>	Least Concern	NA
49.	Spiketail Gourami	<i>Pseudosphromenus cupanus</i>	Least Concern	NA
50.	Spotted Snakehead	<i>Channa punctata</i>	Least Concern	NA
51.	Striped Panchax	<i>Aplocheilichthys lineatus</i>	Least Concern	NA
52.	Striped Rasbora	<i>Rasbora dandia</i>	Least Concern	NA
53.	Tank Goby	<i>Glossogobius giurus</i>	Least Concern	NA
54.	Three Spot Gourami	<i>Trichopodus trichopterus</i>	NA	NA
55.	Thutinjeth Stone Loach	<i>Nemacheilus stigmofasciatus</i>	Data Deficient	NA
56.	Wayanad Mahseer	<i>Neolissochilus wynaadensis</i>	Critically Endangered	NA
57.	Western Ghats Glassy Perchlet	<i>Parambassis thomassi</i>	Least Concern	NA
58.	Western Ghats Loach	<i>Bhavana australis</i>	Least Concern	NA
59.	Zebra Danio	<i>Danio rerio</i>	Least Concern	NA
60.	Zebra Loach	<i>Botia striata</i>	Endangered	NA
61.	Zodiac Loach	<i>Mesonoemacheilus triangularis</i>	Data Deficient	NA
62.	-	<i>Betadevario ramachandrani</i>	Data Deficient	NA
63.	-	<i>Channa rara</i>	Least Concern	NA
64.	-	<i>Dario urops</i>	Vulnerable	NA
65.	-	<i>Glyptothorax kudremukhensis</i>	Least Concern	NA
66.	-	<i>Hemibagrus maydelli</i>	Least Concern	NA
67.	-	<i>Hypselobarbus kurali</i>	Least Concern	NA
68.	-	<i>Nemacheilus anguilla</i>	Least Concern	NA
69.	-	<i>Pangio ammophila</i>	Least Concern	NA
70.	-	<i>Paracanthocobitis mooreh</i>	Data Deficient	NA
71.	-	<i>Pseudolaguvia lapillicola</i>	Data Deficient	NA
72.	-	<i>Schistura denisoni</i>	Endangered	NA

Source: Literature review.

G. Legally Protected Areas

389. The GIS analysis indicates that 14 road stretches (Table IV-23) are located within legally protected areas and 86 roads fall within the eco-sensitive zones of legally protected areas. The legally protected areas are legally designated under the Wild Life (Protection) Act, 1972 for biodiversity conservation and are critical for the protection of wildlife and ecological processes. Eco-sensitive zones, on the other hand, act as buffers to the legally protected areas to ensure that potentially detrimental activities or projects are not located adjoining the protected areas. The MOEF&CC notifies ESZs around legally protected areas through gazetted notifications published on the MOEF&CC ESZ portal. Activities inside ESZs are categorized into three classes: prohibited, regulated, and permitted.

390. Karnataka has an extensive network of protected areas, including national parks and wildlife sanctuaries, many of which fall within the influence zone of the project roads.

1. Chincholi Wildlife Sanctuary

391. Chincholi Wildlife Sanctuary is located in Kalaburagi district in northeastern Karnataka. The sanctuary consists predominantly of dry deciduous and scrub forest types interspersed with grassland patches. The flora includes species such as Acacia, Ziziphus, and hardy grasses adapted to semi-arid conditions. The faunal assemblage includes Blackbuck, Indian Wolf, Hyena, and various bird species. The sanctuary faces pressures from grazing, habitat degradation, and increasing human activity in surrounding areas.

2. Yedahalli Chinkara Wildlife Sanctuary

392. Yedahalli Chinkara Wildlife Sanctuary is located in Bilagi and Mudhol taluks of Bagalkot district, Karnataka, covering an approximate area of 96.37 sq. km. The sanctuary is characterized by a mosaic of scrub forests, grasslands, and rocky outcrops, representing typical dryland ecosystems of northern Karnataka. The vegetation is dominated by species such as Acacia, Albizia amara, Anogeissus latifolia, Chloroxylon swietenia, and Azadirachta indica, along with scattered patches of grasses.

393. The sanctuary supports a variety of fauna including Chinkara [*Gazella bennettii*; LC (IUCN v.2025-2)], Indian Wolf [*Canis lupus*; LC (IUCN v.2025-2)], Striped Hyena [*Hyaena hyaena*; NT (IUCN v.2025-2)], Jungle Cat [*Felis chaus*; LC (IUCN v.2025-2)], Sloth Bear [*Melursus ursinus*; VU (IUCN v.2025-2)], and several bird species, with over 170 avifaunal species reported. It also hosts reptiles such as cobras, skinks, and lizards, contributing to its ecological diversity. The area faces pressures from grazing, habitat degradation, and anthropogenic disturbances, necessitating its designation as an Eco-Sensitive Zone with regulated developmental activities.⁵⁷

3. Bhimgad Wildlife Sanctuary (IBA and KBA)

394. Bhimgad Wildlife Sanctuary lies in Belagavi district in the Western Ghats region. It comprises tropical evergreen and semi-evergreen forests with rich floral diversity including Dipterocarpus, Vateria, and Myristica species. The sanctuary supports fauna such as Tiger [*Panthera tigris*; EN (IUCN v.2025-2)], Leopard [*Panthera pardus*; VU (IUCN v.2025-2)], Elephant [*Elephas maximus*; EN (IUCN v.2025-2)], and several endemic amphibians. Threats include encroachment and disturbances due to nearby human settlements.

4. Ghataprabha Wildlife Sanctuary

395. Ghataprabha Wildlife Sanctuary is located in the Belagavi district of Karnataka (Gokak and Hukkeri taluks) and covers an area of about 29.88 sq. km, consisting mainly of a stretch of the Ghataprabha River. The sanctuary is characterized by a unique riverine ecosystem with more than 22 islands, formed partly due to a weir and dam constructed near Dhupadal in 1883, creating a reservoir and wetland habitat.

396. The vegetation on the islands includes species such as Acacia arabica, Pithecellobium dulce and Bambusa, providing important nesting habitats for birds. It is primarily a bird sanctuary supporting rich avifauna, including species such as little cormorant, egrets, herons, ibis and

⁵⁸ <https://moef.gov.in/uploads/2021/02/yadahili-chinkara.pdf>

storks, along with migratory birds like the Demoiselle Crane [*Anthropoides virgo*; LC (IUCN v.2025-2)] and White Stork [*Ciconia ciconia*; LC (IUCN v.2025-2)] (Nov–Mar). The sanctuary is also associated with landmarks such as the Gokak Falls and attracts tourists, bird watchers and educational visits due to its ecological and scenic importance.

397. To ensure conservation, an Eco-Sensitive Zone of about 22.66 sq. km extending ~300 m around the sanctuary boundary has been notified to regulate anthropogenic activities.⁵⁸

5. Dandeli-Anshi Tiger Reserve (IBA and KBA)

398. Dandeli–Anshi Tiger Reserve is located in Uttara Kannada district of Karnataka, covering parts of Haliyal, Joida, and Karwar taluks, and comprises Dandeli Wildlife Sanctuary and Anshi National Park forming a contiguous protected landscape in the Western Ghats. The reserve has a total notified core area of approximately 814.88 sq. km and forms part of a larger landscape of about 8,800 sq. km of interconnected forests extending into Goa and Maharashtra.

399. The vegetation is dominated by tropical evergreen and semi-evergreen forests along with moist deciduous formations, supporting a rich assemblage of flora including medicinal plants, orchids, and diverse forest vegetation typical of the Western Ghats. The faunal diversity includes key species such as Tiger, Leopard, Dhole [*Cuon alpinus*; EN (IUCN v.2025-2)], Elephant, Gaur [*Bos gaurus*; VU (IUCN v.2025-2)], Sloth Bear, Sambar [*Rusa unicolor*; LC (IUCN v.2025-2)], and Bonnet Macaque [*Macaca radiata*; VU (IUCN v.2025-2)], along with arboreal species and small mammals. The reserve also supports over 270 bird species, including endemic hornbills and significant butterfly diversity, reflecting its high ecological value.

400. Important ecological concerns include habitat disturbance from human settlements, infrastructure development, and regulated activities such as tourism and road expansion within the Eco-Sensitive Zone, necessitating strict management and conservation measures.⁵⁹

6. Kappathagudda Wildlife Sanctuary

401. Kappathagudda Wildlife Sanctuary is located in Gadag district of Karnataka, covering parts of Gadag, Mundargi, Shirhatti, and Laxmeshwar taluks, with an area of approximately 244.15 sq. km. The sanctuary is characterized by dry scrub forests and grassland ecosystems, forming a unique landscape often referred to as the “Western Ghats of North Karnataka.” The flora includes a wide range of medicinal and native plant species such as Acacia, Cassia, Albizia, and other dryland vegetation adapted to semi-arid conditions.

402. The faunal diversity comprises species such as Leopard, Striped Hyena, Indian Wolf, Four-Horned Antelope [*Tetracerus quadricornis*; VU (IUCN v.2025-2)], Blackbuck [*Antelope cervicapra*; LC (IUCN v.2025-2)], Sloth Bear, and several bird species including Indian Peafowl and migratory birds.

403. The sanctuary also supports reptiles and aquatic species, reflecting its ecological heterogeneity and importance as a biodiversity hotspot in the Deccan plateau. However, the area

⁵⁹ <https://moef.gov.in/uploads/2017/06/Ghataprabha%20Bird%20Sanctuary%2C%20Karnataka.pdf>

⁶⁰

https://moef.gov.in/uploads/2017/06/Dandeli%20Wildlife%20Sanctuary%20and%20Anshi%20NP%2C%20Karnataka_0.pdf

faces threats from habitat degradation, climatic variability, and anthropogenic pressures, leading to ecological imbalance and the need for conservation through Eco-Sensitive Zone regulations.⁶⁰

7. Daroji Sloth Bear Sanctuary and Hampi and Daroji IBA

404. Daroji Bear Wildlife Sanctuary is located in Ballari district of Karnataka, covering parts of Hosapete and Sandur taluks, and spans approximately 82.72 sq. km. It is India's only sanctuary specifically established for the conservation of the threatened Indian Sloth Bear [*Melursus ursinus*; VU (IUCN v.2025-2)], with rocky boulders, caves, and scrub forests forming ideal habitats. The vegetation is dominated by dry scrub forests and regenerating woodland ecosystems, supporting diverse native plant species adapted to semi-arid conditions.

405. The sanctuary hosts a rich fauna including Sloth Bear, Leopard, Golden Jackal [*Canis aureus*; LC (IUCN v.2025-2)], Indian Pangolin [*Manis crassicaudata*; EN (IUCN v.2025-2)], Indian Crested Porcupine [*Hystrix indica*; LC (IUCN v.2025-2)], Black-Naped Hare [*Lepus nigricollis*; LC (IUCN v.2025-2)], along with around 150 bird species and several reptiles such as Indian Rock Python [*Python molurus*; NT (IUCN v.2025-2)], cobras, and tortoises. Due to effective conservation practices, previously degraded landscapes have been restored, leading to increased wildlife populations and improved ecosystem health. However, ecological threats such as habitat disturbance, human interference, and developmental pressures necessitate strict protection through the Eco-Sensitive Zone framework.⁶¹

8. Gudekote Wildlife Sanctuary

406. Gudekote Bear Wildlife Sanctuary is located across Kudligi (Vijayanagar), Sandur (Ballari), and Molakalmuru (Chitradurga) taluks of Karnataka, covering about 167.66 sq. km. The sanctuary is characterized by rocky hills, caves, thorny scrub, and dry deciduous forests, providing ideal habitat for sloth bears and other wildlife. It supports a healthy population of around 50–60 Indian sloth bears along with species like Leopard, Golden jackal, Indian pangolin, Small Indian Civet [*Viverricula indica*; NT (IUCN v.2025-2)], Wild Boar [*Sus crofa*; LC (IUCN v.2025-2)], and Black-naped Hare. The area is also rich in biodiversity with over 140 bird species and several reptiles including cobras, Indian Rock Python, and Russell's Viper [*Daboia russelii*; LC (IUCN v.2025-2)]. Vegetation includes dryland species and fruit-bearing trees such as jamun, ber, amla, and custard apple, supporting wildlife survival.

407. Due to its ecological significance and habitat connectivity, an Eco-Sensitive Zone (ESZ) of about 234.54 sq. km has been proposed to regulate development and conserve biodiversity.⁶²

9. Ranebennur Wildlife Sanctuary (IBA and KBA)

408. Ranebennur Wildlife Sanctuary is located in Haveri district of Karnataka, spreading across Ranebennur and Byadgi taluks, and covers an area of approximately 119 sq. km. The sanctuary represents a typical dry habitat comprising scrub forests, grasslands, and plantation areas, particularly suited for grassland-dependent fauna. The vegetation mainly consists of species such as Acacia, Prosopis, Neem, Ziziphus, and other dry deciduous and thorny scrub flora.

409. It is an important habitat for Blackbuck (flagship species) and Indian grey wolf, along with other fauna such as Golden jackal, Indian fox [*Vulpes bengalensis*; LC (v.2025-2)], Wild boar,

⁶¹ https://moef.gov.in/uploads/pdf/kappathaguda_draft.pdf

⁶² <https://moef.gov.in/uploads/2018/12/daroji.pdf>

⁶³ [https://moef.gov.in/uploads/2023/11/SO4747\(E\)-gudekote-final.pdf](https://moef.gov.in/uploads/2023/11/SO4747(E)-gudekote-final.pdf)

Indian Grey Mongoose [*Urva edwardsii*; LC (v.2025-2)], and Indian Crested Porcupine. The sanctuary also supports a variety of avifauna including Indian Peafowl, sandgrouse, partridges, and historically the Great Indian Bustard [*Ardeotis nigriceps*; CR v.2025-2)].

410. However, the ecosystem faces pressures from habitat fragmentation, invasive species, grazing, and anthropogenic activities, necessitating conservation through regulated management under the Eco-Sensitive Zone framework⁶³.

10. Rangayyanadurga Four-Horned Antelope Wildlife Sanctuary

411. Rangayyanadurga Four-Horned Antelope Wildlife Sanctuary is located in Jagalur taluk of Davanagere district in Karnataka, covering an area of about 77.24 sq. km in the dry plains of the state. The sanctuary consists of Southern tropical dry mixed deciduous and thorn scrub forests, characterized by rocky hills, scrub vegetation, and seasonal water bodies. The flora includes species such as *Albizia*, *Anogeissus*, *Azadirachta*, *Cassia*, *Acacia* spp., and drought-resistant shrubs like *Prosopis*. It is a key habitat for the threatened Four-horned Antelope [*Tetracerus quadricornis*; VU (IUCN v2025-2)], along with other fauna such as Leopard, Sloth Bear, Striped Hyena, Jackal, Wild Boar, Indian Pangolin, and several reptiles and bird species.

412. The sanctuary also supports diverse avifauna including peafowl, partridges, vultures, and raptors, along with significant reptilian diversity such as cobras, vipers, and kraits. The area faces ecological pressures from habitat degradation, fragmentation, and anthropogenic activities, necessitating protection through a designated Eco-Sensitive Zone extending 0.95–4.5 km around the sanctuary.⁶⁴

11. Bukkapatna Chinkara Wildlife Sanctuary

413. Bukkapatna Chinkara Wildlife Sanctuary is located in Sira taluk of Tumakuru district in Karnataka, at about 13°39' N latitude and 76°45' E longitude, covering an area of nearly 148 sq. km. It was established in 2019 specifically for the conservation of the Chinkara (Indian Gazelle) and represents the second chinkara sanctuary in Karnataka after Yadahalli.

414. The sanctuary is characterized by wooded savannah ecosystems, including dry deciduous forests, grasslands, scrublands, and rocky hillocks, which provide ideal grazing habitat for antelope species.

415. Its vegetation mainly includes species such as *Hardwickia* (Anjan), *Phyllanthus* (Amla), *Boswellia*, *Tamarindus*, *Pterocarpus*, *Anogeissus*, and *Terminalia*.

416. The sanctuary is best known for its flagship species like Chinkara, along with other antelopes like blackbuck and four-horned antelope. It also supports diverse fauna including Leopard, Sloth bear, Dhole, Spotted deer [*Axis axis*; LC (v.2025-2)], reptiles, amphibians, and over 150 bird species, indicating rich biodiversity.

⁶⁴ <https://moef.gov.in/uploads/2017/06/Ranebennur%20Blackbuck%20Sanctuary%2C%20Karnataka.pdf>

⁶⁵ <https://moef.gov.in/uploads/2017/06/Rangayyanadurga%20Four%20Horned%20Antelope%20Wildlife%20Sanctuary%2C%20Karnataka.pdf>

417. However, the ecosystem faces threats from poaching, habitat loss, mining, encroachment, and human pressures, which led to its declaration as a protected sanctuary to ensure conservation of dryland biodiversity.

12. Shettihalli Wildlife Sanctuary (IBA and KBA)

418. Shettihalli Wildlife Sanctuary is located in the Shivamogga (Shimoga) district of Karnataka, and was notified in 1974 as a protected area. It covers an area of around 395–396 sq. km and forms part of the central Western Ghats biodiversity region.

419. The sanctuary is characterized by a mix of dry deciduous, moist deciduous, and semi-evergreen forests, with increasing rainfall leading to denser vegetation towards the western side. Dominant plant species include *Terminalia*, *Tectona grandis* (teak), *Anogeissus latifolia*, *Cassia fistula*, *Emblica officinalis*, and bamboo, indicating diverse forest composition. Studies show the presence of over 250 plant species, including several endemic to the Western Ghats. The sanctuary hosts rich biodiversity, with major mammals such as Tiger, Leopard, Asiatic elephant, Gaur, Sloth bear, Dhole, Sambar, Chital, and Wild boar. It is also home to reptiles like King cobra, Indian rock python, Indian rat snake, and Marsh crocodile, and birds such as hornbills, kingfishers, woodpeckers, peafowl, and vultures, making it an important bird and biodiversity area (IBA/KBA).

420. Key ecological features include the Tunga Anicut Dam and Mandagadde Bird Sanctuary, which provide habitats for otters and water birds. However, the sanctuary faces pressures from encroachment, habitat degradation, and human settlements, partly due to historical displacement and development activities.

13. Bhadra Wildlife Sanctuary (IBA and KBA)

421. Bhadra Wildlife Sanctuary is located in Chikkamagaluru and Shivamogga districts of Karnataka, spanning Chikkamagaluru, Tarikere, N.R. Pura, Shivamogga and Bhadravathi taluks between about 13°22'–13°47' N and 75°29'–75°45' E. It covers an area of about 500.16 sq. km, including around 87 sq. km of Bhadra reservoir backwaters, and is contiguous with Shettihalli Wildlife Sanctuary. The sanctuary was declared a Tiger Reserve in 2007, making it an important part of India's tiger conservation network. The habitat is highly diverse, consisting of dry deciduous, moist deciduous, semi-evergreen forests, and shola-grassland ecosystems (especially in Kemmanagundi region).

422. Important rivers and streams like Somahini and Tada-behalla flow through the area and join the Bhadra River, forming a crucial watershed system. The sanctuary supports rich biodiversity with around 42 species of mammals, including Tiger, Leopard, Dhole, Sloth bear, Asiatic Elephant, Gaur, Sambar, Mouse Deer [*Moschiola indica*; LC (v.2025-2)], and flying squirrel. It also hosts about 264 species of birds, such as Malabar pied hornbill, great pied hornbill, and Malabar grey hornbill (endemic to Western Ghats) along with reptiles like king cobra and marsh crocodile.

423. Because of its ecological importance, an Eco-Sensitive Zone (ESZ) extending 2 km to 8 km around the sanctuary has been notified, covering about 740.76 sq. km and including 57 villages, to regulate developmental activities.

424. However, the ecosystem faces pressures from mining, deforestation, encroachment, tourism expansion, and pollution, which are strictly regulated or prohibited within the ESZ to ensure long-term conservation.⁶⁵

14. Sharavathi Valley Wildlife Sanctuary (IBA and KBA)

425. Sharavathi Valley Wildlife Sanctuary is located in the Uttara Kannada and Shivamogga districts of Karnataka in the Western Ghats, covering an area of about 930.16 sq. km. The sanctuary is characterized by tropical evergreen and semi-evergreen forests with patches of grasslands, along with rugged terrain and perennial streams. The flora is highly diverse and includes species such as *Artocarpus hirsutus*, *Cinnamomum*, *Syzygium*, *Hopea*, and several endemic and rare plants of the Western Ghats.

426. It is an important habitat for the endangered Lion-Tailed Macaque [*Macaca Silenus*; LC (v.2025-2)], along with other fauna such as Leopard, Dhole, Gaur, Indian pangolin, Malabar giant squirrel [*Ratufa indica*; LC (v.2025-2)], and a wide range of birds, reptiles, and amphibians.

427. The sanctuary supports high biodiversity with several endemic and threatened species, making it ecologically significant within the Western Ghats. However, pressures such as habitat disturbance, developmental activities, and human interference necessitate strict regulation through an Eco-Sensitive Zone extending up to about 5.25 km around the sanctuary.⁶⁶

15. Mookambika Wildlife Sanctuary (IBA and KBA)

428. Mookambika Wildlife Sanctuary is located in Kundapur taluk of Udupi district in Karnataka, situated in the Western Ghats, and covers an area of about 394.65 sq. km. The sanctuary is characterized by hilly and undulating terrain with heavy rainfall, and includes moist deciduous, semi-evergreen, tropical evergreen forests, and shola grasslands across different elevations. The vegetation comprises rich Western Ghats flora such as *Calophyllum*, *Cinnamomum*, *Hopea*, *Artocarpus*, and other endemic species adapted to high rainfall conditions.

429. It supports diverse fauna including Tiger, Leopard, Elephant, Gaur, Sloth bear, Wild dog, and endangered primates like the Lion-tailed macaque, along with Malabar giant squirrel and civet species. The sanctuary is also rich in biodiversity with numerous birds such as hornbills and Malabar species, along with reptiles like king cobra and python. However, due to its ecological sensitivity and biodiversity importance, pressures from human activities are regulated through an Eco-Sensitive Zone extending up to about 10.8 km around the sanctuary⁶⁷.

16. Someshwara Wildlife Sanctuary (IBA and KBA)

430. Someshwara Wildlife Sanctuary is located in the Udupi (Karkala, Kundapur) and Shivamogga (Tirthahalli) districts of Karnataka in the Western Ghats, covering an area of about 314.25 sq. km. The sanctuary experiences very high rainfall (6000–8000 mm) and comprises tropical evergreen, semi-evergreen, and moist deciduous forests across hilly terrain and foothills.

431. The flora is rich and includes Western Ghats species such as *Calophyllum*, *Cinnamomum*, *Hopea*, *Garcinia*, and several endemic plants. It supports diverse fauna including Tiger, Leopard,

⁶⁶ <https://moef.gov.in/uploads/2019/10/bhadra.pdf>

⁶⁷ [https://moef.gov.in/uploads/2023/11/SO4950\(E\)-sharavati-final.pdf](https://moef.gov.in/uploads/2023/11/SO4950(E)-sharavati-final.pdf)

⁶⁸ <https://moef.gov.in/uploads/2017/06/Mookambika%20Wildlife%20Sanctuary%2C%20Karnataka.pdf>

Asiatic elephant, Gaur, Sloth bear, Malabar Civet [*Viverra civettina*; CR (v.2025-2)], along with Malabar Giant Squirrel, Pangolin, and several endemic birds like hornbills. The sanctuary also has high biodiversity with reptiles like king cobra and numerous amphibians, and forms part of the UNESCO Western Ghats World Heritage Site.

432. Due to its ecological sensitivity, development is regulated through an Eco-Sensitive Zone extending up to about 7.8 km around the sanctuary.⁶⁸

17. Kudremukh National Park (IBA and KBA)

433. Kudremukh Wildlife Sanctuary, now designated as Kudremukh National Park, is located in the Chikkamagaluru district of Karnataka within the Western Ghats, covering an area of about 600.32 sq. km. The sanctuary is characterized by montane grasslands interspersed with tropical evergreen and semi-evergreen forests, forming a unique shola-grassland ecosystem. The vegetation is rich in endemic flora including *Strobilanthes*, *Syzygium*, and other Western Ghats species adapted to high rainfall conditions. It supports diverse fauna such as Tiger, Leopard, dhole, Asiatic Elephant, Gaur, and endangered species like the Lion-tailed macaque and Nilgiri marten [*Martes gwatkinsii*; VU (v.2025)], along with rich bird and amphibian diversity. The area is also an important watershed for rivers such as Tunga, Bhadra, and Netravathi, contributing to ecological stability.

434. However, threats such as past mining activities, habitat disturbance, and human pressures necessitate strict conservation measures within the protected area framework.⁶⁹

18. Pushpagiri Wildlife Sanctuary (IBA and KBA)

435. Pushpagiri Wildlife Sanctuary is located in the Kodagu district of Karnataka within the Western Ghats, covering an area of about 102.92 sq. km. The sanctuary is characterized by steep rugged terrain, high rainfall (6000–7000 mm), and predominantly evergreen forests interspersed with shola grasslands, representing a highly diverse ecosystem. The vegetation includes rich Western Ghats flora such as *Dipterocarpus indicus*, *Cinnamomum*, *Hopea*, *Mesua ferrea*, and *Garcinia* species, along with many endemic plant species.

436. It supports diverse fauna including Tiger, Leopard, Wild dog, Asian elephant, Gaur, Sambar, and smaller species like Nilgiri Langur, Lion-Tailed Macaque, Slender loris [*Loris lydekkerianus*; LC (v.2025-2)], and Nilgiri marten. The sanctuary is also an important bird area of the Western Ghats, hosting many endemic bird species along with reptiles such as king cobra and python. Due to its ecological significance, an Eco-Sensitive Zone extending from 1 to 10 km around the sanctuary has been notified to regulate developmental activities and conserve biodiversity.⁷⁰

19. Talacauvery Wildlife Sanctuary (IBA and KBA)

437. Talacauvery Wildlife Sanctuary is located in the Kodagu district of Karnataka in the Western Ghats, covering an area of about 105 sq. km. The sanctuary is characterized by steep rugged terrain with high rainfall (6000–7000 mm) and comprises predominantly tropical evergreen forests with high endemism. The vegetation includes rich Western Ghats flora, supporting a highly

⁶⁹ <https://moef.gov.in/uploads/2019/02/someshwara.pdf>

⁷⁰ <https://moef.gov.in/uploads/2019/10/kudermukh.pdf>

⁷¹ <https://moef.gov.in/uploads/2017/06/Pushpagiri%20Wildlife%20Sanctuary%2C%20Karnataka.pdf>

diverse ecosystem with numerous endemic plant species. It provides habitat for diverse fauna including Tiger, Asiatic elephant, Gaur, Sambar, and endangered species like Lion-tailed macaque, Nilgiri marten, and Malabar civet, along with reptiles such as King cobra and Indian rock python.

438. The sanctuary is also an important bird area of the Western Ghats, hosting several endemic bird species and maintaining high biodiversity. However, due to its ecological significance as the origin catchment of the Cauvery River, conservation is ensured through an Eco-Sensitive Zone extending 1–16 km around the sanctuary⁷¹.

20. Melkote Temple Wildlife Sanctuary (IBA and KBA)

439. Melkote Temple Wildlife Sanctuary is located in the Mandya district of Karnataka, surrounding the historic Melkote temple region, and covers an area of about 45.82 sq. km. The sanctuary is characterized by rocky hillocks, scrub forests, and grasslands, representing a typical dry deciduous ecosystem of the Deccan plateau. The vegetation mainly comprises species such as Acacia, Albizia, Ficus, and other drought-resistant shrubs and grasses adapted to semi-arid conditions. It is an important habitat for fauna such as Indian grey wolf (flagship species), Leopard, Sloth Bear, Hyena, Golden jackal, and Wild boar, along with several small mammals. The sanctuary also supports diverse avifauna including peafowl, partridges, quails, and raptors, besides reptiles like cobra and monitor lizard.

440. However, due to pressures from grazing, habitat degradation, and human activities, conservation is ensured through regulatory measures within its designated protected area framework.

21. Ramadevarabetta Vulture Wildlife Sanctuary (IBA and KBA)

441. Ramadevarabetta Vulture Wildlife Sanctuary is located in the Ramanagara district of Karnataka, covering an area of about 346.42 hectares (≈3.46 sq. km). The sanctuary is characterized by dry deciduous forests, rocky hill terrain, and scrub vegetation, with the Arkavathi River flowing through it, forming part of the Cauvery basin. The vegetation includes dry forest species such as *Wrightia tinctoria* and other hardy plants adapted to semi-arid conditions.

442. It is critically important for fauna, especially as a breeding site for threatened White-rumped vulture and long-billed vulture, along with mammals like Leopard, Sloth bear, Hyena, Golden jackal, Wild dog, and Chital. The sanctuary is also part of the Mysore Elephant Reserve and supports significant populations of peafowl and other dry-zone fauna. Due to its ecological importance in vulture conservation, an Eco-Sensitive Zone extending about 130 m to 1.8 km around the sanctuary has been notified to regulate development.⁷²

22. Brahmagiri Wildlife Sanctuary (IBA and KBA)

443. Brahmagiri Wildlife Sanctuary is located in the Kodagu (Coorg) district of Karnataka, covering an area of about 181.29 sq. km and established in 1974. The sanctuary lies in the Western Ghats and is characterized by rugged terrain, high rainfall (2500–6000 mm), evergreen and semi-evergreen forests interspersed with shola grasslands.

⁷² <https://moef.gov.in/uploads/2017/06/talacauvery%20wildlife%20sanctuary%2C%20Karnataka.pdf>

⁷³ <https://moef.gov.in/uploads/2017/06/Ramadevarabetta%20Vulture%20Sanctuary%2C%20Karnataka%20Final.pdf>

444. The vegetation is highly diverse with species such as *Dipterocarpus indicus*, *Dalbergia latifolia*, *Mesua ferrea*, and *Cinnamomum zeylanicum*, supporting rich biodiversity and high endemism.

445. The sanctuary provides habitat for important fauna including Tiger, Leopard, Wild dog, Asiatic elephant, Gaur, Sambar, Lion-tailed macaque, and notable birds like hornbills. It also forms a crucial corridor connecting Nagarahole NP, Talacauvery WLS (Karnataka) and Wayanad & Aralam WLS (Kerala), and is part of the Mysore Elephant Reserve. To ensure conservation, an Eco-Sensitive Zone extending about 1 to 15 km around the sanctuary has been notified to regulate developmental activities⁷³.

23. Nagarahole National Park (IBA and KBA)

446. Nagarahole National Park is located in the Mysore and Kodagu districts of Karnataka, between 11°50'–12°25' N and 75°56'–76°18' E. It was first declared a Wildlife Sanctuary in 1955, later upgraded to a National Park in 1983 (643.39 sq. km), and is now part of the Nagarahole Tiger Reserve (~847.41 sq. km) under Project Tiger. The park lies within the Nilgiri Biosphere Reserve and is connected with Bandipur Tiger Reserve, Wayanad Wildlife Sanctuary, and Brahmagiri WLS, forming a major wildlife corridor for tigers and elephants.

447. The vegetation includes tropical semi-evergreen, moist deciduous, and dry deciduous forests with species such as teak, sandalwood, *Terminalia*, *Shorea*, and *Acacia*. The terrain ranges from 700–960 m elevation with 1000–1500 mm rainfall, and features grasslands called 'hadlus' that support herbivores. The fauna includes: Tiger, Asiatic elephant, Leopard, Gaur, Chital, Sambar, Wild boar with 330+ species of birds.

448. It is also a catchment for the Cauvery, Kabini and Lakshmanathirtha rivers and supports tribal communities like Jenu Kuruba, Betta Kuruba, and Yerava. An Eco-Sensitive Zone (~568.88 sq. km, 1–7.44 km wide) surrounds the park to regulate activities and ensure conservation⁷⁴.

24. Bandipur National Park (IBA and KBA)

449. Bandipur National Park is located in Karnataka (Mysore and Chamarajanagar districts) between 11°35'–11°55' N latitude and 76°12'–76°51' E longitude. It was declared a National Park in 1974 and later expanded to about 870.36 sq. km in 2001 and today forms part of the Bandipur Tiger Reserve (~912.04 sq. km including buffer areas) under Project Tiger. The park is situated within the Nilgiri Biosphere Reserve and is ecologically connected with Nagarahole National Park, Wayanad Wildlife Sanctuary and Mudumalai National Park, forming one of the largest continuous wildlife habitats in India and serving as a crucial corridor for the movement of large mammals.

450. The natural vegetation shows a gradient from dry scrub forests in the eastern region to dry deciduous forests in the central part and moist deciduous forests in the western region, reflecting variation in rainfall and topography. The forests are rich in species such as teak, sandalwood, *Terminalia*, *Acacia* and *Shorea*, with dense undergrowth in many areas. Bandipur also forms part of the catchment of important rivers such as Kabini, Moyar and Nugu, while the Kabini reservoir provides aquatic habitats that support fish, birds and other wildlife.

⁷⁴ <https://moef.gov.in/uploads/2017/06/Brahmagiri%20Wildlife%20Sanctuary%2C%20Karnataka.pdf>

⁷⁵ <https://moef.gov.in/uploads/2017/06/Nagarahole%20Tiger%20Reserve%2C%20Karnataka.pdf>

451. The park supports a very high faunal diversity, including a dense population of Tigers and Asian elephants, along with large herbivores such as Chital, Sambar, Gaur and Wild boar, and more than 250 species of birds. It is also recognized internationally as one of the major tiger landscapes and forms an important elephant corridor (Kaniyanpura corridor) connecting adjoining reserves.

452. An Eco-Sensitive Zone of about 479.18 sq. km (extending up to 7.78 km from the park boundary) surrounds the park to regulate activities such as mining, industries and large-scale tourism in order to protect the fragile ecosystem and maintain ecological balance.

25. Nugu Wildlife Sanctuary (IBA and KBA).

453. Nugu Wildlife Sanctuary is located in Karnataka (Mysuru district, H.D. Kote and Nanjanagud taluks) and forms part of the Nilgiri Biosphere Reserve. The sanctuary covers an area of about 30.32 sq. km, making it a relatively small but ecologically significant protected area within the larger Bandipur–Nagarahole landscape.

454. The sanctuary is closely associated with Bandipur Tiger Reserve and lies within the same continuous forest ecosystem, contributing to landscape-level connectivity for wildlife movement. It supports a high density of Asian elephants, including a notable proportion of adult tuskers, highlighting its importance for elephant conservation. Nugu Wildlife Sanctuary also harbours diverse fauna such as Tiger, Leopard, Dhole, Striped hyena, Sloth bear, Gaur, Sambar, Chital and Four-horned antelope, along with riverine species like the smooth-coated otter and marsh crocodile, indicating a rich and varied wildlife assemblage.

455. The sanctuary is influenced by nearby forest ecosystems and river systems, forming part of the broader Kabini basin landscape, which supports aquatic biodiversity and enhances habitat diversity across the region.

456. To ensure conservation, an Eco-Sensitive Zone extending from 0.32 km to 7.80 km (covering ~28.38 sq. km and 13 villages) has been declared around the sanctuary to regulate developmental activities and protect its fragile ecosystem.

26. Arabithittu Wildlife Sanctuary (IBA and KBA)

457. Arabithittu Wildlife Sanctuary is located in Karnataka (Hunsur taluk of Mysuru district) between 12°17'16"–12°20'41" N latitude and 76°22'43"–76°28'51" E longitude. It covers a relatively small area of about 13.5 sq. km, making it one of the smaller protected areas in the region. The sanctuary is situated close to the Mysuru-Hunsur landscape and is surrounded by several villages, which results in high anthropogenic pressure such as grazing on forest resources.

458. It also has proximity to areas used by the Defence Research and Development Organisation (DRDO), reflecting mixed land-use patterns in the surrounding region. The vegetation primarily consists of dry deciduous scrub forests, with important species such as sandalwood (*Santalum album*), *Anogeissus latifolia*, *Terminalia tomentosa*, *Acacia* and *Syzygium*, indicating a semi-arid ecosystem. Notably, sandalwood found here is considered an endangered species, adding conservation value to the sanctuary. Despite its small size, the sanctuary supports a range of fauna including Leopard, spotted deer, Wild boar, Indian porcupine, Indian hare, Indian grey mongoose, Indian fox and reptiles like cobra and viper, reflecting moderate biodiversity typical of scrub forests.

459. To protect the fragile ecosystem, an Eco-Sensitive Zone extending from 1 km to 3.25 km (total ~44.82 sq. km covering 20 villages) has been notified around the sanctuary, where activities such as mining, polluting industries and large-scale construction are regulated or prohibited⁷⁵.

27. Biligiri Rangaswamy Temple Wildlife Sanctuary (IBA and KBA)

460. Biligiri Rangaswamy Temple Wildlife Sanctuary is located in Chamarajanagar district of Karnataka, covering an area of about 574.82 sq. km, situated at the junction of the Western and Eastern Ghats. The sanctuary is characterized by diverse terrain with hills, valleys, and altitudinal variation, resulting in varied vegetation types including dry deciduous, moist deciduous, semi-evergreen forests, and shola grasslands.

461. The flora is highly diverse with species such as *Terminalia*, *Anogeissus*, *Tectona grandis*, *Albizia*, and several medicinal plants typical of transitional ecosystems. It supports rich fauna including Tiger, Leopard, Elephant, Gaur, Dhole, Sloth bear, Sambar, and endangered species like the grizzled giant squirrel and elephant populations forming important corridors.

462. The sanctuary acts as a crucial wildlife corridor connecting Brahmagiri, Nagarahole, Bandipur, and Sathyamangalam landscapes, ensuring genetic exchange of species. Due to its ecological importance, conservation is ensured through regulated management and its designation as a Tiger Reserve under Project Tiger⁷⁶.

28. Malaimahadeshwara Wildlife Sanctuary (KBA)

463. Malaimahadeshwara Wildlife Sanctuary is located in the Chamarajanagar district of Karnataka (Hanur taluk) and covers an area of about 906.19 sq. km, forming part of the Mysore Elephant Reserve. The sanctuary is characterized by savannah woodland forests and rugged terrain, with the Palar River flowing through it, and supports a mosaic of dry forests with rich biodiversity.

464. The vegetation includes species such as *Anogeissus latifolia*, *Terminalia*, *Pterocarpus marsupium*, *Santalum album* and other dry forest flora. It supports diverse fauna including Elephant (high density), Tiger (recently recorded), Leopard, Dhole, Sloth bear, Gaur, Sambar and Chital, along with otters and reptiles like marsh crocodile.

465. The sanctuary forms a crucial landscape connectivity zone linking BRT Tiger Reserve, Sathyamangalam Tiger Reserve and adjoining forests, creating a large contiguous habitat exceeding 3000 sq. km for wide-ranging species.

466. Due to its ecological sensitivity, an Eco-Sensitive Zone extending about 0.45 km to 4.20 km around the sanctuary has been notified, where infrastructure activities such as roads require careful regulation and environmental safeguards⁷⁷.

⁷⁶ <https://moef.gov.in/uploads/2017/06/Arabithittu%20Wildlife%20Sanctuary%2C%20Karnataka.pdf>

⁷⁷ <https://moef.gov.in/uploads/2019/10/billingirangana.pdf>

⁷⁸

<https://moef.gov.in/uploads/2017/06/Malai%20Mahadeshwara%20Wildlife%20Sanctuary%2C%20Karnataka%20Final.pdf>

29. Cauvery Wildlife Sanctuary (IBA and KBA)

467. Cauvery Wildlife Sanctuary is located in Karnataka (Ramanagara, Mandya and Chamarajanagar districts) and covers an area of about 1027.53 sq. km, lying between 11°56'–12°24' N latitude and 77°09'–77°46' E longitude. The sanctuary is dominated by southern tropical dry deciduous forests, forming an important habitat traditionally known as a prime tiger and prey landscape and also part of the Project Elephant - Mysore Elephant Reserve. The vegetation largely consists of dry deciduous and riverine forests, while the Cauvery River flows through the sanctuary, supporting rich aquatic and riparian ecosystems.

468. It supports diverse fauna including Tiger, Leopard, Dhole, Striped hyena, Sloth bear, Elephant, Gaur, Sambar, Chital and Four-horned antelope, along with aquatic species like smooth-coated otter, marsh crocodile and the endangered Deccan mahseer fish. The sanctuary is an important bird area (IBA) supporting over 280 bird species, including threatened vultures and endemic species of the Western Ghats region.

469. It forms a crucial landscape corridor connecting MM Hills, BRT Tiger Reserve and Bannerghatta National Park, enabling movement of large mammals across southern India. To protect its ecosystem, an Eco-Sensitive Zone of about 600.7 sq. km extending 1 km to 14.5 km around the sanctuary has been notified to regulate developmental activities⁷⁸.

30. Bannerghatta National Park (IBA and KBA)

470. Bannerghatta National Park is located in Karnataka (Bengaluru Urban and Ramanagara districts) and covers an area of about 260 sq. km, situated near Bengaluru city. The park is characterized by undulating terrain with dry deciduous forests, scrublands, and patches of moist deciduous vegetation, reflecting transitional ecological conditions. The vegetation mainly includes species such as Anogeissus, Terminalia, Acacia, Albizia, and other dry forest flora adapted to semi-arid conditions.

471. It supports diverse fauna including Asiatic elephant, Tiger, Leopard, Sloth bear, Gaur, Sambar, Spotted deer, and Wild boar, along with various bird and reptile species. The park is an important elephant corridor linking Cauvery Wildlife Sanctuary with adjacent forest areas, playing a key role in regional wildlife movement. Due to increasing urban pressure, conservation is ensured through regulated management and protected area status to maintain ecological balance⁷⁹.

31. Kamasandra Wildlife Sanctuary

472. Kamasandra Wildlife Sanctuary is located in Karnataka (Tumakuru district) and covers a small area of around 28 sq. km, forming part of the semi-arid Deccan plateau ecosystem. The sanctuary is characterized by undulating terrain with dry deciduous forests and scrub vegetation, typical of interior Karnataka landscapes.

473. The vegetation mainly includes species such as Acacia, Albizia, Terminalia, and other drought-resistant shrubs adapted to low rainfall conditions. It supports fauna including Blackbuck, Chinkara, Indian fox, Golden jackal, Wild boar, and various small mammals, along with common dry-zone bird species and reptiles.

⁷⁹ <https://moef.gov.in/uploads/2017/06/Cauvery%20Wildlife%20Sanctuary%20Karnataka%20Final.pdf>

⁸⁰ <https://moef.gov.in/uploads/2019/10/bannerghata.pdf>

474. Despite its relatively small size, the sanctuary plays a role in maintaining local biodiversity and supporting grassland-dependent species. However, pressures from grazing, habitat degradation, and nearby human activities highlight the need for continued conservation and regulated management.

32. Tungabhadra Reservoir IBA

475. Tungabhadra Reservoir is located in Karnataka and Andhra Pradesh, near Hosapete (Vijayanagara district) and has been designated as an Important Bird Area (IBA) due to its ecological significance. The reservoir is characterized by a large man-made lake with extensive wetlands, islands, and shallow water zones, providing ideal habitats for waterbirds and migratory species.

476. The surrounding vegetation includes aquatic plants, grasslands, and scrub vegetation, supporting both terrestrial and aquatic biodiversity. It supports rich avifauna including pelicans, storks, herons, cormorants, ibises, and migratory birds such as flamingos and ducks, making it one of the key bird habitats in peninsular India. The reservoir also supports fish diversity and acts as an important feeding and breeding ground for birds, enhancing its ecological importance. Due to increasing pressures such as water management, fishing, and human disturbances, conservation importance is recognized under the IBA network to ensure protection of its bird habitats.

477. A total of 14 roads fall within or traverse legally protected areas, 86 roads fall within or traverse ESZs, whereas 307 roads are within or traverse forest lands (Figure IV-29). A meeting with the Principal Chief Conservator of Forests (PCCF) and Head of Forest Force (HoFF), Karnataka Forest Department Dr. Meenakshi Negi (IFS), PCCF (Wildlife) and Chief Wildlife Warden Mr. Kumar Pushkar (IFS), PCCF (Forest Conservation) Mr. Mahesh Shirur (IFS), and CCF (Forest Conservation) Smt. Prachi Gangwar (IFS) was held on 14 July 2026 and was attended by KRRDA and ADB representatives to establish the views of the stakeholders and the protected area managers. During the meeting, the details of the proposed Project were presented to the Forest Department staff along with the outcome of additional activities such as CHA and BAP. A layer containing the roads proposed for improvement along with their widths/RoW has been shared with the Forest Department, and the ADB EIA team is working closely with the Forest Department to ascertain if any roads fall within the lands under the jurisdiction of the Forest Department, thereby attracting additional clearance or permits. Prima facie, it appears that only one road, 4817 in Belagavi district will require Forest Clearance for the diversion of 0.748 hectares of forest land. Other roads which are in forest lands, legally protected areas, and eco-sensitive zones, will require working permission or NOC from the forest department. The final list of such roads which will require the working permission or NOC is being determined by KRRDA in collaboration with the forest department during detailed mapping exercise. No works will be undertaken in such roads unless the required clearances, permissions, and documents have been received from the Karnataka Forest Department.

478. ADB SPS (2009) requires the fulfilment of the conditions bulleted below. The proposed works will be restricted to the ROW and deal only with the improvement of the roads. No widening or expansion is proposed. Roads within the legally protected areas will require Wildlife Clearance from the Standing Committee of the National Board for Wildlife. The Wildlife Clearance will be provided subjected to the fulfilment of the conditions. Additionally, the implementation of the EMP and the BAP will ensure that regulatory compliance is ensured. Further, KRRDA and Karnataka Forest Department are jointly investigating specific regulatory requirements for the road improvement on a case-by-case basis. This is to ensure that the opinions of the protected area

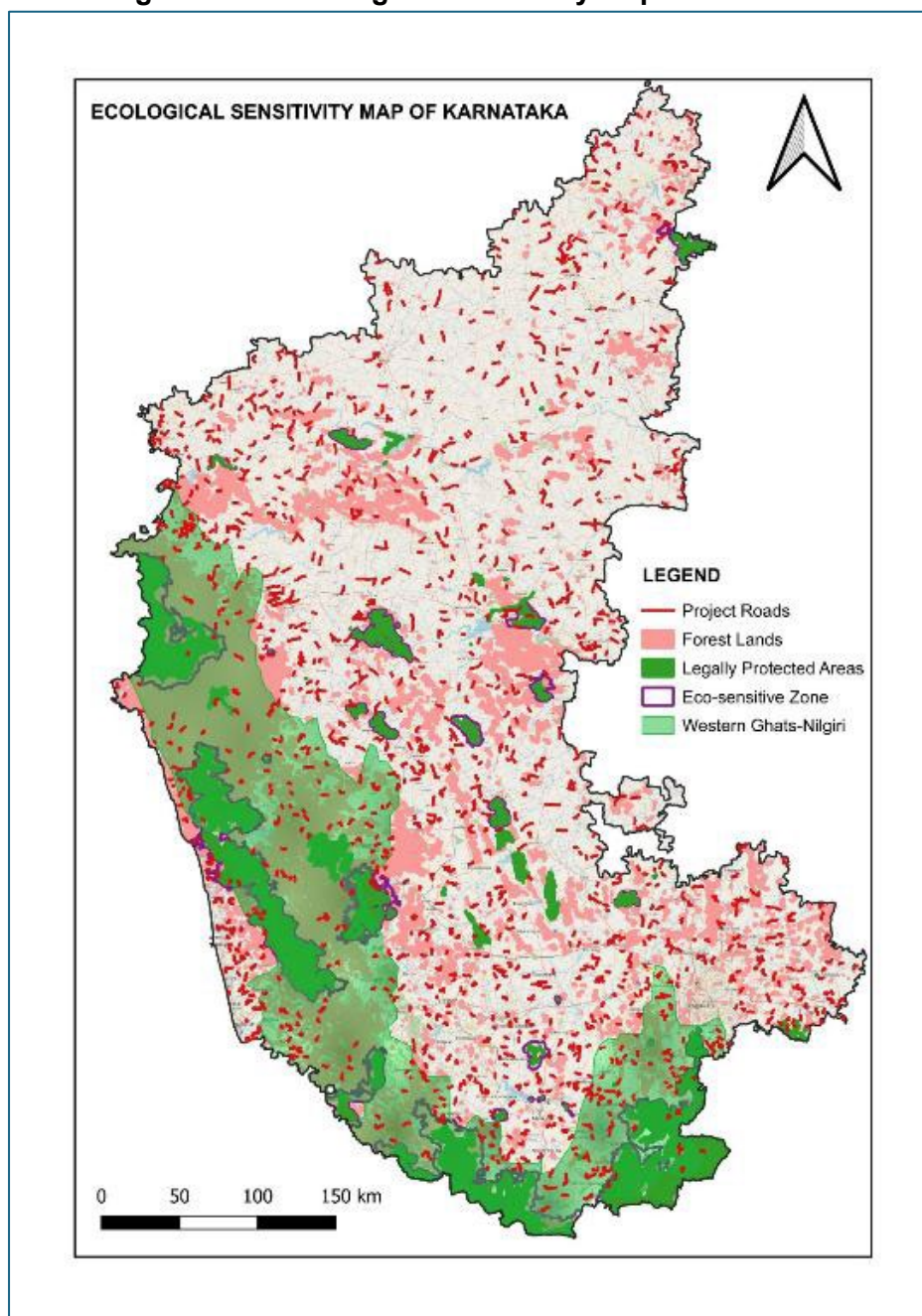
sponsors and managers have been established. Additionally, the sites for offset will be determined with the help of Karnataka Forest Department. The implementation of the BAP in ecologically sensitive areas is aimed at the promotion and enhancement aims of the protected areas.

- Act in a manner that is consistent with defined protected area management plans.
- Consult protected area managers and sponsors, local communities, and other key stakeholders on the proposed project.
- Implement additional programmes, as appropriate, to promote and enhance the conservation aims of the protected area.

Table IV-23: A List of Road IDs inside Legally Protected Areas

SN	Road ID	Protected Area
1	1521	Attiveri Bird Sanctuary
2	2628	Bhadra Wildlife Sanctuary/Tiger Reserve
3	2503	Biligiri Rangaswamy Hills Tiger Reserve
4	2536	Cauvery Wildlife Sanctuary
5	3891	Cauvery Wildlife Sanctuary
6	4221	Cauvery Wildlife Sanctuary
7	4054	Dandeli Wildlife Sanctuary
8	1644	Ghataprabha Bird Sanctuary
9	3212	Hiresulikeri Sloth Bear Conservation Reserve
10	596	Kamsandra Wildlife Sanctuary
11	556	Mookambika Wildlife Sanctuary
12	1551	Mookambika Wildlife Sanctuary
13	1960	Someshwara Wildlife Sanctuary
14	1644	Ghataprabha Wildlife Sanctuary

Figure IV-29: Ecological Sensitivity Map of Karnataka



H. Western Ghats Biodiversity Hotspot/UNESCO World Heritage Site

479. Western Ghats as a biodiversity hotspot and UNESCO World Heritage Site has been covered elaborately in the CHA. The hotspot falls under an EAAA called as the 'Broadleaf Forests EAAA', which has been designated as a critical habitat for supporting threatened and range-restricted species, key evolutionary processes, ecosystem services, and being highly threatened or unique, and of social, cultural, or economic importance.

480. A GIS-based analysis indicates that out of the 1335 Project roads, 148 roads are located within the Western Ghats.

I. Archaeological Sites and Cultural Heritage

481. Karnataka has a highly diverse range of physical (tangible) and cultural (intangible) heritage resources, shaped by successive dynasties such as the Chalukyas, Hoysalas, Vijayanagara Empire, and Deccan Sultanates.

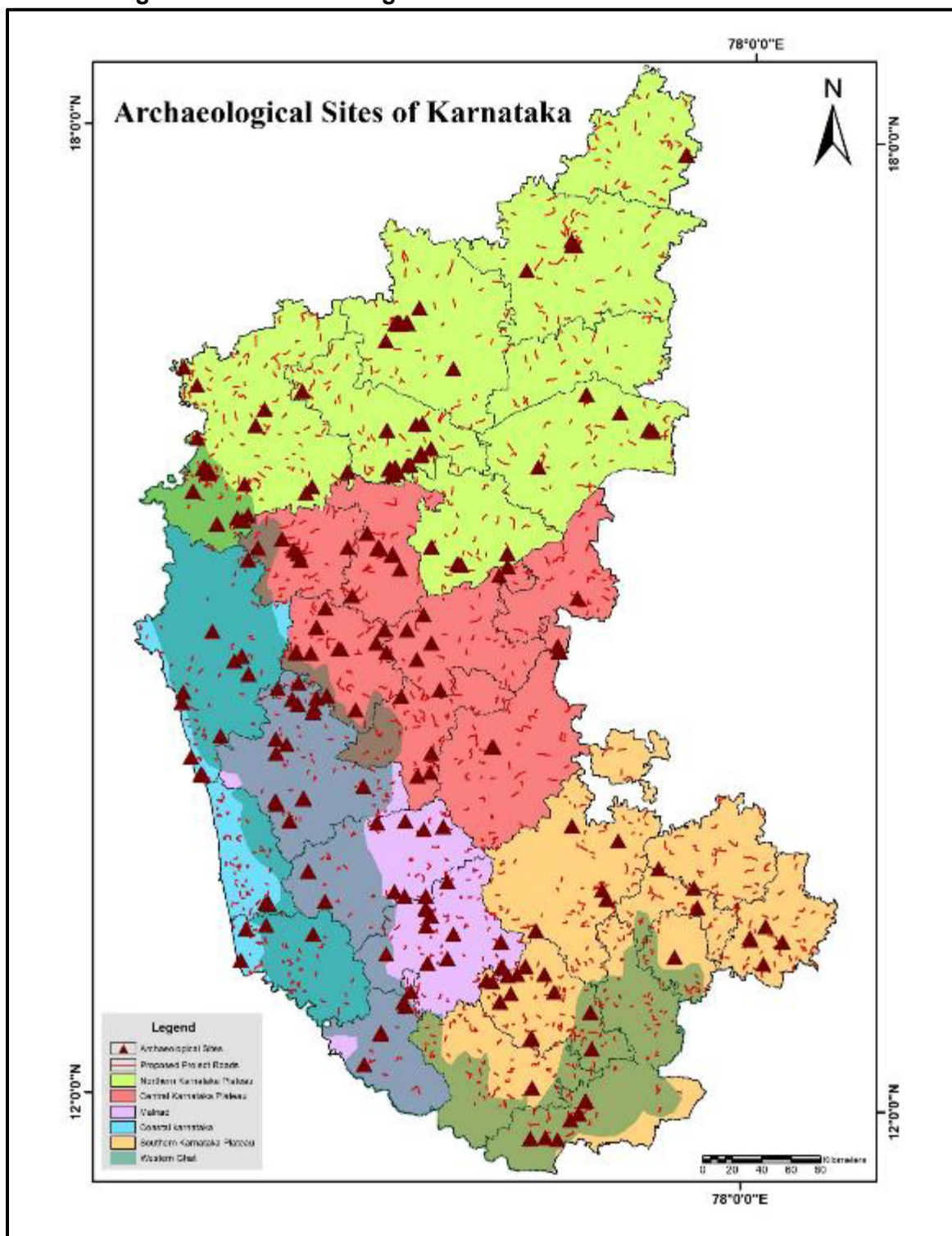
482. Karnataka has four officially designated UNESCO World heritage sites, of which three are cultural heritage sites and one is natural heritage site (i.e. Western Ghats). Based on the Western Ghats serial nomination maps, 10 component areas fall within Karnataka, distributed across the Talacauvery and Kudremukh sub-clusters.⁸⁰

483. A GIS-based analysis indicates that out of the 1335 Project roads, 148 roads are located within the Western Ghats. Of these, an approximately 92 m stretch of Project Road ID 1960 traverses through Someshwara Wildlife Sanctuary (WLS). In addition, Project Road ID 1552 is located approximately 200 m from the boundary of Someshwara WLS.

484. According to the Archaeological Survey of India (ASI), the state has over 500 Monuments of National Importance, administered under different ASI circles (Bengaluru, Dharwad, and Hampi), along with 1753 state-protected monuments notified by the Department of Archaeology, Museums and Heritage, Government of Karnataka (Figure IV-30). Refer section G (Protected Area) above, for details on roads falling within regulated zone of ASI monuments.

⁸⁰ <https://whc.unesco.org/document/117784>

Figure IV-30: Archaeological sites/monuments in Karnataka state



485. Cultural assets of national, local and importance have been studied within 2 kms from the roads. 111 such roads have been identified where cultural assets are available. These assets are within 2 km from the roads but outside the right of way of the roads. So, these assets are not within the direct impact zone. The list of such cultural assets is provided in Appendix 5.

486. **Archaeological Sites.** The Ancient Monuments and Archaeological Sites and Remains Act, 1958 (AMASR Act), as amended, establishes statutory protection zones around centrally protected monuments and archaeological sites. The area extending 100 m from the notified limit of a protected monument or protected area is the prohibited area, while the subsequent 200 m is the regulated area. New construction, including government/public works, is not permitted in the prohibited area, while construction, reconstruction, repair or renovation within the regulated area requires prior permission from the designated Competent Authority in accordance with the applicable National Monuments Authority (NMA) process and heritage bye-laws. These distances are the minimum statutory limits and may be extended for individual monuments through applicable notifications. List of Proposed Project Roads with Cultural Heritage Properties Located within 2 km of the Road Alignment is provided in Appendix 5.

487. The project roads were assessed through GIS-based proximity screening against the locations of archaeological sites. Based on the screening, there are 5 project roads within 300 m of ASI monuments (Table IV-24).

Table IV-24: Project Roads Identified within 300 m of ASI Monuments Based on GIS Proximity Screening

SN	Road ID	District	Proximity to ASI Monuments (GIS screening)	Name of ASI Monument	Permission Requirement
1.	1430	Shimoga	~210 m	Kedareshwara Temple	Not applicable; as per KRRDA clarification on ASI
2.	1679	Tumkur	~100 m	Kedareshwara Temple	Not applicable; as per KRRDA clarification on ASI
3.	2895	Hassan	~250 m	Lakshmidevi Temple	Not applicable; as per KRRDA clarification on ASI
4.	2611	Shimoga	~150 m	Trimurtinarayana Temple	Not applicable; as per KRRDA clarification on ASI
5.	4446	Vijaynagar	~200m	Hampi Lakshmi Narshimha Temple	Applicable

488. Out of the six roads, two roads are located at approximately 100 m and is conservatively considered to fall within/at the prohibited-area boundary, while four roads are located between approximately 150 m and 300 m and are considered to fall within or at the outer limit of the regulated area.

489. Following the GIS-based proximity screening, ground verification was undertaken in coordination with the DPR consultants to confirm the actual spatial relationship of the Project roads with the identified ASI monuments and their statutory protection zones. Based on the ground verification and review of the proposed road works, only Road ID 4446 is confirmed to fall within the regulated areas of the respective ASI monuments and requires permission from the Archaeological Survey of India.

490. For Road ID 4446 located approximately 200 m from the identified Lakshmi Narasimha/Narasimha monument, the project has already initiated the applicable consultation with ASI and permission process. Consultation was undertaken on 2 July 2026, and the

application will be placed in next committee meeting of Central ASI, Hampi World Heritage Area Management Authority (HWHAMA) and Tourism department.

491. Ground verification confirmed that NMA permission is not applicable for Road IDs 1430, 1679, 2895, 3381 and 2611.

J. Socio-Economic Environment

1. Demographic Profile

492. The districts across Karnataka where Project roads are located have a combined demographic profile comprising both rural and urban populations. According to the Census of India 2011 data, the highest populations are recorded in Bengaluru urban, Belagavi, Mysuru, Tumakuru, Kalaburagi, Ballari, Vijayapura (Bijapur) and Dakshina Kannada districts.

493. Rural population is higher than urban population in most districts, including Belagavi, Bidar, Vijayapura (Bijapur), Kalaburagi, Bagalkot, Raichur, Koppal, Bengaluru Rural, Kolar, Mysuru, Tumakuru, Chikkaballapur, Ramanagara, Chamarajanagar, Shivamogga, Chikkamagaluru, Hassan, Kodagu, Ballari, Chitradurga, Gadag, Davanagere, Haveri, Uttara Kannada, Udupi, Yadgir and Dakshina Kannada. Higher urban populations are recorded in Bengaluru Urban and Dharwad.

494. The sex ratio ranges from 916 in Bengaluru Urban and Mandya to 1,094 in Udupi. Literacy rates range from 51.8% in Yadgir to 88.6% in Dakshina Kannada. Scheduled Caste population is highest in Bengaluru Urban, Mandya, Kalaburagi, Belagavi, Mysuru, Ballari, Tumakuru and Kolar. Scheduled Tribe population is highest in Ballari, Raichur, Mysuru, Chitradurga, Belagavi, Bidar, Davanagere and Tumakuru.

495. Detailed district-wise demographic profile of Karnataka state where Project roads are located, is presented in Table IV-25 below.

Table IV-25: Demographic Profile of Districts where Project roads are located

Districts	Indicators								
	Total Population	Male	Female	Urban	Rural	Sex Ratio	Literacy rate (%)	Scheduled Caste	Scheduled Tribe
Belagavi	47,79,661	24,23,063	23,56,598	12,11,195	35,68,466	973	73.5	5,77,418	297,198
Bidar	17,03,300	8,70,665	8,32,635	4,25,952	12,77,348	956	70.51	3,99,785	2,35,822
Bijapur	2,177,331	1,111,022	1,066,309	501,978	1,675,353	960	67	442,773	39,314
Kalaburgi (Gulbarga)	25,66,326	13,01,755	12,64,571	8,35,551	17,30,775	971	64.9	6,48,782	65,259
Bagalkot	1,889,752	950,111	939,641	597,846	1,291,906	989	68.8	319,149	97,203
Raichur	19,28,812	9,64,511	9,64,301	4,90,348	14,38,464	1,000	59.6	4,00,933	3,67,071
Koppal	13,89,920	6,99,926	6,89,994	2,33,704	11,56,216	986	68.1	2,58,608	1,64,271
Bengaluru Urban	96,21,551	50,22,661	45,98,890	87,49,944	8,71,607	916	87.7	11,98,385	1,90,239
Bengaluru Rural	9,90,923	5,09,172	4,81,751	2,68,744	7,22,179	946	77.9	2,13,700	52,903
Kolar	15,36,401	7,76,396	7,60,005	4,80,073	10,56,328	979	74.4	4,65,867	78,875
Mandya	1,805,769	905,085	900,684	308,362	1,497,407	995	70.4	265,294	22,402
Mysuru	30,01,127	15,11,600	14,89,527	12,45,413	17,55,714	985	72.8	5,36,643	3,34,547
Tumkuru	26,78,980	13,50,594	13,28,386	5,99,078	20,79,902	984	75.14	5,06,901	2,09,559
Chikballapur	12,55,104	6,36,437	6,18,667	2,81,119	9,73,985	972	69.76	3,12,565	1,56,487
Ramnagara	10,82,636	5,48,008	5,34,628	2,67,759	8,14,877	976	69.22	2,03,819	22,946
Charamrajanagara	10,20,791	5,12,231	5,08,560	1,74,974	8,45,817	993	61.4	2,59,445	1,20,219
Shivamoga	17,52,753	8,77,415	8,75,338	6,23,727	11,29,026	998	80.4	3,08,158	65,412
Chikkamagalur	11,37,961	5,66,622	5,71,339	2,39,508	8,98,453	1,008	79.2	2,53,651	44,970
Hassan	18,05,769	9,05,085	9,00,684	3,08,362	14,97,407	995	76.1	2,65,294	22,402
Kodagu	5,54,519	2,74,608	2,79,911	80,988	4,73,531	1,019	82.6	73,584	58,054
Bellary	24,52,595	12,36,954	12,15,641	9,20,239	15,32,356	983	67.43	5,17,409	4,51,406
Chitradurga	16,59,456	8,40,843	8,18,613	3,29,533	13,29,923	974	73.7	3,89,117	3,02,554
Dharwad	18,47,023	9,37,206	9,09,817	10,49,539	7,97,484	971	80	1,77,855	87,548
Gadag	10,64,570	5,37,147	5,27,423	3,79,309	6,85,261	982	75.12	1,74,196	61,654
Davanagere	19,45,497	9,86,400	9,59,097	6,29,010	13,16,487	972	75.7	3,92,595	2,33,112
Haveri	15,97,668	8,19,128	7,78,540	3,55,501	12,42,167	950	77.4	2,19,976	1,41,380
Vijayanagara (carved out of Bellary in 2021)									
Uttar Kannada	14,37,169	7,26,256	7,10,913	4,18,981	10,18,188	979	84.1	1,16,431	34,239
Udupi	11,77,361	5,62,131	6,15,230	3,34,061	8,43,300	1,094	86.2	75,429	52,897
Dakshin Kannada	20,89,649	10,34,714	10,54,935	9,96,086	10,93,563	1,020	88.6	1,48,178	82,268
Yadgir	11,74,271	5,90,329	5,83,942	2,20,677	9,53,594	989	51.8	2,73,315	1,46,849

Source: District Census Handbooks 2011, Census of India

2. Socio-economic profile

496. The districts of Karnataka where Project roads are located collectively exhibit diverse household distribution and occupational structures. According to the Census of India 2011, Bengaluru Urban records the highest number of households (2,377,305) and total workers (approximately 4.25 million) followed by Belagavi with 979,342 households and approximately 2.11 million workers. Tumakuru, Mysuru, Ballari, Kalaburgi, Dakshina Kannada Vijayapura, Raichur, Mandya, Hassan and Chitradurga and Davanagere also have substantial worker populations ranging from approximately 0.85 million to 1.35 million.

497. Across most districts, main workers constitute the dominant share of the workforce, typically accounting for approximately 75–93% of total workers, while marginal workers form a smaller proportion. Agricultural dependence remains high in districts such as Belagavi (711,980 cultivators and 649,517 agricultural labourers), Raichur (383,526 agricultural labourers; 245,299 cultivators), Kalaburagi (415,267 agricultural labourers), Belagavi (711,980 cultivators; 649,517 agricultural labourers), Hassan (388,981 cultivators) and Tumakuru (505,910 cultivators). In contrast, districts such as Bengaluru Urban records the highest number of other workers (approximately 3.94 million), followed by Dakshina Kannada (746,430), Mysuru (625,767) and Belagavi (683,829), reflecting a relatively greater concentration of non-agricultural employment in these districts.

498. District wise socio-economic profile is presented in the Table IV-26.

Table IV-26: District wise distribution of Households, Workforce Participation, and Occupational Structure in Karnataka

Districts	Indicators								
	No. of Household	Total Workers	Main Workers	Marginal Workers	Non-Workers	Cultivators	Agricultural Labourers	Workers in household industry	Other Workers
Belagavi	979342	2105668	1,734,501	371,167	2,673,993	711,980	649,517	60,342	683,829
Bidar	2,39,979	702,608	551,763	150,845	1,000,692	141,302	280,091	18,095	263,120
Bijapur	407,493	927,722	760,083	167,639	1,249,609	262,217	351,600	25,379	288,526
Kalaburgi (Gulbarga)	4,69,020	10,87,028	8,44,237	2,42,791	14,79,298	2,20,198	4,15,267	25,891	4,25,672
Yadgir	2,01,300	5,47,696	4,37,241	1,10,455	6,26,575	1,59,333	2,34,655	13,192	1,40,516
Bagalkot	359,946	818,081	676,407	141,674	1,071,671	196,199	303,243	44,797	273,842
Raichur	362299	9,03,413	7,25,985	1,77,428	10,25,399	2,45,299	3,83,526	19,095	2,55,493
Koppal	2,63,941	6,54,766	5,08,089	1,46,677	7,35,154	1,63,413	2,73,016	18,794	1,99,543
Bengaluru Rural	2,28,553	4,59,891	3,89,989	69,902	5,31,032	1,27,770	84108	19,457	2,28,556
Bengaluru Urban	23,77,305	42,46,927	38,58,342	3,88,585	53,74,624	95619	97914	1,08,898	39,44,496
Kolar	3,32,474	7,17,872	5,84,590	1,33,282	8,18,529	1,83,057	2,01,233	24,178	3,09,404
Mandya	428,625	428,625	428,625	428,625	428,625	428,625	428,625	428,625	428,625
Mysuru	6,98,302	13,14,268	10,82,108	2,32,160	16,86,859	3,49,337	3,11,002	28162	6,25,767
Tumkuru	6,37,887	1354646	1078431	276215	1324334	505910	352286	54523	441927
Chikballapur	2,83,662	639778	535565	104213	615326	212226	206939	20276	200337
Ramnagara	2,59,837	531459	458841	72618	551177	208130	102460	17723	203146
Charamrajanagara	2,44,338	481693	381408	100285	539098	113105	214303	14007	140278
Shivamoga	4,05,221	7,80,598	6,52,789	1,27,809	9,72,155	2,04,493	2,46,464	15,087	3,14,554
Chikkamagalur	2,74,922	5,65,774	4,80,229	85545	5,72,187	1,55,392	1,26,600	8,873	2,74,909
Hassan	4,27,363	8,71,408	7,14,901	1,56,507	9,34,361	3,88,981	2,16,159	17,834	2,48,434
Kodagu	1,41,932	2,78,938	2,58,753	20185	2,75,581	21174	15,153	1,549	2,41,062
Bellary	489118	1116880	969388	147492	1335715	258080	406092	22832	429876
Chitradurga	356095	856587	667479	189108	802869	286245	294337	26235	249770
Dharwad	381565	784833	690948	93885	1062190	164279	207642	16463	396449
Gadag	218337	495722	423451	72271	568848	127441	200310	15485	152486
Davanagere	4,08,902	8,75,207	7,05,099	1,70,108	10,70,290	2,30,846	2,95,873	31438	3,17,050
Haveri	329488	730066	601951	128115	867602	203055	311263	20217	195531
Vijayanagara (carved out of Bellary in 2021)									
Uttar Kannada	3,23,304	6,08,526	4,98,304	1,10,222	8,28,643	1,11,581	1,16,336	9,492	3,71,117
Udupi	2,52,223	5,13,241	4,59,446	53795	6,64,120	63143	63,390	10,580	3,76,128
Dakshin Kannada	4,37,494	9,97,721	9,14,476	83245	10,91,928	33810	29274	1,88,207	7,46,430

Source: District Census Handbooks 2011, Census of India

K. Land Use

499. The Land use map of the Karnataka prepared by Karnataka Remote Sensing Application Centre (KRSAC), Government of Karnataka (Figure IV-31) shows the spatial variance of land use across the state. Physiographic region wise land use characteristics are as follows:

500. **Northern Karnataka Plateau.** The Northern Karnataka Plateau exhibits a more semi-arid landscape with agriculture as the dominant land use, interspersed with notable patches of wastelands (brown) and grasslands. Forest cover is minimal and fragmented. Built-up areas are present but dispersed, indicating lower urban concentration compared to the southern plateau.

501. **Southern Karnataka Plateau.** The Southern Karnataka Plateau is predominantly characterized by intensive agricultural land use. This region also shows a high concentration of built-up areas, particularly around major urban centres like Bengaluru, indicating significant urban expansion and land transformation. Forest cover is limited and fragmented, often restricted to isolated patches. Additionally, occurrences of grazing lands and wastelands are observed.

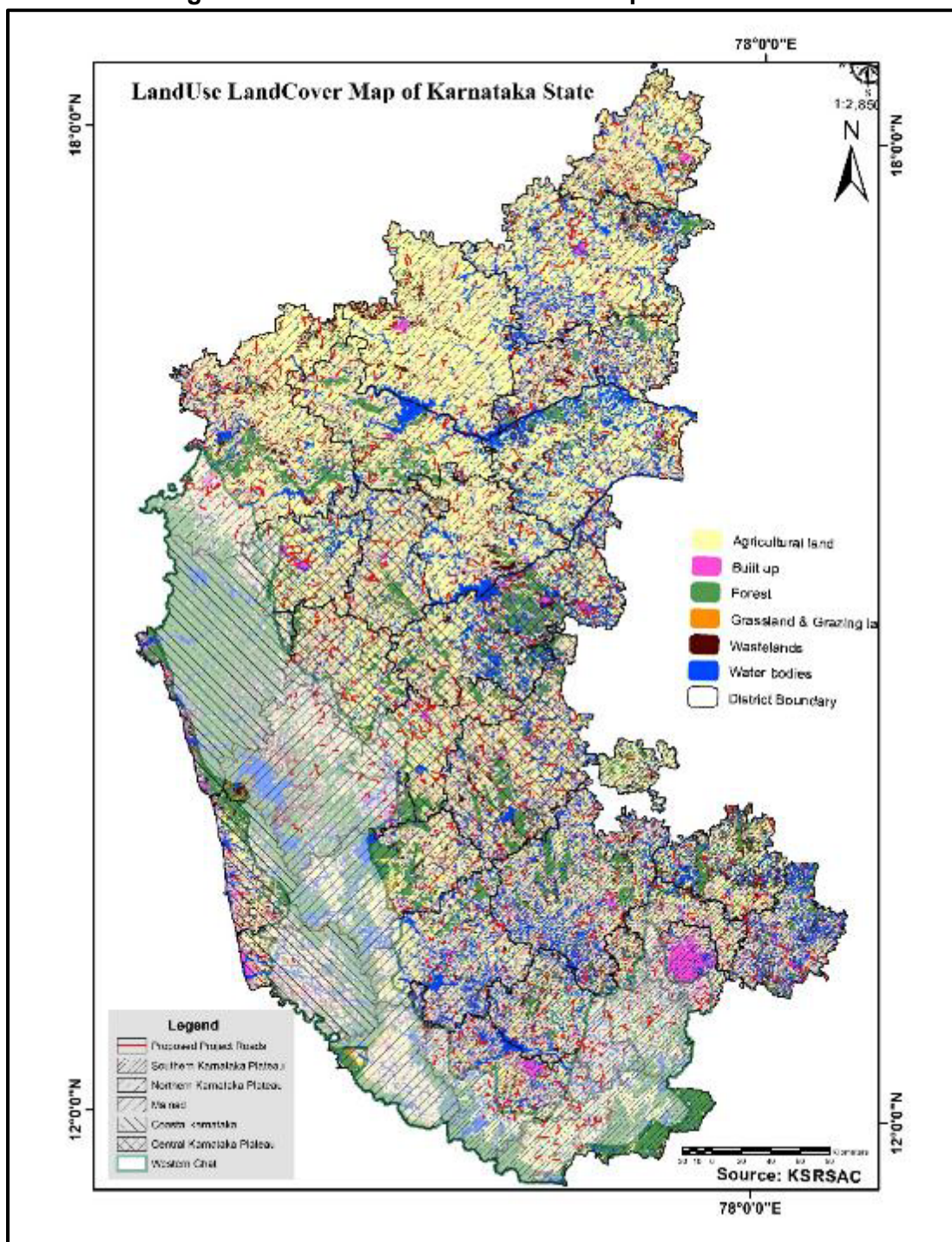
502. **Malnad.** The Malnad region, forming a transitional belt between the Western Ghats and the plateau, exhibits a mixed and mosaic land use pattern. Forests remain significant but are interspersed with plantation crops such as coffee, tea, and spices, as well as patches of agricultural land. The terrain supports a moderate density of water bodies, including streams and reservoirs, owing to relatively high rainfall. Settlements and built-up areas are scattered.

503. **Central Karnataka Plateau.** The Central Karnataka Plateau exhibits a predominantly agriculture-dominated landscape, as evidenced by extensive yellow areas across districts in the central part of the state. The map shows fewer forest patches compared to the western regions, and these are mostly fragmented. Water bodies, including tanks and reservoirs, are present but not as dense as in the southern plateau. Built-up areas appear as dispersed clusters, indicating moderate levels of settlement and urbanization. Some patches of wasteland are also visible.

504. **Coastal Karnataka.** The Coastal Karnataka region demonstrates a heterogeneous but ecologically rich land use pattern shaped by high rainfall and proximity to the Arabian Sea. The landscape is dominated by dense vegetation, including evergreen and semi-evergreen forests, along with extensive plantation agriculture such as coconut and arecanut. Paddy cultivation is common in low-lying areas. The region also exhibits a notable presence of water bodies, including rivers, estuaries, and backwaters, contributing to a well-developed drainage network. Built-up areas are primarily concentrated along coastal urban centres.

505. **Western Ghats of Karnataka.** The Western Ghats region is characterized by extensive and contiguous forest cover, making it one of the most environmentally sensitive zones in the state. The LULC pattern is dominated by dense forest cover with minimal fragmentation. This region has least representation of agricultural land and very sparse built-up areas.

Figure IV-31: Land Use-Land Cover Map of Karnataka



Source: Karnataka Remote Sensing Application Centre (KRSAC), Government of Karnataka

L. Utilities in Project Area

506. Utilities identified along or within the RoW of the project roads are power transmission (electric) and telephone lines and drinking water supply network.

507. Approximately 789 Project roads are reported to have electric lines and/or poles are traversing within RoW. Drinking-water supply infrastructure is also widely distributed, with water-supply pipelines reported along nearly 495 roads and water-supply facilities, including borewells, tubewells and pumps, reported along ~440 roads. Overall, one or more forms of drinking-water supply infrastructure are reported along ~626 Project roads. Telephone lines and/or poles are reported along a comparatively limited number of roads (~12 Project roads).

508. Electricity lines and associated poles generally run parallel to or cross the existing road RoW at various locations. Similarly, drinking-water supply pipelines, including networks developed under the Jal Jeevan Mission (JJM), traverse the RoW in several villages and provide water supply to adjoining settlements. Borewells, tubewells and pumping facilities associated with the water-supply network are also present within the RoW at several locations.

M. Competing Resources

509. Groundwater and surface water resources detailed in the section E above are identified as competing resources for the local communities.

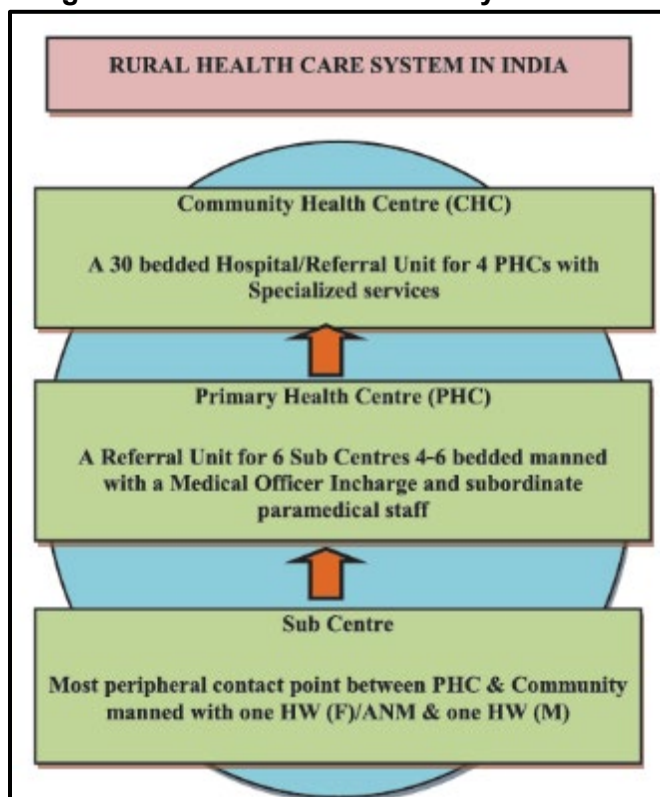
N. Community Health and Safety

1. Healthcare Facilities

510. The healthcare system in Karnataka is structured along the three-tier public health framework adopted across India, comprising primary, secondary, and tertiary levels of care. The system is supported by a mix of public and private providers, with the public sector playing a critical role in rural and underserved areas, while urban regions have a strong presence of private healthcare facilities.

511. The state government has implemented several rural health programs to ensure better healthcare for the population living in the rural areas. Karnataka State follows a three-tier rural public health infrastructure (Figure IV-32) primary, secondary and tertiary. Rural healthcare contains a hierarchical structure such as:

- Sub-Centres (SCs): First point of contact for basic maternal, child health, and preventive services.
- Primary Health Centres (PHCs): Provide outpatient care, basic diagnostics, and minor treatments.
- Community Health Centres (CHCs): Act as referral units with limited specialist services.

Figure IV-32: Rural Healthcare System in Karnataka

Source: Ministry of Health and Family Welfare, Statistical Division, Government of India

512. Karnataka, at rural level has 8762 nos. of SCs, 2132 nos. of PHCs, 182 nos. of CHCs. There are 147 nos. of sub divisional district hospitals, 16 nos. of district hospitals and 19 nos. of medical colleges in the state as of March 2023.⁸¹

513. Out of the 1335 Project roads, nearly 197 Anganwadi centres and approximately 96 PHCs have been identified along or in proximity to 230 Project roads. In several locations, more than one Anganwadi centre or PHC is reported along the same road corridor, reflecting the role of these roads in providing access to essential community services. Anganwadi centres are more widely distributed across the Project road network compared to PHCs.

510. Table IV-27 presents Project roads where PHC/healthcare facilities have been identified within the vicinity of the road alignment.

⁸¹ Health Dynamics of India (Infrastructure & Human Resources) 2022-23, Government of India, Ministry of Health and Family Welfare, Statistical Division

Table IV-27: Healthcare Facilities Located Along or Near Project Road Alignments

SN	Road ID	District	Healthcare / Community Health Facility
1	30	Dharwad	General Hospital located approximately 1.2 km from Kundagol (Ch. 0.00 km)
2	46	Dharwad	Anganwadi near Ch:0.00 km; PHC Morab near Ch:0.00 km
3	49	Bagalkot	Anganwadi at bhairamatti village
4	60	Chikkaballapur	Anganwadi are located at ch: 6.455
5	69	Koppal	Anganwadi in Mattur village Anganwadi in Betageri village
6	71	Koppal	Anganwadi in Kunikeri Tanda village
7	72	Koppal	Anganwadi in Chilavadagi village
8	118	Bagalkot	PHC Narasapur village
9	127	Dharwad	Anganwadi; PHC Alagwadi
10	168	Chikmagalur	Anganwadi at 30mtr distance from road
11	174	Udupi	Anganwadi at 100 m; PHC at 100 mtr distance from road
12	183	Koppal	Anganwadi in Budihal village Anganwadi in Bikanalli village
13	186	Koppal	Anganwadi in Betageri village Anganwadi in Hanakunti village
14	198	Dharwad	Anganwadi at ch 0.00km; PHC amminbhavi at 500m
15	205	Dharwad	Anganwadi at ch 3.55km,0.00km
16	212	Koppal	Anganwadi in Budagumpa village; PHC in Budagumpa village
17	215	Koppal	Anganwadi in Sangapur village Anganwadi in Lebageri village
18	218	Dharwad	Anganwadi at ch 4.78km,0.00km; PHC amminbhavi at 500m
19	220	Koppal	Anganwadi in Abbigeri and Gudadalli villages
20	240	Koppal	Anganwadi in Venkatagiri village; PHC in Venkatagiri village
21	254	Vijayapura	Anganwadi within 500 m Radius
22	309	Udupi	Anganwadi at 200m; PHC at 200mtr distance from road
23	329	Udupi	Anganwadi at 500mtr distance from road
24	339	Koppal	Anganwadi in Ryavanki village
25	346	Dharwad	Anganwadi at ch:0.00km, 3.00km
26	349	Dharwad	Anganwadi at ch:0.00, 3.50km
27	409	Chikkaballapura	Anganwadi at ch: 10 & 5725m
28	517	Koppal	Anganwadi in Bandi village
29	519	Udupi	Anganwadi at 1000 m; PHC at 1000 mtr distance from road
30	524	Koppal	Anganwadi in Hiremyageri village
31	536	Davanagere	Anganwadi
32	547	Udupi	Anganwadi at 100mtr distance from road
33	550	Koppal	Anganwadi in Basarihal village; PHC in Basarihal village
34	556	Udupi	Anganwadi at 100 mtr distance from road
35	695	Ballari	Anganwadi At Ch:10m in vanenur
36	798	Koppal	Anganwadi in kalakera village
37	858	Mysuru	Anganwadi at ch: 2205 m
38	897	Chitradurga	Govt Hospital located approximately 20 m from the RoW at Ch. 0.100 km
39	915	Shimoga	Anganwadi located 300.00 metre from the road.
40	977	Dharwad	Anganwadi ch :0.00km
41	979	Dharwad	Anganwadi at ch 0.00km 3.55km; Civil Hospital at Ch. 0.00 km
42	1014	Bidar	Government Hospital, Janawada, approximately 100 m from the proposed road alignment
43	1057	Dakshina Kannada	Anganwadi @ ch 0.00km

SN	Road ID	District	Healthcare / Community Health Facility
44	1059	Dakshina Kannada	Anganwadi @ ch 5.40km
45	1093	Mandya	PHC
46	1094	Haveri	PHC at km at 0.00 M
47	1108	Kolara	Anganwadi Kendra Vaddarahalli KGF at Ch: 4.99
48	1169	Haveri	PHC at km at 0.00
49	1231	Udupi	Anganwadi at 100 m; PHC at 100 mtr distance from road
50	1299	Koppal	Anganwadi
51	1315	Udupi	Anganwadi at 340 mtr
52	1330	Udupi	Anganwadi at 100 mtr distance from road
53	1358	Dharwad	Anganwadi ch:0.15km Anganwadi
54	1366	Dharwad	Anganwadi at Ch:0.15km
55	1371	Udupi	Anganwadi at 100 mtr distance from road
56	1386	Uttara Kannada	PHC is located 500 m from the road
57	1391	Shivamogga	Anganwadi located 150.00 metre from the road.
58	1430	Shivamogga	Anganwadi located 10 0.00 metre from the road.
59	1435	Uttara Kannada	Anganwadi is located adjacent to the road
60	1455	Shimoga	Anganwadi located 50.00 metre from the road.
61	1465	Bengaluru Rural	Anganwadi located at a distance of 25m from road Anganwadi located at a distance of 60m from road; PHC located at a distance of 55m from road
62	1498	Shimoga	Anganwadi located 25.00 metre from the road.
63	1521	Uttara Kannada	PHC located 200m from the start of the road
64	1549	Udupi	Anganwadi at 100 mtr distance from road
65	1552	Udupi	Anganwadi at 100 mtr distance from road
66	1568	Chikmagalur	Anganwadi at 80mtr distance from road
67	1618	Vijayapura	2 Anganwadi distance distance within 500 m Radius
68	1619	Vijayapura	2 Anganwadi and nos of within 500 m Radius
69	1620	Vijayapura	PHC within 500 m Radius
70	1622	Vijayapura	Anganwadi within 500 m Radius
71	1700	Belgaum	Anganwadi At CH 2.5km
72	1817	Ramanagara	Anganwadi located 20m, 35m from the road.
73	1818	Ramanagara	Anganwadi located at 85m from the road.
74	1960	Udupi	Anganwadi at 200 m; PHC at 200 mtr distance from road
75	2001	Dharwad	Anganwadi Km away 0.30 Km away from start point at Yaraguppi village. GS is located at 0.10; PHC 0.50 Km
76	2143	Bengaluru Rural	PHC Konenahalli located at a distance of 30mt
77	2213	Shivamogga	Anganwadi at ch:1.25km
78	2228	Vijayanagara	Anganwadi located within 500 metre Radius.
79	2237	Haveri	PHC
80	2265	Bagalkot	Anganwadi; PHC Amarawatil Village
81	2289	Yadgir	PHC at M.T.Palli and Chepetla village
82	2318	Kalburgi	Anganwadi 5m; PHC 25m From the Center of the Road
83	2324	Shivamogga	Anganwadi located 200 metre from the road.
84	2357	Belagavi	Anganwadi and PHC
85	2363	Haveri	PHC at ch 1.750 From Road Center 250 mtr
86	2439	Shimoga	Anganwadi located 400.00 metre from the road.
87	2456	Chikkamagaluru	Anganwadi at Ch Govt at Ch 0
88	2458	Tumakuru	Anganwadi 100m from the road
89	2468	Yadgir	PHC at Kadechur village
90	2486	Yadgir	PHC at 2.00km
91	2502	Yadgir	PHC at Rajankollur village

SN	Road ID	District	Healthcare / Community Health Facility
92	2552	Udupi	Anganwadi at 350 mtr
93	2567	Chikmagalur	Anganwadi at 80mtr distance from road
94	2631	Kalburgi	Anganwadi 10 m From Center of the Road
95	2639	Kalburgi	PHC 15 m From the Center of the Road
96	2690	Uttara Kannada	PHC is located 200 m from the road
97	2757	Chikmagalur	Anganwadi at 70mtr distance from road
98	2893	Udupi	Anganwadi at 300 mtr distance from road
99	2910	Udupi	Anganwadi at 300 m; PHC at 300 mtr distance from road
100	2919	Mandya	PHC
101	2958	Kolar	Anganwadi at ch: 1.40
102	3088	Chikmagalur	Anganwadi at 100mtr distance from road
103	3092	Dharwad	Anganwadi at ch 0.00km; PHC
104	3093	Dharwad	Anganwadi at ch 3.00km,0.00km
105	3094	Dharwad	Anganwadi at ch 5.8
106	3097	Dharwad	Anganwadi at ch:0.00km; PHC at ch:0.00km
107	3114	Raichur	Anganwadi
108	3173	Shimoga	Anganwadi located 5.00 metre from the road.
109	3212	Koppal	Anganwadi located 100 m
110	3235	Koppal	Anganwadi in Vadaganal Village
111	3247	Bagalkot	Anganwadi; PHC Ilkal Village
112	3299	Koppal	Anganwadi in Kukanoor village; PHC in Kukanoor village
113	3302	Koppal	Anganwadi in Vajrabandi village
114	3313	Bagalkot	PHC
115	3327	Koppal	Anganwadi in Balageri village; PHC in Balageri village
116	3349	Kalburgi	Anganwadi 10m From the Center of the Road
117	3366	Ballari	PHC
118	3393	Bagalkot	Anganwadi
119	3407	Bagalkot	Anganwadi; PHC Ilkal Village
120	3424	Udupi	Anganwadi at 200 m; PHC at 200 mtr distance from road
121	3434	Vijayanagara	Anganwadi located within 500 metre Radius.
122	3441	Vijayanagara	Anganwadi located within 500 metre Radius.
123	3451	Vijayanagara	Anganwadi located within 500 metre Radius.
124	3462	Kolara	Anganwadi CH CH: 2.55
125	3509	Yadgir	PHC at 3.980km
126	3510	Yadgir	PHC at Madnal and Ingalagi village
127	3512	Yadgir	PHC
128	3546	Kolara	Anganwadi
129	3578	Udupi	Anganwadi at 100 mtr distance from road
130	3581	Udupi	Anganwadi at 100 m; PHC at 100 mtr distance from road
131	3613	Kalburgi	PHC 40m From the Center of the Road
132	3690	Bangalore Rural	Anganwadi located at a distance 50mt from Road Anganwadi located at a distance 150mt frm road
133	3730	Udupi	Anganwadi at 100 m; PHC at 100 mtr distance from road
134	3807	Mandya	PHC Ch. km
135	3869	Chikkaballapura	Anganwadi at Ch:250m
136	3891	Ramanagara	Anganwadi located at 120m, 210m from the road.
137	3940	Mandya	PHC Ch. km
138	3999	Koppal	Anganwadi in Huligi village
139	4038	Haveri	Anganwadi at ch 0.150 km 450m from road Center 2. PHC at devihous; PHC from road Center at Ch 6.940km
140	4083	Mandya	PHC; Health Sub-Centre at Ch. 4.620 km, approximately 5 m from the road centreline
141	4084	Mandya	PHC

SN	Road ID	District	Healthcare / Community Health Facility
142	4117	Shimoga	Anganwadi located 500.00 metre from the road.
143	4133	Tumakuru	Anganwadi at ch 0.10km at Hemdore village
144	4161	Tumakuru	Anganwadi 100m from the road
145	4252	Vijayapura	PHC within 500 m Radius
146	4253	Vijayapura	PHC within 500 m Radius
147	4268	Bengaluru (Urban)	Rural Health Centre / Rajarajeshwari Hospital at approximately 800 m
148	4312	Udupi	PHC at 200 mtr distance from road
149	4326	Mandya	PHC Distance
150	4350	Mandya	Sub-Health Centre at Ch. 0.600 km, approximately 10 m from the road centreline
151	4369	Mandya	PHC
152	4370	Kalburgi	Anganwadi 5m
153	4374	Kalburgi	PHC 6m From the Center of the Road
154	4386	Yadgir	PHC at 1.50km
155	4406	Kalburgi	PHC 15 m From the Center of the Road
156	4408	Mandya	PHC Ch. km
157	4409	Udupi	Anganwadi at 200 mtr distance from road
158	4410	Raichur	Anganwadi
159	4435	Kalburgi	Anganwadi 30m From the Center of the Road
160	4446	Ballari	Anganwadi
161	4480	Raichur	Anganwadi
162	4507	Raichur	Anganwadi
163	4516	Mandya	Ayush Hospital at Ch. 1.170 km, approximately 15 m from the road centreline
164	4561	Mandya	Anganwadi located 35 m
165	4564	Mandya	PHC Distance
166	4575	Bangalore Rural	Anganwadi Geddalapura
167	4580	Gadag	Anganwadi approximately 150 m from the road
168	4583	Mandya	Anganwadi located 125 m
169	4695	Vijayapura	Anganwadi within 500 m Radius
170	4696	Vijayapura	2 Anganwadi within 500 m Radius
171	4697	Vijayapura	2 Anganwadi within 200 m Radius
172	4714	Hassan	PHC m in Nagenahalli
173	4760	Udupi	PHC at 200 mtr distance from road
174	4762	Yadgir	PHC at Gogi(k) and Banthihal village
175	4766	Yadgir	PHC at 0.560km
176	4767	Yadgir	PHC at Kembhavi village
177	4772	Koppal	Anganwadi in Gandal village; PHC in Gandal village
178	4790	Dharwad	Anganwadi at Sulla village; PHC located 1.00 Km away from end point
179	4833	Dharwad	Anganwadi at ch 0.00km
180	4836	Dharwad	Anganwadi at ch 0.00km Anganwadi at ch:7.24km
181	4837	Dharwad	Anganwadi at ch 0.00km
182	4838	Dharwad	Anganwadi at ch 0.00km
183	4868	Vijayanagara	Anganwadi located within 500 metre Radius.
184	4869	Vijayanagara	Anganwadi located within 500 metre Radius.
185	4872	Udupi	Anganwadi at 200 m; PHC at 200 mtr distance from road
186	4883	Udupi	Anganwadi at 200 m; PHC at 200 mtr distance from road
187	4889	Chikmagalur	Anganwadi at 50mtr distance from road
188	4906	Vijayapura	4 Anganwadi within 500 m Radius
189	4907	Vijayapura	2 Anganwadi 15 m distance From the Road Edge. and taluk; Taluk Hospital within 500 m radius

SN	Road ID	District	Healthcare / Community Health Facility
190	4909	Vijayapura	3 Anganwadi within 500 m Radius
191	4910	Vijayapura	Anganwadi within 500 m Radius
192	4920	Raichur	Anganwadi
193	4935	Shimoga	Anganwadi located 500.00 metre from the road.
194	4939	Koppal	Anganwadi in Chalgera village
195	4941	Koppal	Anganwadi in Donnegudda and Yalabunachi village
196	4942	Koppal	Anganwadi in Donnegudda and Yalabunachi village
197	4945	Koppal	Anganwadi
198	4946	Shivamogga	Anganwadi located 20.00 metre from the road.
199	4978	Haveri	PHC Inside Kanavalli Village
200	4983	Udupi	Anganwadi at 100 mtr distance from road
201	5002	Yadgir	PHC at Kudalagi and Baichbal village
202	5005	Vijayapura	PHC at 100 m
203	5029	Mandya	PHC Distance
204	5036	Mandya	PHC Ch. km
205	5047	Kodagu	Anganwadi at ch 0 M
206	5054	Vijayapura	PHC within 500 m Radius
207	5058	Kodagu	Anganwadi at 5 Mt
208	5071	Mysuru	Anganwadi at ch: 1770 m
209	5142	Ramanagara	Anganwadi m 1100m from the road.
210	5151	Koppal	Anganwadi in Budagumpa village; PHC in Budagumpa village
211	5172	Kalburgi	PHC 10 m From the Center of the Road
212	5194	Ramanagara	Anganwadi 30m from the road.
213	5236	Vijayapura	PHC Managuli
214	5239	Vijayapura	Anganwadi nos Within 500 m Radius; PHC and Within 500 m Radius PHC Within 500 m Radius
215	5240	Vijayapura	Anganwadi Within 500 m Radius
216	5242	Vijayapura	PHC Ronihal
217	5243	Vijayapura	Anganwadi
218	5244	Vijayapura	Anganwadi within 500 m Radius
219	5249	Raichur	Anganwadi
220	5251	Bagalkot	Anganwadi Neelagund village
221	5277	Vijayapura	Anganwadi within 300 m Radius
222	5284	Vijayapura	Anganwadi at Golgeri village; PHC at Golgeri village
223	5285	Vijayapura	Anganwadi within 500 m Radius
224	5300	Vijayapura	PHC within 500 m Radius
225	5320	Shivamogga	Anganwadi located 20.00 metre from the road.
226	5327	Vijayapura	PHC within 500 m Radius
227	5338	Yadgir	PHC at M.T.Palli and Gajarkot village
228	5340	Shivamogga	Anganwadi located 20.00 metre from the road.
229	5382	Yadgir	Anganwadi End Chainage km Chainage: 4.200km
230	5409	Chitradurga	Anganwadi are located at 120 m from ROW at Ch. 3.710 km
231	5448	Mandya	PHC
232	5453	Mandya	PHC Distance
233	5454	Mandya	PHC
234	5455	Mandya	PHC
235	5485	Bengaluru Rural	Anganwadi at a distance of 15m from road. Kempaligapura Anganwadi at 22m from road
236	5506	Bengaluru Rural	Anganwadi located at a distance of 135m from road
237	5513	Bengaluru Rural	Anganwadi 20mt

Source: Information shared by DPR consultants

514. However, access to healthcare may vary across villages depending on distance from the nearest health facility, road condition, terrain, availability of public transport, ambulance access and staffing levels at the facility. In remote, hilly or forested areas, timely access to emergency and specialised healthcare may be relatively constrained.

2. Malaria and other vector-borne diseases

515. During 2024–25 up to December 2024, Karnataka recorded 741 malaria cases and three deaths. In the same period, the State recorded 32,886 dengue cases with 20 deaths, 2,954 chikungunya cases, and 688 Acute Encephalitis Syndrome cases, including 31 Japanese Encephalitis cases.⁸²

3. Human Immunodeficiency Virus (HIV) and Sexually Transmitted Infections (STIs)

516. As per Karnataka State Acquired Immunodeficiency Syndrome (AIDS) Prevention Society, HIV prevalence among antenatal clinic attendees declined from 1.5% in 2004 to 0.57% in 2022–23. HIV testing data for 2024–25 indicates positivity of 0.32% among general clients and 0.03% among Antenatal Care (ANC) clients tested through Integrated Counselling and Testing Centre (ICTC) services. Karnataka has 443 stand-alone ICTCs and 2,610 facility-integrated ICTCs, along with ART and STI/ Reproductive Tract Infection (RTI) service facilities.⁸³

4. Other Medical Issues

517. Common health concerns in Karnataka include diarrhoeal diseases, acute respiratory infections, non-communicable diseases, dog bites, snake bites and road traffic injuries. According to the National Family Health Survey (NFHS) report-2019-20, diarrhoea was reported among 5.3% of children under five years of age in Karnataka.⁸⁴ Road safety is a key concern, with 43,440 road accidents, 12,321 deaths and 52,547 injuries reported in Karnataka in 2023.⁸⁵

5. Disability

518. As per Census 2011 data reported by the Department for the Empowerment of Differently Abled and Senior Citizens, Government of Karnataka, the State had 13,24,205 persons with disabilities, of which 7,92,694 lived in rural areas and 5,31,511 in urban areas.

O. Occupational Health and Safety

519. Construction of the project roads will require workers at worksites and labour camps. Adequate accommodation, health, safety, and welfare facilities must be provided and maintained throughout the construction stage.

520. The contractors are likely to engage local unskilled labour, while specialized road construction equipment requires trained personnel not readily available locally. The construction workforce is expected to be about 140-150 workers per package, although this will vary by activity.

⁸² Karnataka Economic Survey 2024–25 reports NCD prevalence, malaria, dengue, chikungunya, AES/JE and HIV screening data. https://des.karnataka.gov.in/uploads/media_to_upload1756798837.pdf. Accessed on 15.June.2026.

⁸³ Karnataka State AIDS Prevention Society report provides HIV surveillance, ICTC, ART and STI/RTI service details.

⁸⁴ NFHS-5 Karnataka factsheet provides data on diarrhoea, ARI and treatment-seeking among children under five.

⁸⁵ Karnataka State Police Road Accident Report 2023 provides accident, fatality and injury data for the State.

P. Labour and Working Conditions

521. Nationally, the engagement of children below 14 years of age is prohibited in all occupations and processes, while adolescents between 14 and 18 years are prohibited from working in hazardous occupations and processes.⁸⁶

522. In Karnataka, child labour continues to be monitored through the Labour Department and the Karnataka State Child Labour Eradication Project Society; however, the risk may still be relevant in informal sectors, migrant labour households, small establishments and construction-related supply chains.⁸⁷

Q. Indigenous Peoples

523. Karnataka has 50 Scheduled Tribes (STs) notified under the Constitution (Scheduled Tribes) Order (Amendment) Act, 2003, with their distribution varying widely across the state. Some tribes are concentrated in specific districts, while others are scattered across multiple regions. Major ST communities include Nayaka/Valmiki, Gond, Koli Dhor, Jenu Kuruba, Koraga, Yerava, Sholigaru, Hakki Pikki, and Siddi, among others. A few groups are identified as Primitive Tribal Groups/Particularly Vulnerable Tribal Groups (PVTGs), and several tribes are either exclusive to or primarily inhabit Karnataka. Overall, the tribal population reflects significant social and cultural diversity, with notable concentrations in districts such as Ballari, Raichur, Chamarajanagar, Mysuru, Kodagu, Dakshina Kannada, Udupi, Uttara Kannada, and Bengaluru Urban.

524. The livelihoods and traditional resource-use patterns of ST communities differ by physiographic region. In the northern and central plateaus, tribal communities are largely dependent on rainfed agriculture, livestock rearing, wage labour, bamboo work, and rural crafts, with seasonal migration and increasing reliance on welfare schemes and rural employment programs. In the southern plateau, tribes such as Jenu Kuruba, Kadu Kuruba, Iruliga, and Hakki Pikki combine forest-based activities, marginal farming, and urban informal employment, while still depending on common lands and forest fringes. In the Malnad, Western Ghats, and coastal regions, communities such as Koraga, Yerava, Siddi, and Kattunayakan are more closely linked to forest and coastal ecosystems, relying on non-timber forest products, honey collection, basket weaving, fishing, plantation labour, and small-scale agriculture. This shows that tribal livelihoods in Karnataka remain closely tied to local ecological conditions, although many communities are increasingly diversifying into wage labour and urban occupations.

525. An assessment of potential impacts on Tribal/Indigenous communities has been undertaken. The assessment identified 74 roads with a significant Tribal/Indigenous population, as presented in Table IV-28. Based on the findings, it was determined that the Tribal/Indigenous communities do not have any dependence on forest land that is proposed for acquisition or expected to be affected during the construction phase. Also, during the consultation with forest department, it was found that the Forest Rights under the Forest Rights Act (FRA), 2006 does not trigger.

⁸⁶ The Child and Adolescent Labour (Prohibition and Regulation) Act, 1986, as amended, prohibits child labour below 14 years and hazardous work for adolescents aged 14–18

⁸⁷ <https://childlabour.karnataka.gov.in/5/about-us>. Accessed on 18.6.2026

Table IV-28: List of Roads having Significant Number of ST Beneficiaries

SN.	District	Constituency	Name of Road	Length (Kms)	Habitations	Total ST Population	% of ST in Total Population
1	Bagalkot	Bilgi	Teggi to Ballur Shed (Inam Hanchinal) Road	3.4	Teggi	1816	35.48
2	Ballari	Bellary	Y Budihal cross road to Y Budihal - Bobbakunta main road via vijayapura camp	2.7	Yettinabudihal Vijayapura Camp Bobbukunta	2176	54.76
3	Ballari	Bellary	Old Yerragudi to Ballari-Adoni main road	2.94	Hosa Yerragudi Yerragudi	2521	62.05
4	Ballari	Bellary	Meenahalli to joladarasi	5.62	Meenahalli Hagari Station Sidiginamola Joladarashi	2873	45.40
5	Ballari	Bellary	Vanenur to Gududur camp	6.07	Vanenur	1406	45.96
6	Ballari	Bellary City	Ballari - Kolagal MDR to Allipur- Kolagal MDR	3.86	1) Batri 2) Kolagallu 3) Shanthi Nagar	2728	13.21
7	Ballari	Bellary City	Thirumalanagar B Camp to K.Bevinahalli - Shankarabanda MDR	2.88	1) Thirumalanagar B Camp 2) Shankarabanda	831	58.36
8	Ballari	Bellary City	Improvements to road from Hanuman Nagar to Ballari bypass via Patrabudihal	2.32	1) Hanuman Nagar 2) Patrabudihal	2016	7.75
9	Ballari	Bellary City	Thirumalanagar camp to Bandihatti via Mangamma camp , Hanuman Nagar,	15.05	1) Mangamma Camp 2) Bandihatti 3) Guggarahatti 4) Mundrigi 5) Thirumalanagar Camp	3742	8.11
10	Ballari	Kampli	Vadhatti Cross To Vadhatti	2.77	Vaddatti Vaddatti Camp	1593	30.19

SN.	District	Constituency	Name of Road	Length (Kms)	Habitations	Total ST Population	% of ST in Total Population
					Rambabu Camp Annapurneshwari Camp		
11	Ballari	Kampli	Basarakodu to Gududur via allum sumangalamma camp from Ch 4.50Km to 7.62Km	3.12	Basarakodu Gududur Allamsumanagalamma Camp	1643	37.94
12	Ballari	Kampli	Mustagatta to Arjun raj camp via baburao camp	6.96	Mustagatta Baburao Camp Arjun Raja Camp	1,860	57.34
13	Ballari	Kampli	Somalapura cross to H Veerapura via Somalapura chitiginahal	6.39	Somalapura Chitiginahal Chitiginahal Camp Thataraja Camp	2380	58.75
14	Ballari	Sandur	Gouripura to D.B.Halli Cross via S Oblapura	3.46	Gouripura, Db Halli, S.Oblapura	472	34.40
15	Ballari	Sandur	Surravanahalli to Taluka Border (jarmali cross)	4.02	Survvanahalli, S.Lakkalahalli, S Gollarahatti	743	70.76
16	Ballari	Siraguppa	Gundiganuru to sirigeri via gundiganuru camp	3.84	Gundiganur Sirigeri	2391	20.75
17	Belagavi	Athani	Improvements to Road Savadi RC Road to MDR(Athani Jamkhandi Road)	5.39	Savadi Rc Savadi Radderhatti Gaikwad Tota	2200	26.85
18	Belagavi	Chikkodi-Sadalga	Improvements to road from Ingali to Shedabal via Ganesh Nagar	3.38	Ingali Shedabal	2400	13.19
19	Belagavi	Kagwad	Improvements to Road Ugar BK to Lokur via Turaiwadi	9.15	Lokur Mamdapuri Sangappagol Vasti Borakatri Kalloti Vasti Kallal Shedbal	2925	12.24

SN.	District	Constituency	Name of Road	Length (Kms)	Habitations	Total ST Population	% of ST in Total Population
					Turai Vadi Ugar Bk		
20	Belagavi	Yemkanamardi	Improvements to Road from Indira Nagar to T09 Road	2.77	Indira Nagar	385	31.95
21	Belagavi	Yemkanamardi	Daddi to Bidrewadi to Aladal	3	Daddi, Bidrewadi, Aladal	1862	48.65
22	Bidar	Basavakalyan	Kitta Cross to Basavakalyan (Rural Police Station Basavakalyan)	3.75	Kitta, Gokul, Narayanpur, Narayanpurwadi, Yadlapur, Basavakalyan, Dhannura R, Janapur	7281	9.50
23	Bidar	Basavakalyan	Hirnagaon to Chiknagaon via Gangaram Tanda, Banjara Tanda	6.63	Hirnagaon, Chiknagaon, Mudbi, Gangaram Tanda, Banjara Tanda, Chiknagaowadi	2353	24.23
24	Bidar	Bidar	Gadgi to Nandgoan	3.67	Hamilapur, Ghumma, Nandagonv, Malegoan, Gadagi, Odwada	2580	22.18
25	Bidar	Bidar South	Mandaknalli To Kashampur(P) Via Malik Mirzapur	4	Kamthana , Kashampur(P) And Malik Mirzapur	4275	27.71
26	Bidar	Bidar South	Nirna To Bashirapur And Towards Meenkera	5.8	Nirna, Bashirapur , Meenkera, Boral, Alipur And Alipur Thanda	3683	21.70
27	Bidar	Humnabad	MDR to Rajola Tanda	2.65	Rajola, Rajola Tanda, Ghatboral, Hunsgera	2676	15.83
28	Bidar	Humnabad	Pandergera to MDR	3.5	Pandergera, Pandergera Tanda, Rajeshwar, Yarbag, Sadlapur, Dhannura K	2590	13.55
29	Bidar	Humnabad	Fathimapur To Walkhindi -Itga Junction (Balance Length)	4.8	Chitguppa, Walkhindi And Itga	2573	8.36
30	Bidar	Humnabad	Humnabad to Kallur Thanda	3.65	Kallur Thanda, Basvatirth, Kallur And Basvanthpur	1643	31.75
31	Bidar	Humnabad	Sindhenkera to Hankuni and towards Fathimapur	5.6	Sindhenkera, Hankuni And Humnabad	4261	8.19

SN.	District	Constituency	Name of Road	Length (Kms)	Habitations	Total ST Population	% of ST in Total Population
32	Bidar	Humnabad	Gogga to Hulgutti	2	Gogga, Mallikarjunwadi	1310	89.42
33	Chamarajanagara	Hanur	Improvements to Road from Marur to Ponnachi	3.06	Marur Ponnachi	1476	33.74
34	Chikkaballapura	Chintamani	CMY ROAD to Y.Kurupalli Road via I.Kurupalli, Myakapothalahalli, Junjanahalli, Naravamakalahalli, Puligundlahalli	9.73	I.Kurupalli, Myakapothalahalli, Junjanahalli, Naravamakalahalli, Puligundlahalli	630	34.50
35	Chitradurga	Challakere	Nannivala to Taluk Border (Hosakatappanahatty) Via Nakkalarahatty	5	Chikkatanahatty, Hosakatappanahatty, Naklarahatty, Nannivala, Ningalarahatti, Rathnagiri Hatti	858	40.84
36	Chitradurga	Chitradurga	Jodichikkenahally to Jodichikkenahalli G.hatty upto Taluk border (Balenahalli)	3.86	Jodichikkenahally, Jodichikkenahalli G.Hatty, Jodichikkenahalli L. Hatti, Ennegere	642	31.21
37	Chitradurga	Molakalmuru	Thaluku to Maraihanahatty via Hosahalli	4.59	Maraihnahatty, Hosahally, Talak	1241	34.96
38	Dakshina Kannada	Mangalore City North	Paduperar korakambala kattalsar Road	2.53	Barankila, Budiogadi, Katinje Varakala , Balvandi, Paduperar Proper, Padpu Kora Kambala	4832	98.81
39	Davanagere	Channagiri	SH near Bilahalli cross to Hosabanihatti via Bilahalli,Bussenahalli	8.6	Bilahalli Hosabanihatti Bilahalli Bussenahalli Muddenahalli Agarabannihatti Channagiri	38293	13.30
40	Davanagere	Davanagere South	NH48 near Davanagere to	7.65	Davanagere Chandranahalli Pamenahalli	36218	14.58

SN.	District	Constituency	Name of Road	Length (Kms)	Habitations	Total ST Population	% of ST in Total Population
			Chandranahalli via Pamenahalli				
41	Davanagere	Jagalur	Bangarakkanagudda to Donnehally Via Hoasahatty	4.5	Bangarakkanagudda , Donnehally, Hoasahatty, Kananakatte, Hosa Kananakatte, Aknur, Siddammanahalli, Hucchavvanahalli, Honnamaradi, Kamagethanahalli, Bharamasamudra	2631	21.52
42	Haveri	Byadgi	Arbagonda - Katenahalli (SH136) to kalladevar Via Kengonda	3.86	Kalladevar, Kengonda	1495	35.23
43	Kalburgi	Sedam	SH10 to Hanganalli-Udagi Road via Rajiv Nagar	2.7	Hanganhalli And Rajiv Nagar	820	35.34
44	Koppal	Kanakagiri	Chikkadankankal-Basaweshwar nagar-29th distributory camp-Tondihal road	6.61	Chikkadankankal , 29th Distributory Camp	844	41.17
45	Koppal	Kanakagiri	improvements to road from basarihal to varankheda vai bailakkampura	6.09	Basarihal , Varankheda , Bailakkampura	2083	72.88
46	Koppal	Yelburga	Imporvements to road from Gandal to Katagihalli	4.8	Gandal Katagihalli	1595	34.73
47	Koppal	Yelburga	Imporvements to road from Makkalli to Vajrabandi SH Vai Salabhavi	2.92	Salabhavi Makkalli,	648	54.64
48	Mysuru	Heggadadevankote	Improvements to road from Hulikura to Hebbalakuppe	2.76	Hebbalaguppe Hulikura	1432	38.41

SN.	District	Constituency	Name of Road	Length (Kms)	Habitations	Total ST Population	% of ST in Total Population
49	Mysuru	Hunsur	Improvements to road from Periyapatna Taluk Border to Virajpet Road (SH-90) via Vadli Manuganahalli	3.01	Vadimanuganahalli	220	52.13
50	Mysuru	Nanjangud	Karalapura MDR to Volgere - Masage Joining road via Handijogicolony	5.37	Karlapura Kalale Hadijogicolony Masage-Hosakote	4813	43.37
51	Mysuru	Nanjangud	Hadya to Shettahalli	8.69	Channapatana Hadya Hadyadahundi Jogipalyadahundi Kadajetti Kanenur Kappasoge Mangaloor Mudalahundi Shanthaiahnahundi Shettahalli Taraganahaly	3226	24.07
52	Mysuru	Piriyapatna	Gonikoppa Main road to Habaturu- Laxmipura Hadi To Booditittu	3.35	Habaturu, Laxmipura Hadi, Booditittu	1400	35.60%
53	Raichur	Devadurga	Galag Main Road to Jalmardi	3.65	Galag, Jalmaradi	178	47.98
54	Raichur	Devadurga	Kyadigera to AG Colony	5.15	Kyadigera, Ag Colony	2665	37.90
55	Raichur	Devadurga	SH 61 to Nagadadinni	7.44	Nagadadinni	875	35.00
56	Raichur	Devadurga	SH-61 to G irabgera	6.27	G Irabgera, K Irabgera	3573	55.85
57	Raichur	Manvi	RG Road to Rajaldinni	1.99	Rajaldinni	439	64.75

SN.	District	Constituency	Name of Road	Length (Kms)	Habitations	Total ST Population	% of ST in Total Population
58	Raichur	Manvi	Sangapur to mallinamadu	2.46	Sangapur Mallinamadu	2021	48.78
59	Raichur	Manvi	Dr. Camp to Nugdoni via N.Hosur	3.9	Dr. Camp N Hosur Nugdoni	1147	33.84
60	Raichur	Maski	Sanbal-maski road to Budinni	3.71	Sanaba, Maski,Biddinni	2378	9.34
61	Raichur	Maski	veerapur to mullur	4.66	Veerapur,Mullur	1574	54.79
62	Raichur	Maski	Benchmardi road to Maski via Sanabal	9.46	Benchamaradi , Maski,Sanabal	2546	10.10
63	Raichur	Raichur Rural	SH link to Maldoddi via kothadoddi J	3.37	Maldoddi Kothadoddi J	544	31.45
64	Raichur	Sindhanur	C.S.F To Ayyanur road via Vigneshwara camp,Venkateshwara camp,Annapurna camp,Paparao camp.	14.25	Ayyanur Vigneshwara Camp Venkateshwara Camp Annapurna Camp Paparao Camp	1947	34.30
65	Shivamogga	Shimoga Rural	Rechikoppa-Ragihosalli road to kumshi (NH-69)	3.71	Kumsi Ragihosalli	1535	40.97
66	Shivamogga	Shimoga Rural	SH115 (K K Road) to Hossa Chandanakere Via D B Halli	4.37	Hossachandanakere Dombabayranahalli Chandanakere	686	31.82
67	Uttara Kannada	Haliyal	Rayapattan to Garadalli in Haliyal Taluk, U.K District.	3.16	R Gouliwada,Gadgera,Garadolly, Wada,Rayapattana	723	50.00
68	Vijayanagara	Kudligi	Sanklapura to chiratagundu - Koracharahatti road	2.34	Koracharahatti, Myasarahatti,Yarralinganahalli,E kkegundi,Obalashettihalli,Chirtag undu	4931	64.98
69	Vijayanagara	Kudligi	Siddapura to Jummobanahalli-Hosahalli Road	3.5	Chikkajogihalli,Siddapura Vaddrahatti,Chikkjogihalli Thanda,J Myasarahatti,Siddapura,Siddapura Gollrahatti,Jummobana Halli	3400	46.64
70	Vijayanagara	Kudligi	MB Ayyanahalli to Bhisnahalli cross	4.17	Bellikatte,M B Ayyanahalli,B T Guddi,B Gollarahatti,B T Guddi	2691	23.64

SN.	District	Constituency	Name of Road	Length (Kms)	Habitations	Total ST Population	% of ST in Total Population
					Gollarahatti,Bhishnahalli,Harakabavi		
71	Vijayanagara	Kudligi	Arodhi to SH02	3.35	Nagarahunase,Jermali,A.Dibbadahalli,Harudi	1774	44.45
72	Vijayanagara	Kudligi	NH-50 to MDR via Boragatti	2.45	A Sooranahalli,Boragatta	563	58.58
73	Yadgir	Shorapur	Kakkera Main Road to Yadalbhavi	5	Kakkera,Yadalabhavi	9351	41.54
74	Yadgir	Shorapur	Rajankollur To Geddalmar Cross via Rajawal, KadadralKadadral	9.2	Rajankolloor,Geddalmari,Rajwal, Kaddral	2494	25.50

V. ANALYSIS OF ALTERNATIVES

A. Introduction

526. This chapter discusses the analysis of alternatives that have been considered for the improvement of proposed project roads in Karnataka. The assessment considers alignment, design, construction approach, technology, and operation and maintenance options, guided by the mitigation hierarchy from avoidance through offset. Each alternative has been examined with reference to likely environmental and social implications, technical feasibility, cost considerations, suitability to local conditions, and institutional requirements for implementation and monitoring. The purpose of the analysis is to demonstrate that the selected option represents the most appropriate and sustainable alternative in accordance with the principles of the Asian Development Bank's Safeguard Policy Statement (2009).

B. Screening of Roads for Project Consideration

527. KRRDA had initially proposed to improve 1,353 roads within Karnataka. The selection process ensured that all the districts and/or the constituent assemblies were represented. At this initial stage, limited consideration was given to the adverse environmental and social impacts of road improvements.

528. The 1,335 roads suggested for improvement included 334 roads that fell inside forest lands, legally protected areas, or their ESZs. The roads were subjected to a desk-based screening process wherein the location of every road was analysed on the basis of the potential impacts to biodiversity.

529. KRRDA was appraised on the biodiversity risks from the improvement of roads in ecologically sensitive habitats, and revisions to the list of roads for improvement were recommended. The screening criteria followed the application of the mitigation hierarchy from avoidance through offset.

530. The screening process for the inclusion or exclusion of roads in the project is presented below:

- The 1,335 roads were mapped against the available forest-related data including forest lands, legally protected areas, and ESZs
- Where a legally protected area did not have a notified ESZ, a 10 km default buffer was used
- Data from KRRDA regarding proposed improvement, RoW requirement, available RoW, requirement of additional land in forest or protected areas were sourced and analysed
- Roads within extremely sensitive areas such as inside legally protected areas or requiring additional forest land were listed and shared with KRRDA with a recommendation of excluding those roads from improvement.
- The list of roads thereby underwent further assessment by KRRDA from 1,353 to 1,335; with impacts to biodiversity being an important consideration in the revision of the list of roads for improvement
- The number of roads inside ecologically sensitive areas was minimized. Only those roads which had enough available RoW, such that no additional land in forest or

natural habitats would be required, were retained. This resulted in the lowering of the number of roads inside ecologically sensitive areas from 334 to 286.

531. The BAP is being developed in a way that is overarching and caters to the ecological considerations for these 286 roads as well.

1. Analysis of “Without Project” Scenario (No Project Alternative)

532. Under the no-project scenario, the existing rural road network would continue to function in its present condition, with only routine and reactive maintenance being undertaken. No pavement strengthening, carriageway improvement, drainage upgrading, or geometric correction measures would be implemented. As a result, existing deficiencies in road condition, safety, and serviceability would remain unaddressed and are likely to worsen over time.

a. Environmental Implications

- Progressive deterioration of the road surface would continue to generate higher levels of fugitive dust during dry weather, adversely affecting roadside air quality.
- Limited access to roads during the monsoon season due to flooding and waterlogging.
- Existing drainage deficiencies would remain unresolved, thereby increasing the likelihood of waterlogging, edge damage, and localized soil erosion.
- No opportunity would arise to improve roadside environmental conditions, slope stability, or landscape quality through planned engineering and plantation measures.
- Environmental management and monitoring would remain limited to ad hoc maintenance practices, without a structured framework for mitigation, supervision, or reporting.

b. Ecological Implications

- 286 roads have been found to be traversing through forest lands, legally protected areas, and eco-sensitive zones. Further, a preliminary assessment based on one season survey data, 591 roads are within critical habitats supporting Critically Endangered, and Endangered, and restricted range species based on the results of the CHA, which is slated for completion by February 2027⁸⁸. Subsequently, CHA and BAP will be updated after completion of four-season survey.
- Poor road conditions would continue to limit access for the Forest Department to the incidents spots in timely manner and reduce the effectiveness of routine patrolling activities.
- The improvement of rural/PMGSY roads is usually done without much consideration towards biodiversity impacts, as these are typically short and narrow, and are characterized by low traffic volumes. The underlying assumption is that there are no significant impacts to biodiversity from the improvement of rural/PMGSY roads. The without-project scenario would result in the improvement of existing roads by KRRDA or other state-level agencies without much consideration towards biodiversity-related impacts, including those on species of conservation concern as well as natural and/or critical habitat. The no-project

⁸⁸ KRRDA is in the process of identifying the roads under this improvement project for presence of forest areas.

scenario would not provide an opportunity to achieve biodiversity no-net loss followed by net gains; the project provides for an opportunity to implement the proposed Biodiversity Action Plan and associated species-specific conservation, habitat restoration, and monitoring measures would not be implemented.

c. Socio-Economic Implications

- Rural communities would continue to experience constrained access to markets, health facilities, educational institutions, and other essential services.
- Travel time unreliability and higher vehicle operating costs would persist, reducing transport efficiency for passengers and goods.
- Existing road safety risks associated with poor pavement condition, inadequate drainage, and substandard geometry would remain.
- The broader objectives of rural connectivity, local economic development, and inclusive service access would be only marginally achieved.

d. Cost Implications

- **Capital Cost:** No major upfront capital investment would be required.
- **Recurrent Cost Implications:** Although immediate expenditure would be limited, the scenario would result in substantial indirect and lifecycle costs due to recurrent patch repairs, higher vehicle operating expenses, travel delays, and forgone economic benefits.

e. Institutional and Policy Considerations

- The option would not require significant additional institutional arrangements, environmental supervision, or capacity-building inputs beyond routine maintenance functions.
- However, it would not adequately support state and national objectives related to improved rural accessibility, safer transport infrastructure, and balanced regional development.
- The scenario is also inconsistent with the safeguard and development outcomes expected under Asian Development Bank supported infrastructure improvement initiatives.

2. Analysis of “With Project” Scenario

533. The proposed Project involves improvement of the identified rural roads through pavement strengthening, localized widening within the available right-of-way, upgrading of cross-drainage and side-drain systems, geometric improvement at critical locations, and provision of road safety features. The project has been designed to maximize the use of the existing corridor and to integrate environmental management measures into planning, construction, and operation.

a. Environmental Implications

i. Construction Phase

- Construction activities would give rise to temporary and localized impacts, including dust emissions, noise, traffic disruption, soil disturbance, and risks of surface water contamination.
- Minor vegetation clearing and disturbance to roadside land may occur within the existing project corridor, particularly at locations requiring drainage and safety improvements.
- Construction and demolition waste, spoil, and used materials would require handling and disposal in accordance with established environmental management procedures.
- These impacts are expected to be short term and manageable through implementation of the Environmental Management Plan and good construction practices.

ii. Operation Phase

- Improved pavement condition would substantially reduce dust generation and enhance roadside environmental quality.
- Roads will be accessible in all-weather including monsoon season.
- Upgraded drainage infrastructure would reduce the incidence of waterlogging, pavement damage, and localized erosion.
- Roadside plantation and slope stabilization measures, where included, would contribute to visual improvement and local environmental enhancement.
- Overall, the project is expected to generate positive long-term environmental outcomes following completion of construction and implementation of mitigation measures.

b. Ecological Implications

- The Project would provide an opportunity to implement targeted biodiversity management interventions for the identified roads traversing through ecologically sensitive areas supporting Critically Endangered and Endangered, as well as range-restricted, or other species of conservation concern. A CHA has been initiated which led to the identification of critical habitats under the criteria of ADB's SPS (2009). The Project will lead to the engagement of qualified ecologists who will document the actual biodiversity-losses prior to and during the construction stage and monitor the performance against the targets set out in the BAP.
- Improvement of road conditions would facilitate timely access for the Forest Department incident locations and support more effective routine patrolling, surveillance and response within ecologically sensitive areas.
- The Project would support opportunities to achieve biodiversity net gains through implementation of proposed BAP.

c. Socio-Economic Implications

- The Project would improve connectivity between rural settlements and service centres, thereby reducing travel time and improving mobility.
- Vehicle operating costs and fuel consumption are expected to decline as a result of better pavement condition and improved road geometry.

- Road safety would improve through enhanced surface condition, improved drainage, geometric correction at critical stretches, and installation of safety provisions.
- Construction activities would generate short-term local employment and associated economic benefits.
- The project would also improve access to healthcare, education, markets, and administrative services, thereby supporting broader rural development objectives.

d. Cost Implications

- **Capital Cost:** The Project requires an initial capital investment for civil works, drainage improvement, road safety provisions, and implementation of environmental management measures.
- **Recurrent Cost Implications:** Routine and periodic maintenance would continue under a structured maintenance system; however, lifecycle costs are expected to be lower than under the no-project scenario due to improved asset condition.
- **Economic Benefits:** The expected reduction in travel time, vehicle operating costs, and accident risks would generate significant net economic and social benefits over the operational life of the roads.

e. Institutional and Monitoring Requirements

- Implementation of the Environmental Management Plan would be required throughout pre-construction, construction, and operation stages.
- Regular monitoring, documentation, and reporting would be necessary to verify compliance with safeguard commitments and environmental performance requirements.
- Capacity building and orientation of contractors, supervision personnel, and project staff would be required to support effective implementation of mitigation measures.
- Institutional strengthening of the implementing agencies, including the PMU and PIUs, would support effective oversight, coordination, and corrective action where needed.

C. Evaluation of Site, Design, and Technology Alternatives

1. Selection of Roads for the Project

- At the outset, the total road of 1353 initially considered, and 1335 roads were finalised for the DPR and EIA preparation.
- Out of 1353, 334 roads were found to be close proximity to ecologically sensitive area. These roads were analysed using GIS and site verifications by the KRRDA. Further 18 roads were dropped due to ecological risk and 269 roads were retained due to connectivity importance.
- During the analysis of 334 roads the following exercise were conducted.
 - 111 roads in the forest area were replaced while the remaining 189 roads continue to traverse RF/ESZ/WLS areas and have been subjected to further evaluation. Justifications were then submitted for 165 roads out of 189, followed by site verification. This resulted in 156 roads being retained as critical for local-community connectivity and 9 being dropped. This

- decision reflects a balance between developmental needs and environmental feasibility, supported by clarifications received from KRRDA. A subset of adjustments and refinements is also evident: 22 roads initially categorized under forest involvement have been reassessed, with 2 roads dropped due to lack of prior clarification and 20 roads retained following additional inputs. Within the 165 shortlisted roads, minor adjustments such as alignment corrections and duplication removal (e.g., 2 roads adjusted for the same road ID) have been undertaken to ensure data accuracy. A total of 9 roads, initially excluded, have been subsequently re-included based on further clarifications, indicating an iterative and evidence-based screening process. Overall, 187 roads have been identified as traversing RF/ESZ/WLS either partially or fully. Of these: 157 roads fall within Reserved Forest areas and are recommended for further review, including potential curtailment or dropping, subject to regulatory clearances. 32 roads intersect Wildlife Sanctuaries (7 roads) and ESZs (25 roads) and are recommended for dropping due to stringent statutory restrictions and conservation sensitivities. In conclusion, the screening framework demonstrates a robust, multi-stage decision-making process that integrates environmental safeguards, regulatory compliance, and project feasibility. The outcomes reflect a clear prioritization of minimizing ecological impacts, while advancing only those road projects that can be reasonably aligned with environmental and statutory requirements.
- Remaining 1019 roads (out of initial 1353 list) with no forest involvement were retained for DPR preparation. However, after further assessment by KRRDA, 316 new roads were added, making the final list of roads of 1335.
- The preferred option makes maximum use of the existing right-of-way (5 to 13 meters), thereby eliminating the need for private land acquisition and reducing environmental, biodiversity and resettlement-related impacts.
- Approximately 80 trees were identified to be fell for fifteen number of project roads improvement. KRRDA will align these roads in a way to avoid cutting of these trees.

2. Design Alternatives

- The road cross-sections and engineering provisions consistent with applicable design guidance such as PMGSY Environmental Code of Practice, Project planning and Design IRC SP 20:2002, are adopted to ensure functional adequacy, safety, and maintainability.
- Geometric improvements were confined to essential safety-critical locations to avoid unnecessary widening and additional land acquisition.
- Drainage structures and roadside protection measures were selected with due consideration to local terrain, runoff characteristics, and maintenance needs.

3. Technology and Materials

534. The selected technology and materials were chosen to balance technical suitability, cost-effectiveness, ease of maintenance, and environmental performance.

a. Pavement Selection

- Flexible pavement is selected for non-habitation stretches because it is cost-effective, relatively easy to construct, and compatible with locally available materials and prevailing maintenance practices.
- Rigid pavement is selected in village habitation areas due to its lower maintenance requirements and better suitability for sections subject to concentrated local use.

b. Construction Methods

535. Conventional and locally proven construction methods were preferred to support efficient implementation, effective quality control, and practical long-term maintenance by the responsible agencies.

c. Environmental Considerations

536. Environmental considerations have been integrated into material selection and construction planning through regulated sourcing of materials, appropriate siting of plants and construction camps, and restoration of disturbed areas after completion of works.

4. Operation and Maintenance Alternatives

- A structured and performance-oriented maintenance approach has been preferred to preserve road condition.
- Environmental upkeep measures, including maintenance of drainage, roadside plantation, and slope protection works, will be integrated into routine maintenance arrangements.

5. Pollution Prevention and Abatement

- The selected option reflects application of the mitigation hierarchy advocated under the Asian Development Bank's SPS 2009:
 - **Avoidance:** reliance on the existing alignment to avoid unnecessary land take and disturbance.
 - **Minimization:** control of dust, noise, spoil, and traffic disruption through good construction management practices. Management of emissions, waste, and occupational and community health and safety in line with World Bank Group Environmental, Health and Safety (EHS) General Guidelines.
 - **Rehabilitation:** restoration of borrow areas, work sites, and temporarily disturbed land following completion of works.
 - **Compensation/Enhancement:** compensatory plantation and other site-specific enhancement measures, where required.

D. Comparative Evaluation of Alternatives

537. The comparative evaluation of alternatives is presented in Table V-1:

Table V-1 With and Without" Project Scenarios - A Comparative Assessment

Evaluation Criteria	Without Project Scenario	With Project scenario
Overall environmental outcome	Existing environmental problems would continue or worsen, with no structured mitigation or enhancement.	Short-term construction impacts would occur, but these are manageable and outweighed by long-term environmental improvement.
Air quality and dust	Dust emissions from deteriorated road surfaces would persist.	Improved pavement conditions would reduce dust generation and improve roadside air quality.
Drainage and erosion	Poor drainage, localized waterlogging, and erosion risks would remain unresolved.	Improved drainage provisions would reduce waterlogging, protect pavement, and minimize erosion.
Ecological and roadside conditions	Limited disturbance in the form of vegetation/habitat clearance would occur, but there would also be no ecological restoration or biodiversity conservation, environmental enhancement or restoration.	Minor and localized impacts may occur during construction, with restoration and plantation measures improving long-term biodiversity conditions.
Social and economic benefits	Connectivity constraints, transport inefficiency, and limited access to services would continue.	The project would improve mobility, reduce travel time and costs, and support livelihoods and service access.
Road safety	Existing safety deficiencies related to pavement condition and geometry would remain.	Safety would improve through better road conditions, drainage, geometry correction, and dedicated safety features.
Cost implications	Low immediate capital outlay, but high indirect and lifecycle costs over time.	Higher initial investment, but better value over the asset life due to lower operating and maintenance inefficiencies.
Institutional requirements	Minimal additional institutional effort, but with limited capacity for environmental performance management.	Requires defined implementation, monitoring, and reporting arrangements, which support stronger safeguard compliance.
Policy and safeguard alignment	Does not adequately support transport development objectives or safeguard-driven improvement outcomes.	Consistent with government development priorities and the safeguard principles of the Asian Development Bank.

E. Basis for Selection of Preferred Alternative

538. The “with project” alternative has been identified as the preferred option based on its superior environmental, ecological, social, technical, and economic performance when compared with the no-project scenario. The principal considerations supporting this selection are set out below:

- Potential adverse environmental impacts are largely temporary, site-specific, and capable of being effectively avoided, minimized, or managed through the Environmental Management Plan.
- The Project provides an opportunity to implement targeted biodiversity management interventions for the roads traversing ecologically sensitive areas

and the roads falling within EAAAs through BAP, thereby supporting biodiversity conservation and potential net gains.

- The Project would generate substantial long-term benefits in terms of improved connectivity, reduced transport costs, enhanced road safety, and better access to essential services.
- The selected design makes maximum use of the existing right-of-way and thereby minimizes land acquisition requirements and associated social and environmental disturbance.
- The engineering and pavement options adopted are practical, cost-effective, and appropriate to local construction and maintenance conditions.
- Institutional arrangements are available, or can be strengthened, to support implementation, environmental monitoring, and safeguard compliance.
- The preferred alternative is aligned with rural infrastructure development objectives and with the safeguard expectations of the Asian Development Bank's Safeguard Policy Statement (2009).

539. The analysis indicates that the “with project” alternative is preferable to the no-project scenario from environmental, social, technical, and economic perspectives. While the proposed works would involve limited and manageable construction-stage impacts, these are outweighed by the long-term benefits arising from improved road condition, enhanced drainage, better safety performance, reduced transport costs, and strengthened rural connectivity. On this basis, the selected project configuration is considered the most appropriate and sustainable option for implementation.

VI. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

540. Road improvement projects are likely to bring several changes in the local environment, both beneficial for longer duration and adverse limited to construction phase. This section presents identification and evaluation of anticipated impacts during pre-construction, construction and operational phases of the improvement of 1,335 rural roads, identified under Category A. The proposed project interventions are expected to result in environmental and social impacts during the pre-construction, construction, and operation phases of the project.

541. The subsequent sections deal with the prediction and assessment of impacts due to the improvement of Project roads on the physical, biological and cultural environment. Environmental impacts have been assessed based on the data collected from the Project activities of DPR preparation, screening & scoping of environmental attributes, and baseline data collected during the EIA study.

A. Methodology of Impact Assessment

542. The methodology of identification of environmental impact, area of impact assessment, duration and severity of impacts are provided below. The assessment addresses direct, indirect, induced and cumulative impacts within the Project's area of influence, in accordance with ADB SPS 2009 (Safeguard Requirements 1).

1. Category of Impact

543. The methodology of assessing environmental impacts from the project entailed clearly identifying the environmental components that will be impacted, type of impacts, assessment area where the impacts will be felt and defining the criteria for assessing the significance of each type of impact. After defining these aspects, a screening of project impacts during preconstruction, construction and operation stages of the project was carried out to identify the minor, moderate and major impacts to guide development of mitigation measures and ensure that there are no or minimal residual impacts.

2. Identification and Screening of Impacts

544. This includes identifying the valued environmental components (VEC) of the physical, biological, and human environments that are at risk of being impacted by the Project. The VECs for this project which are based on the environmental baseline are:

- **Physical environment** – air quality and greenhouse gas (GHG) emissions, land and soil, and groundwater quality and quantity.
- **Biological environment** – terrestrial and aquatic ecology, flora and fauna.
- **Human environment** – private land and buildings, public infrastructure including utility structures, noise and vibration levels, schools and anganwadis⁸⁹, cultural/heritage buildings, water bodies along and crossing the project roads, commercial centres and occupational health and safety for the construction workers and local community living within the vicinity of the Project area.

⁸⁹ The Anganwadi system is a component of India's Integrated Child Development Services (ICDS) program, a government initiative, focused on improving the health and development of children, pregnant women, and nursing mothers. Key services include supplementary nutrition, pre-school education, health education, immunization, health check-ups, and referral services.

3. Type of Impact on the VECs

545. The type of impact can be described as:

- **Positive:** Improvement in the quality of the VECs because of the Project
- **Negative:** Degradation or reduction in the quality of the VECs because of the Project
- **Neutral:** No noticeable change in VECs.

546. Identified VECs is presented in Table VI-1.

Table VI-1 Identified VECs

Impacted component	Potentially impacting activities	Reason for inclusion
Physical and Biological Environment		
Air quality	Construction machinery at the Project site, and vehicular movement	There are settlements, schools, colleges, universities and anganwadis along the roads, which are potential sensitive receptors for ambient air quality. Construction activities will result in air emissions from fuel combustion in construction equipment and machinery. Road improvement will lead to increase in vehicular traffic leading to increased vehicular emissions.
Noise	1. Noise from construction equipment and machinery, and vehicular movement	There are settlements, schools, colleges, universities and anganwadis along the roads, which are potential sensitive receptors for ambient noise quality. Noise will be generated from construction equipment and machinery during construction and increased vehicular movement during operation.
Water resources	• Accidental Spills • Sedimentation and siltation • Groundwater and surface water abstraction	Water bodies covering ponds, lakes, irrigation canals, streams, tanks are crossing the roads and/or are along the roads. Water will be required during construction phase of the Project. Accidental spills and runoff can lead to contamination of the water resources.
Biodiversity and ecosystem services	Vegetation clearance, forest land diversion during construction, increased vehicle speed and traffic volumes during operations, marginal levels of tree felling	Loss or degradation and fragmentation of habitat due to vegetation clearance, degradation or loss of habitats where additional land is required in forest lands, habitat fragmentation, incremental on-road mortalities during operations Additional approvals and management of respective impacts will be required.
Socio-Economic Environment		
Migrant worker influx	Engagement of migrant workers during the construction.	Migrant labour (mainly local/ intra-state) mostly of a limited number of specialised skilled personnel may be engaged during the construction phase of the Project. The workforce is otherwise expected to be sourced from local villages and from within Karnataka. If the Project hires migrant labourer, contractors, and subcontractors, they might stay in local villages and could provide an influx of money into local businesses.

Impacted component	Potentially impacting activities	Reason for inclusion
Community health, safety, and security	- Noise impacts (assessed under physical environment) - Community health and safety - Air impact during construction	Noise generated during the construction phase may cause temporary disturbances to nearby communities and other sensitive receptors located along the project corridor. Community health and safety risks may arise from increased noise levels, dust emissions, traffic disruptions, and potential impacts associated with accidental structural damage. In addition, accidental spills or leakages of fuel, lubricants, or other hazardous materials could result in fire hazards and contamination of soil and water resources.
Cultural Heritage	Tangible and Intangible cultural heritage sites along the roads	Sites of cultural and religious significance are present along the roads, including temples, deities, graves, sacred trees, etc.
Community Livelihood	Construction activities	Shops, agricultural fields, plantations and other businesses are identified along the roads. Access to the business and work will be hampered during the road construction.
Common community areas	Construction activities	Access to common community areas like gram panchayat, fire station, public health centres (PHC), school, anganwadi etc. will be impacted.

547. The screening was carried out for impacts that are expected without mitigation. Hence, it guided the identification of impacts that need mitigation and clearly point out significant/major negative impacts that need to be prioritized for mitigation.

4. Area of Impact Assessment

548. Area of Impact Assessment has been determined for the site for establishing baseline. The area covered for assessing direct impacts include:

- **Core Zone/Direct Impact Area** - The study area includes a corridor extending 100 m on either side of the project alignment, which was considered for the assessment of direct project impacts. For most environmental parameters, a 100 m radius was adopted as the core impact zone for the identification and mapping of sensitive receptors during field surveys and for conducting baseline environmental monitoring. Borrow areas, quarries and storage areas for construction material are also considered for impacts from project activities.
- **Buffer Zone/ Indirect Impact Area** - In addition, a 2 km buffer was studied for indirect impacts.

549. The area of impact entails the spatial scale of impact on one or more of the VECs. The terms regional, local and limited are used to describe the area of impact:

- (i) Limited: The impact is felt within the direct impact zone
- (ii) Local: The impact is felt within the indirect impact zone
- (iii) Regional: The impact is felt beyond the indirect impact zone. In addition, induced impacts (those arising from Project-enabled activities, including workforce presence, associated facilities and increased connectivity) and cumulative impacts (the incremental contribution of the Project when combined with other existing and

reasonably foreseeable developments affecting the same receptors, in particular the EAAAs designated as critical habitat, shared surface and groundwater sources, and protected area buffers) are assessed.

5. Duration of Impact

550. Duration means the time dimension of the impact on the VECs. The terms permanent, temporary and short-lived are used to describe the duration of impact:

- **Short-lived:** The impact disappears promptly
- **Temporary:** The impact is felt during one Project activity or, at most, during the construction period of the Project
- **Permanent:** The impacts are felt throughout the life of the infrastructure.

6. Severity of Impact

551. The severity or seriousness of an impact entails understanding the repercussion or risks posed by the impact. This is a subjective criterion, which is defined as high, medium or low as below:

- (i) **High:** The severity of impact is high if grave repercussions are expected as a result of the impact due to any of the following or similar situations: the impact will be felt by a large number of people or receptors; the receptors are highly sensitive; the impacts will cause serious health issues; there is already a history of complaints from the project area and people have raised significant concerns during public consultation; some of the VEC in the project area already severely degraded and maybe further worsened by the project; there will be a significant change in one or more VEC because of the project
- (ii) **Medium:** The severity of impact is medium due to any of the following or similar situations: the impact will be felt by a small number of people; some receptors are affected but they are not sensitive; the impact will not cause serious health issues; some concerns were raised during public consultations, but they were not significant; there will be minor changes in one or more VEC because of the project
- (iii) **Low:** The severity of impact is low due to any of the following or similar situations: the impact will not be felt by anyone; no or limited receptors are affected; no concerns were raised during public consultations; there will be no noticeable changes in one or more VEC because of the project.

552. Based on the rating of duration, area and severity of impact as described above the overall significance of each impact as major, moderate or minor was determined as demonstrated in Table VI-2 below.

Table VI-2 Criteria for Rating the Significance of Impacts

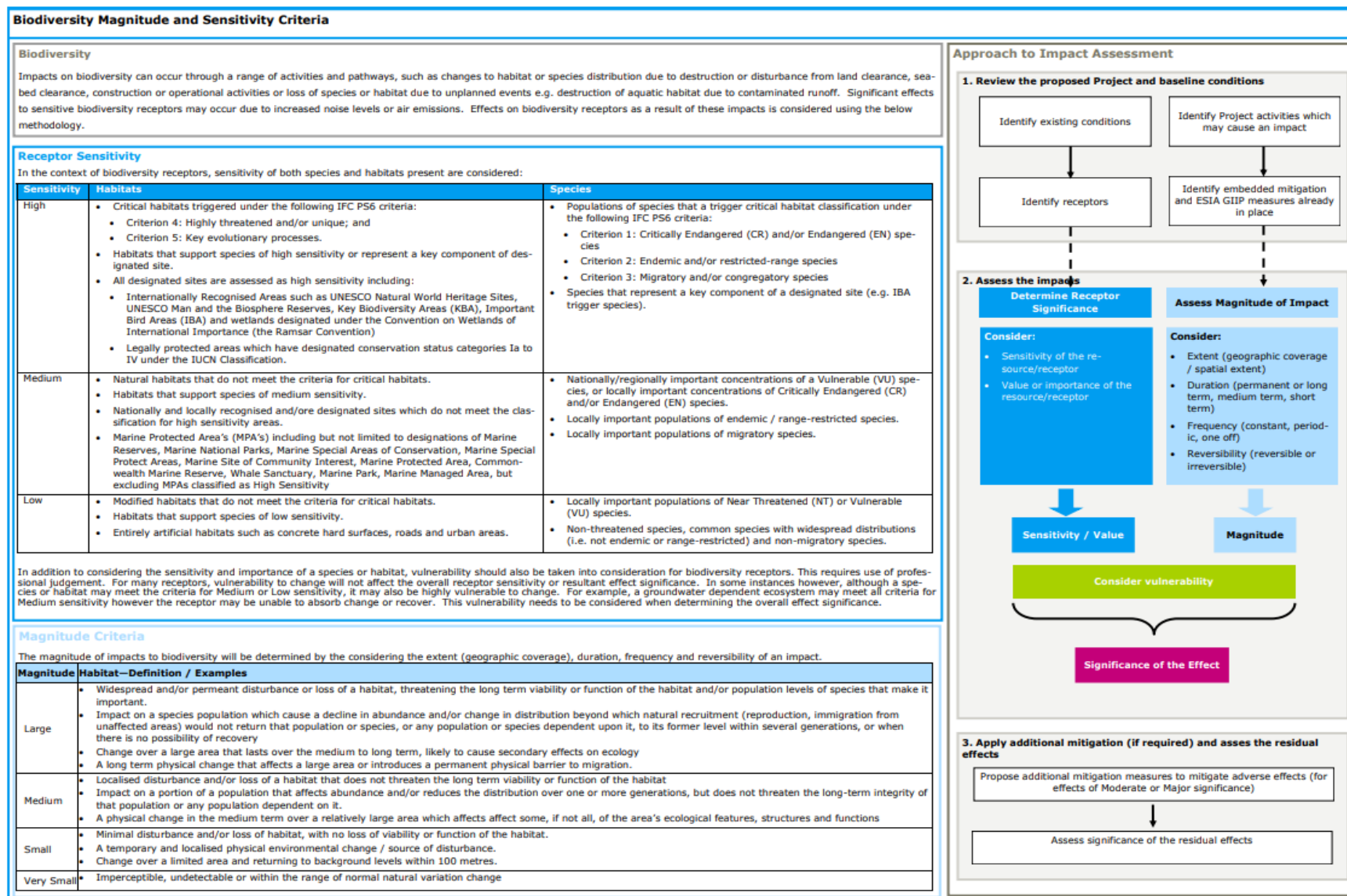
Significance	Duration	Area	Severity
Minor	Short lived or temporary	Limited or local	Low
	Permanent	Limited	Low
Moderate	Temporary	Limited or local – construction specific	Medium
	Permanent	Limited	Medium
Major	Temporary	Limited or local	Medium
	Permanent	Local or regional	High

553. For biodiversity and ecosystem services, receptor sensitivity and impact magnitude, and impact significance determination took into account aspects such as the threat or protection status of the receptors and the extent, duration, and nature of impacts. The determination was performed as illustrated in the Table VI-3 below.

Table VI-3 Biodiversity Impact Significance Determination

Impact Magnitude	Receptor Sensitivity		
	Low	Medium	High
Very Small	Negligible	Negligible	Minor
Small	Negligible	Minor	Moderate
Medium	Minor	Moderate	Major
Large	Moderate	Major	Major

Figure VI-1: Biodiversity Receptor Sensitivity and Magnitude Determination



554. The following section discusses the details of impacts on each of the VECs. Appropriate mitigation measures are provided to ensure that there are minimal or no residual impacts. Locations of roads near sensitive receptors, potential impacts on water and land resources, common community and cultural resources, and health and safety have negative impacts with major significance. These are reduced through the mitigation measures set out in this chapter; residual significance after mitigation is reported in the aspect-impact tables and remains moderate.

B. Typical Potential Beneficial Impacts

555. The immediate benefits of road construction and improvement will come in the form of direct employment opportunities during construction for wage labourer, petty contractors and suppliers of raw materials. During operation stage, connectivity of other villages, urban centres, taluka and district headquarters will increase. Project will accelerate the economic opportunities resulting in reduced migration. Other benefits of project road improvement are: (i) reduction in travel time, (ii) better mode and frequency of transport, (iii) access to quality health care, educational, and other infrastructural facilities (iv) improved quality of life of rural population, (v) reduced accidents, and (vi) better investment climate for industries creating more employment opportunities for local people.

C. Typical Potential Adverse Impacts

556. Major anticipated impacts arising from the improvement of rural roads are: (i) temporary livelihood impacts during construction, (ii) cutting of trees and temporary disruption in forest fringe areas, (iv) adverse impacts due to borrowing and quarrying, (v) increased risk of accident due to faster vehicular movement, and (iv) increased air and noise pollution due to increased traffic. Greenhouse gas emissions from construction plant and from induced traffic growth during operation are also considered. The estimated consumption of diesel is approximately 15,040 liters road⁹⁰ of average length 3.76 kms, during construction. Scope 1⁹¹ (direct onsite emission) GHG emissions will be approximately 39,706 kg per road of average length 3.76 kms. The Scope 1 GHG emission of operation stage will be significantly low as no significant consumption fuel or operation vehicles required during the operation stage, so it will not exceed the 100,000 tCO_{2e} per year threshold in ADB SPS 2009. Most of the impacts are reversible, temporary, localized in nature, and can be mitigated or minimised through effective implementation of the Environmental Management Plan (EMP). Certain operational impacts are, however, permanent, notably incremental on-road wildlife mortality within critical habitats and noise exceedances at sensitive receptors adjacent to the project roads, and these retain residual significance after mitigation. Residual exceedance of CPCB silence-zone limits may remain slightly above standards, especially at night, at many sensitive receptors even after barriers. Vegetation clearance in critical and/or natural habitat during the construction phase may lead to loss of or impacts to natural and/or critical habitats beyond in-situ restoration.

D. Detailed Impact Assessment

1. Soil Quality

⁹⁰ Considering average road length of 3.76 km and approximately 4000L diesel consumption per km during construction.

⁹¹ Scope 1 emissions are direct greenhouse gas emissions from sources owned or controlled by an organisation, such as fuel combustion in company facilities, vehicles, or equipment.

a. Construction

557. **Description.** Analysis of land use on either side of the existing road shows that predominant land use is vegetation land, comprising of agriculture, plantations, forest or wild vegetation. Disturbance or change in existing land use within the RoW is not anticipated due to the project activities. Predominance of coarse- to medium-textured soils, as reported along the project roads, generally have moderate to high drainage potential and may be susceptible to erosion where slopes or exposed surfaces remain unprotected.

558. Based on the soil texture, more than 20% of the roads are within moderate and high risk erosion area.

559. **Assessment-** KRRDA have required RoW for the improvements and expansion of roads, where applicable.

560. The potential of soil erosion is pervasive during the construction stage and earth work on the existing alignment. Starting with clearing and grubbing, wild vegetation comprising of shrubs and herbs will be stripped away, exposing raw soil. Earth works and embankment will also prone to erosion during rains. Soil erosion will add siltation to the runoff during the monsoon season.

561. On average, approximately 6,269 m³ of borrow material per road is estimated to be required for embankment, granular sub-base (GSB), shoulder, and subgrade works. Of this requirement, approximately 979 m³ per road is expected to be met through material generated from roadway cutting and drain excavation, thereby reducing the requirement for borrow material from external sources. Locations for borrow areas will be identified by the respective contractors. The extent of distance from the borrow area will be selected based on the DPR consultant's assessment. The requirement to restrict borrow areas to within 200 m is intended to promote localized material sourcing and minimize haulage-related impacts such as dust, emissions, traffic disruption, road damage, spillage, and community safety risks. However, considering the large number of project roads distributed across multiple districts, this requirement will be applied as a preferred siting principle and will be verified during pre-construction planning.

562. The contractor will identify suitable borrow areas and such areas will be reviewed and approved by the PIU/PMC before use. Borrow areas will be selected only where land availability, permissions, environmental suitability, community safety, and absence of ecological or socially sensitive constraints are confirmed. Where suitable borrow areas are not available within 200 m, material will be sourced from approved alternative borrow/quarry locations with required permissions, transport controls, and restoration measures.

563. Notwithstanding above, a borrow area management plan has been developed in the EIA to demonstrate the mitigation hierarchy. This will include the safeguards requirement for selection, operation and closure of borrow area. This will also include the transportation related risks.

564. The major source of debris generation is dismantling of existing cross drainage structures, scarifying of bitumen from carriageway and removal of existing road for up gradation.

565. The excavation of borrow pits used for obtaining soil for road construction can cause direct, and indirect long-term major adverse impacts on the environment. While loss of productive soil is the most direct negative impact from borrow areas, other significant indirect negative impacts can also occur.

566. Contamination of the soil may take place from the following activities at the construction zones, construction plant sites and other auxiliary facilities required for the construction, scarified bitumen wastes, debris generation due to dismantling of structures, maintenance of the machinery and operation of the diesel generator sets on site, oil spill from the operation of the construction machineries, maintenance and diesel storage and diesel generator sets, spillage bitumen from operation of hot mix plant, wastes storage and stock yards of bitumen.

567. **Anticipated Impact.** Aspect impact matrix for impact on soil during construction phase (Table VI-4).

Table VI-4 Aspect Impact table of Soil Environment

Aspect	Impacts		
Impact Description	Soil Erosion	Loss in productivity	Soil contamination
Receptor Importance/ Sensitivity	Medium	Medium	Medium
Extent	Core Zone	Buffer Zone	Core Zone
Duration	Permanent	Permanent	Temporary
Frequency	Single event	Recurring	Single event
Likelihood	Certain	Certain	Certain
Reversibility	Reversible	Reversible	Reversible
Magnitude/ Severity	Medium	High	Medium
Effect	Negative	Negative	Negative
Direct/ Indirect	Direct	Direct	Direct
Significance	Moderate	Major	Moderate
Additional Mitigation (Y/N)	Y	Y	Y
Residual Significance	Minor	Moderate	Minor

b. Mitigation Measures

568. **Embedded Mitigation Measures (EDM)-** EDMs applicable to the project are provided in Chapter 3 of this report. Following EDMs are applicable to mitigate the impacts on soil quality.

EDM	Description
EDM3	The DPR includes hydrology-based cross-drainage design and provides for replacement of damaged culverts and addition of new culverts where drainage crossings require intervention. This allows runoff to pass along natural drainage paths instead of getting obstructed by the road. The culvert outlets will be designed to minimize the soil erosion risk of water flow through the culverts and outfall to the soil erosion potential.
EDM7	The DPR includes turfing and stabilization of embankment slopes and earthen shoulders after road formation. This is an embedded bioengineering measure intended to stabilize bare soil surfaces that would otherwise erode during rainfall.
EDM8	The DPR requires topsoil from borrow areas and disturbed surfaces to be stripped, stored separately, and reused during site restoration. This is an important embedded mitigation measure because the design documentation recognizes topsoil as a resource to be conserved and reused.
EDM9	The DPR places controls on borrow area development by limiting excavation depth, maintaining distance from the embankment, and requiring rehabilitation/redevelopment of borrow areas after material extraction. This means the source area is considered part of the environmental footprint and not ignored.
EDM13	The DPR incorporates traffic signs, retro-reflective signs, pavement markings, stop lines, and zebra crossings at relevant locations. These measures are embedded because they are included as part of the road safety design and not left only to later operation-stage action.

569. **Additional Mitigation Measures (ADM).** In addition to the EDMs mentioned above, following ADMs will be applicable to mitigate the impacts.

ADM	Description
SQ1	When soil is spread on slopes for permanent disposal, it shall be buttressed at the toe by retaining walls.
SQ2	Borrow areas if required, shall not be located near forest areas. The edges of borrow sites shall be no closer than 3 metres from any fence line or boundary. Adequate clearance shall be provided for the construction of catch drains. Borrow sites shall have adequate drainage outlets unless the relevant landowner has agreed that the borrow area is to create a permanent tank or dam. Cut batter slopes shall not be steeper than 3 to 1 and shall be left by the Contractor in a tidy and safe condition to the satisfaction of the Engineer. Written clearance from the land owner/village head shall be obtained before leaving a site. The depths in borrow pits to be regulated so that the sides shall not be steeper than 25%, to the extent possible, borrow areas shall be sited away from habituated areas. Borrow areas shall be levelled with salvaged material or other filling materials which do not pose contamination of soil. The haulage distance from borrow areas will be selected based on the DPR consultant's assessment, with borrow areas to be sourced within 200 m of the alignment wherever suitable material is available, to minimise haulage and transport-related impacts (refer to the Borrow Area Management Plan at Appendix 13). Identification and verification of compliant borrow areas across all project roads shall be undertaken by the contractor and cleared by the PIU/PMC prior to opening any borrow area. (Refer Appendix 13 Borrow Area Management Plan.)
SQ3	Obtain statutory approval from competent authority as detailed in chapter 2 (recent policy initiatives on mining of minor mineral). The extent of distance from the borrow area will be selected based on the DPR consultant's assessment. The requirement to restrict borrow areas to within 200 m.
SQ4	Fuel and lubricants shall be stored at the predefined storage location. The storage area shall be paved with gentle slope to a corner and connected with a chamber to collect any spills of the oils.
SQ5	Unavoidable waste shall be stored at the designated place prior to disposal. To avoid soil contamination at the wash-down and re-fueling areas, "oil interceptors" shall be provided. Oil and grease spill and oil-soaked materials are to be collected and stored in labelled containers (Labelled: WASTE OIL; and hazardous sign be displayed) and sold off to SPCB/ MoEF&CC authorized refiners.) (Refer Waste Management Plan- Appendix 3)
SQ6	Septic tank or mobile toilets fitted with anaerobic treatment facility shall be provided.
SQ7	It will be Contractor's responsibility to ensure that spoil material does not spill in valley or any unwanted location. Contractor will have to dump spoil material at the approved dumping site. If loss to orchard, agricultural land causes due to Contractor's action, Contractor shall compensate such loss from his own cost. Dumping locations are given in EMP and guidelines has been provided for identification of dumping sites in EMP.
SQ8	The top soil (25cm depth) from the productive land shall be preserved and reused for plantation purposes. It shall also be used as top cover of embankment slope for growing vegetation to protect soil erosion. (Refer Appendix 9-Top Soil Management Plan). It will be ensured that the land taken on lease for access road, borrow areas is restored back to its original land use.

c. Operation

570. **Description.** Impacts on soil quality are not anticipated during operation phase of the project. Hence not assessed further in this report.

2. Natural Hazards

a. Construction

571. **Description.** Karnataka is prone to the droughts, landslide, flood, cyclone and thunderstorms. Sensitivity and exposure of roads for each natural hazard is provided in Chapter 4 (Description of the Environment) of this report, above.

572. **Assessment-** Karnataka is prone to thunderstorms and lightning events, which have resulted in recurring loss of life and damage to property across the state. A significant proportion of lightning-related fatalities occur among people working outdoors in agricultural fields and other rural settings. Districts of Kalaburagi, Dakshina Kannada, Vijayapura, Belagavi, Chikkamagaluru, Raichur, Shivamogga, Uttara Kannada and Tumakuru observed high to very high incidences of cloud-ground lightning events. Event(s) of lightning during construction phase will lead to health hazard for the workers.

573. 38 project roads are located within the high drought recurrence taluks with 12–15-year drought frequency class, in the districts of Kalaburagi, Bagalkot, Raichur, Ballari, Kolar, Tumakuru, Chikkaballapura, Ramanagara, Chamarajanagar and Vijayapura. Drought will impact construction activities in these districts, as water will be required for construction works. In the event of a drought during construction, water resource will become a competing resource for community and construction activities. Water as competing resource is covered under section 'Competing Resources' below.

574. Western Ghats, Malnad and coastal hill regions, with steep slopes, highly weathered terrain, intense southwest monsoon rainfall, fragile geology and expanding road infrastructure contribute to slope instability are prone to landslides in Karnataka. These include districts of Uttara Kannada, Chikkamagaluru, Kodagu, Dakshina Kannada, Shivamogga, Udupi and Hassan. 75 project roads falls under the moderate, high and very high sensitivity to landslides. Landslide events around or over these roads during construction will be a health hazard for the workers. The coastal belt of Karnataka remains susceptible to cyclonic storms and associated high-wind events.

575. Impacts from lightning, landslide and cyclone events are covered under section 'Occupational Health and Safety' below.

b. Operation

576. **Description.** After the improvement, project roads falling in the landslide and flooding prone zones, as described in Chapter 4 (Description of the Environment) of this report, above, will be prone to damage and danger to the road users.

577. **Assessment.** Highest concentration of landslide events is recorded in Uttara Kannada and Chikkamagaluru districts, followed by significant occurrences in Kodagu, Dakshina Kannada, Shivamogga, Udupi and Hassan. High landslide density is particularly associated with coastal

and ghat sections of Uttara Kannada, Charmadi, Koppa, Sringeri, Kalasa and Bababudangiri belts in Chikkamagaluru, Kodagu hill slopes, Dakshina Kannada ghat roads, and Malnad hill regions of Shivamogga and Hassan.

578. Karnataka has experienced severe flooding, particularly within the Krishna and Cauvery river basins during the monsoon season. Flood recurrence is highest in the Western Ghats, coastal Karnataka and certain northern river basin taluks, particularly in districts such as Uttara Kannada, Udupi, Dakshina Kannada, Kodagu, Shivamogga, Hassan, Belagavi, Bagalkot, Vijayapura, Raichur and parts of Kalaburagi.

579. In the events of flooding, landslides and cyclone roads will get blocked and damaged posing danger to the road users during and after the event.

580. **Anticipated Impacts.** Impact matrix (Table VI-5) is presented below.

Table VI-5: Aspect impact table of impact of natural hazards for operation phase

Aspect	Impacts
Impact Description	Danger to road users
Receptor Importance/ Sensitivity	High
Extent	Core Zone
Duration	Permanent
Frequency	Continuous
Likelihood	Likely
Reversibility	Reversible
Magnitude/ Severity	High
Effect	Negative
Direct/ Indirect	Direct
Significance	Major
Additional Mitigation (Y/N)	Y
Residual Significance	Moderate

c. Mitigation Measures

581. **Embedded Mitigation Measures (EDM).** EDMs applicable to the project are provided in Chapter 3 of this report. Following EDMs are applicable to mitigate the impacts of natural hazards.

EDM	Description
EDM3	The DPR includes hydrology-based cross-drainage design and provides for replacement of damaged culverts and addition of new culverts where drainage crossings require intervention. This allows runoff to pass along natural drainage paths instead of getting obstructed by the road. The culvert outlets will be designed to minimize the soil erosion risk of water flow through the culverts and outfall to the solid erosion potential.
EDM4	The DPR provides roadside drainage, side drains, and drainage chambers at relevant locations so that storm water is collected and safely conveyed to low points and discharge points.
EDM5	In low-lying sections, the DPR proposes raising the embankment and maintaining freeboard above the recorded flood level. This is a climate-resilient design measure embedded in the engineering profile of the road.
EDM7	The DPR includes turfing and stabilization of embankment slopes and earthen shoulders after road formation. This is an embedded bioengineering measure intended to stabilize bare soil surfaces that would otherwise erode during rainfall.

582. **Additional Mitigation Measures (ADM).** In addition to the EDMs mentioned above, following ADMs will be applicable to mitigate the impacts.

ADM	Description
NH1	Regular cleaning of side drains, culverts and causeways.
NH2	Install simple signboards in landslide/flood-prone areas.
NH3	Use local rainfall observation to restrict traffic during heavy rain.

3. Ambient Air Quality

a. Construction

583. **Description.** Road projects involving improvement of existing roads have a significant impact on the ambient air environment, primarily due to the dust emission from various construction activities. During road improvement, scarification activity to remove the existing worn-out bitumen layer, where required, in addition to earthmoving and material handling. Diesel generated construction machinery, hot mix plant, generators and vehicles are engaged for the construction phase. Fine aggregates and filler material are stored near the project roads for construction. Base preparation for the construction requires blowing away the dust and foreign matters from the road. For the concrete cement roads, where applicable, there will not be batching plant operations for the project and premix will be procured by contractors from a third party. Borrow areas identification, operation and closure will be done by the contractors, following borrow area management plan (Appendix 13) with the approval of PIU and PISC. Movement of material from borrow areas will result in fugitive emissions.

584. **Assessment-** According to the baseline study, ambient air quality in rural parts of the Karnataka meets prescribed National Ambient Air Quality (NAAQ) standards, while maximum and spatial average concentrations of PM₁₀ and PM_{2.5} are higher than the World Bank Group General EHS guideline values. The maximum SO₂ concentration also exceeds the applicable WBG guideline value. Activities during construction of the Project roads will add dust and other pollutants to the ambient air.

585. Scarification activity leads to disturbance of soil, and emission of particulate matters such as PM₁₀ and PM_{2.5} suspended in air. Diesel generated machinery, hot mix plant, generators and vehicles are mobile sources of emissions and emit gases such as Carbon Dioxide (CO₂), Nitrogen and Sulphur Oxides (NO_x and SO_x), Carbon Monoxide (CO) and other Volatile Organic Compounds (VOCs). Base preparation by blowing away dust, and storage of fine aggregates and filler material lead to fugitive dust emissions.

586. Generation of dust is a critical issue and is likely to have adverse impact on health of workers, residents along the roads and agriculture and vegetation in surrounding areas. Although the impact will be much localized, it can be dispersed downwind depending on the wind speeds.

587. During the construction activities, dust and gases will be emitted sporadically and temporarily. The impacts of dust and gaseous emissions will be localized and time limited. Dust reduces air quality, aesthetics, and reduced plant photosynthesis thus subsequently hamper the growth of the plants.

588. Therefore, anticipated impact on ambient air quality will be temporary and restricted within the vicinity of the construction activities along the project road and allied activities area such as, borrow areas.

589. At this stage we do not envisage the establishment of ancillary facilities like plant site. However, mitigation measures cover safeguards for anticipated impacts from the establishment of hot mix plant, as a precautionary approach in the unlikely scenario that their establishment is required.

590. **Anticipated Impacts.** Aspect impact matrix (Table VI-6) for ambient air environment is presented below.

Table VI-6 Aspect impact matrix for ambient air environment

Aspect	Impacts	
	Impact due to particulates, oxides of sulphur, oxides of nitrogen and hydrocarbons from vehicular movement and diesel generators, and hot mix plant	Impact due to particulate matter suspension from dust from scarification and base preparation
Impact Description		
Receptor Importance/ Sensitivity	High	High
Extent	Core Zone	Core Zone
Duration	Short term	Short term
Frequency	Once	Once
Likelihood	Certain	Certain
Reversibility	Reversible	Reversible
Magnitude/ Severity	Medium	Medium
Effect	Negative	Negative
Direct/ Indirect	Direct	Direct
Significance	Moderate	Moderate
Additional Mitigation (Y/N)	Y	Y
Residual Significance	Minor	Minor

b. Mitigation Measures

591. **Embedded Mitigation Measures (EDM)-** EDMs applicable to the project are provided in Chapter 3 of this report. Following EDMs are applicable to mitigate the impacts on ambient air quality.

EDM	Description
EDM17	The DPR/EMP provisions require construction materials to be transported with tarpaulin cover and haul roads to be maintained and dust-controlled. Contractor shall sprinkle water to suppress dust as per site condition. Contractor shall maintain existing road and haul road so that vehicles can pass easily and ensure that generation of dust is minimized. The excavated earth /construction materials shall be stored properly so that it does not generate fugitive emissions. Storage area should be located downwind of the habitation area. Contractor shall install wet scrubber or any other suitable pollution control mechanism for hot mix plant and ensure that flue gas passes through the wet scrubber before releasing into ambient air. Contractor shall also ensure that wet scrubber or other filter is always operational when hot mix plant is in operation. Although implemented during construction, these are embedded in the project documentation and therefore form part of the planned mitigation package. The setback conditions for sensitive receptor as prevailing CPCB guidelines is 500 m from human habitation, 200 m from highways, and 500 m from sensitive ecological/institutional zones. Where the setback distances specified above cannot be achieved and no alternative location is available, and subject to prior approval of the PIU/PISC, barricading with 6-meter-high GI sheets will be provided as a supplementary control. Barricading shall not be treated as a substitute for the prescribed separation distances, and avoidance of siting within the setback shall remain the first order of preference.
EDM19	LPG should be used as a fuel source in construction camps instead of wood. Ambient air quality shall be monitored by the Contractor as per the environmental monitoring plan of the EIA to ensure parameters are within permissible limits. Contractor shall follow Generic Guidelines for Environment Friendly Construction Methodology appended in EMP. DG set shall be provided with chimney of adequate height as per CPCB guidelines (Height of stack in meter = Height of the building + $0.2 \sqrt{\text{KVA}}$).

592. **Additional Mitigation Measures (ADM).** In addition to the EDMs mentioned above, following ADMs will be applicable to mitigate the impacts.

ADM	Mitigation Measures
AA1	All vehicles and equipment to be procured for the proposed upgradation of project roads shall conform to the relevant Bureau of Indian Standard (BIS) norms. Vehicles and machinery shall be maintained regularly and Pollution Under Control (PUC) certificates shall be obtained by the Contractor regularly.

c. Operation

593. **Description-** Road transport is identified to be a critical contributor to air pollution in the Indian context. Rural communities in India, including Karnataka are public-transport dependent

with low frequencies and poor coverage. According to the Karnataka Economic Survey 2024–25⁹² inadequate transportation facilities continue to be a constraint to rural development. The inadequacy in public transport, also promotes purchase of vehicles at households' level, to meet the regular commute demands for education, health and market. Additionally, diesel run vehicles for agricultural activities and movement of agricultural produce are frequent on the rural roads. The majority of motor vehicles are running with diesel and petrol, as clean fuel like Compressed Natural Gas (CNG) is yet to be available in most part of the country for every kind of vehicle.

594. The motor vehicle stock in Indian cities, as well in rural areas has grown steadily in the past and is expected to continue with the momentum in the future due to the increase in population, migration, and economic growth. Development of existing roads will add to existing traffic which in turn to air pollution, on human establishments etc. along the road corridor. In case of road projects, vehicular traffic is the main source of air pollution and responsible for poor air quality along the road corridor. Well maintained and new engine technology-based vehicles causes less pollution as compared to old technology and ill maintained vehicles. Concentration of pollutants depends not only on traffic volume but on other factors also. Estimation of pollution emission rate is complex process especially when traffic is heterogeneous in nature.

595. **Assessment.** The air quality parameter is the most common environmental feature, which is being affected by any infrastructure projects. The pollutants of concern (recognized by the Central Pollution Control Board (CPCB) as potentially damaging to human health) for the Project are the substances emitted by the traffic plying on the road stretch. The main pollutants of concern that may be generated from vehicular emission are nitrogen dioxide (NO₂), sulphur dioxide (SO₂), Carbon Monoxide (CO), particulate matter (PM) as PM₁₀ and PM_{2.5}, Ammonia (NH₃), Ozone (O₃), Lead (Pb), Arsenic (As), Nickel (Ni), Benzo(a)pyrene (BAP) and Benzene. The intensity of air pollution is linked with inadequate vehicle maintenance, load of vehicles, speed of vehicle and use of adulterated fuel in vehicles.

596. Existing baseline data suggests vehicular emissions to be source of gaseous pollution in the rural areas. Quantitative operational air quality modelling is not considered for the KRRIP rural road improvement project because the project comprises rehabilitation and upgrading of existing low-volume rural roads rather than development of new traffic corridors. The project does not introduce major stationary emission sources and is not expected to induce substantial increases in traffic volume. Most road sections traverse open rural environments where pollutant accumulation is unlikely. The operational air quality impacts are of low significance and can be adequately assessed through baseline monitoring, qualitative evaluation, and implementation of standard mitigation measures.

597. **Anticipated Impacts.** Aspect impact matrix for ambient air environment during operation (Table VI-7) of the rural roads, after improvement is presented below.

Table VI-7 Aspect impact matrix for ambient air environment during operation

Aspect	Impacts
Impact Description	Impact due to particulates, oxides of sulphur, oxides of nitrogen and hydrocarbons from vehicular movement
Receptor Importance/ Sensitivity	High
Extent	Core Zone
Duration	Long term

⁹² https://planning.karnataka.gov.in/uploads/media_to_upload1741692168.pdf (accessed on 30 April 2026)

Aspect	Impacts
Frequency	Regular
Likelihood	Certain
Reversibility	Reversible
Magnitude/ Severity	Medium
Effect	Negative
Direct/ Indirect	Direct
Significance	Moderate
Additional Mitigation (Y/N)	Y
Residual Significance	Minor

d. Mitigation Measures

598. **Embedded Mitigation Measures (EDM).** EDMs applicable to the project are provided in Chapter 3 of this report. Following EDMs are applicable to mitigate the impacts on ambient air quality.

EDM	Description
EDM20	Road (main carriage way) damage to be promptly rectified with proper road repair and maintenance work to avoid dust emission.

599. **Additional Mitigation Measures (ADM).** In addition to the EDMs mentioned above, following ADMs will be applicable to mitigate the impacts.

ADM	Mitigations
AA2	Develop green belts or roadside plantations to act as biological air filters for pollutants like PM _{2.5} , PM ₁₀ , NO ₂ , SO ₂ , and CO. Development of green belts or roadside plantations should be restricted to wet evergreen, semi-evergreen, moist deciduous, dry deciduous, and subtropical broadleaved forests only. Only those species occurring in these forests should be used in plantation. No exotic or non-native species should be used. Development of green belt and roadside plantations in grasslands and thorn forests is discouraged.

4. Ambient Noise Quality

a. Construction

600. **Description.** Road construction activities significantly increase local noise levels, affecting workers, nearby residents, educational institutes, wildlife, and structural integrity, with potential health and social consequences. The sources of noise will be mainly from heavy machineries such as excavators, bulldozers, and power tools such as jackhammers, drills and saws, noise from trucks while transporting construction materials and from mixing plants on-site.

601. **Assessment.** During construction period noise impacts will be high due to operation of construction machineries and the conflict with the regular traffic requiring more honking of vehicle horns and more stop and go (acceleration and deceleration process).

602. All temporary noise related impacts in the immediate vicinity of the project roads will occur during the construction activities. This will be occurred along the construction zones as well as construction camps, hot mix plants, Wet Mix Macadam (WMM) plants.

603. According to the primary data collected, noise level along the project roads vary during daytime (Leq) in the range of 32 dB (leq) to 76 dB (leq) and nighttime 30 (leq) to 63 db. Difference in noise levels in plain, hilly and coastal terrain did vary during day and night times.

604. Typical noise levels associated with road construction is given in the Table VI-8 below. The magnitude of impact will depend upon the specific types of equipment used, the construction methods employed and the scheduling of the work.

Table VI-8: Typical noise levels of principal construction equipment's (Noise Level in dB (A) at 50 Feet)

Activities/ Operation of Equipment	Noise Level dB(A)	Activities/ Operation of Equipment	Noise Level dB(A)
CLEARING AND GRUBBING		STRUCTURE CONSTRUCTION	
Bulldozer	80	Crane	75-77
Front end loader	72-84	Welding generator	71-82
Jack hammer	81-98	Concrete mixer	74-88
Crane with ball	75-87	Concrete pump	81-84
		Concrete vibrator	76
EXCAVATION & EARTH MOVING		Air compressor	74-87
Bulldozer	80	Pneumatic tools	81-98
Backhoe	72-93	Bulldozer	80
Front end loader	72-84	Cement and dump trucks	83-94
Dump truck	83-94	Front end loader	72-84
Jack hammer	81-98	Dump truck	83-94
Scraper	80-93	Paver	86-88
GRADING AND COMPACTING		LANDSCAPING AND CLEAN-UP	
Grader	80-93	Bulldozer	80
Roller	73-75	Backhoe	72-93
		Truck	83-94
PAVING		Front end loader	72-84
Paver	86-88	Dump truck	83-94
Truck	83-94	Paver	86-88
Tamper	74-77	Dump truck	83-94

Source: U.S. Environmental Protection Agency. Noise From Construction Equipment and Operations. Building Equipment and Home Appliances. NJID. 300.1. December 31, 1971.

605. The noise level will increase during the construction period, which will have significant impact for a limited period on the surrounding environment. Noise sources identified are:

- Construction activities such as demolition of structures, clearing and grubbing, hill cut, excavation & earth moving, grading and compacting, structure construction.
- Transportation of construction material/debris/spoil through heavy vehicles.

606. Sensitive Receptor: Land use adjacent to the Project roads across Karnataka is primarily agricultural fields and settlements. Number of settlements or households vary with roads and geography. However, there are schools and anganwadis identified along the number of roads, along with settlements. Places of worship for communities are also identified along various roads.

607. **Anticipated Impacts.** Impact matrix for the construction phase of noise environment (Table VI-9) is presented below.

Table VI-9 Aspect impact table for noise environment during construction phase

Aspect	Impacts
Impact Description	Impact due to noise from heavy machinery, power tools, crusher and mixing plants and transportation of heavy vehicles.
Receptor Importance/ Sensitivity	High
Extent	Core Zone
Duration	Short term
Frequency	One time
Likelihood	Certain
Reversibility	Reversible
Magnitude/ Severity	Medium
Effect	Negative
Direct/ Indirect	Direct
Significance	Moderate
Additional Mitigation (Y/N)	Y
Residual Significance	Minor

b. Mitigation Measures

608. **Embedded Mitigation Measures (EDM).** EDMs applicable to the project are provided in Chapter 3 of this report. Following EDMs are applicable to mitigate the impacts on ambient noise quality.

EDM	Description
EDM21	The plants and equipment used for construction will strictly conform to Central Pollution Control Board (CPCB) noise standards. Vehicles, equipment and construction machinery shall be monitored regularly with particular attention to silencers and mufflers to maintain noise levels to minimum. Use of noise shields to construction machinery and provision of earplugs to the heavy machine operators are some of the mitigation measures.

609. **Additional Mitigation Measures (ADM).** In addition to the EDMs mentioned above, following ADMs will be applicable to mitigate the impacts.

ADM	Description
AN1	All noisy construction in natural and critical habitats will be stopped between 10 PM and 6 AM except in case of laying of cement concrete pavement for which lower working temperature is a requirement Hot mix plant, batching or aggregate plants shall not be located within 500 m from human habitation, 200 m from highways, and 500 m from sensitive institutional zones, and natural/critical habitats, if applicable.
AN2	Near to the sensitive receptors such as anganwadis and schools, construction time can be aligned with the institutions' operation timing to prevent noise impacts on the students.
AN3	Phase demolition, earthmoving and ground-impacting operations, so as not to occur in the same time period. Unlike noise, the total vibration level produced could be significantly less when each vibration source operates separately.

c. Operation

610. **Description-** Noise generation during operation phase of the project roads, will be primarily due to movement of vehicles on the roads. With improved rural roads, number of vehicles is anticipated to increase.

611. **Assessment-** Traffic will increase after the improvement of roads, leading to increase in noise levels due to movement of vehicles. There will be vehicular engine and honking noise as a result of traffic movement.

612. For the project, noise impact analysis was undertaken for selected ten roads based on the sensitive receptors identified, using SoundPLAN Essential 5.1. The model assess the noise levels for sensitive receptors, for following three scenarios:

- a. current scenario (baseline)
- b. Project implementation

613. Noise levels are assessed against the Noise Pollution (Regulation and Control) Rules, 2000 limits applicable to Silence Zones (50 dB(A) day; 40 dB(A) night). These limits have been compared against the World Bank Group EHS noise level guidelines for institutional and educational receptors (55 dB(A) daytime / 45 dB(A) night-time), as silence or sensitive zone guidelines are not available, and the more stringent of the national and EHS values has been applied for impact determination and mitigation design, as required by ADB SPS 2009. Table VI-10 below provides road IDs and districts identified for noise modelling.

Table VI-10 Road IDs and districts for noise modelling

Road ID	District	Rationale for road selection
462	Chikballapur	anganwadi 30 m from the road
5130	Ramnagara	School classroom 50m from the road
827	Dakshin Kannada	School classroom 50m from the road
174	Udupi	School classroom 50m from and anganwadi 30m from the road
1206	Uttar Kannada	School classroom 50m from the road
136	Bagalkot	School classroom 50m from the road
2085	Bagalkot	School classroom 50m from the road
3088	Shikaripura	Located approximately 200 m from the protected boundary of Viranarayana Temple
3254	Shivamogga	Located approximately 400 m from King's Seat
4561	Mandya	Maaramma Temple at distance of 25m from the road and Basaveshwara temple at distance of 20m from the road

614. Traffic data used for the noise modelling was based on Annual Average Daily Traffic (AADT) for existing and projected road conditions. Traffic projections were developed assuming a 6% growth rate in motorized traffic. A uniform day-to-night traffic distribution of 4:1 was adopted, with approximately 80% of traffic occurring during daytime and 20% during nighttime. The vehicle composition remained unchanged between existing and projected scenarios, comprising approximately 41% motorcycles/tri- and quadricycles, 29% medium heavy vehicles, 17% powered two-wheelers, 9% heavy vehicles, and 4% light motor vehicles. Consequently, the increase in operational noise levels predicted under the project scenario is attributable primarily to the increase in traffic volume rather than a change in traffic composition.

615. According to the assessment under:

- **Scenario 1-** In existing road condition with current traffic volume, existing carriageway width and speed of the vehicles, model indicates that most receptors located close to the carriageway already experience noise levels exceeding CPCB silence-zone limits. Existing daytime noise levels at receptors generally ranged between 56–69 dB(A) and nighttime levels between 51–63 dB(A), except roads 3088 and 3254 where day and night time noise levels were noted within standards, as the receptors are located at a distance of 20 to 400 m from the carriage way.
- **Scenario 2-** This scenario represents the first year of project operation after road improvements, incorporating projected Annual Average Daily Traffic (AADT) data, improved carriageway and higher traffic speed. Under this scenario daytime noise levels at receptors ranged between 57–70 dB(A) and nighttime levels between 52–64 dB(A), except roads 3088 and 3254.

616. Only Road IDs 1206 and 174 achieved compliance during daytime, while nighttime remained above the standard.

617. Hence, it can be concluded that traffic growth associated with road improvements results in only moderate increases in receptor noise levels. Residual exceedances remain at several receptors even after mitigation, particularly at schools and anganwadis located immediately adjacent to the project roads, suggesting that additional measures such as speed restrictions, traffic calming, horn prohibition, dense roadside plantations are required during operation, and shall be incorporated into the EMP and verified through operational noise monitoring. Where vegetation-based barriers are proposed, the establishment period shall be accounted for and temporary or engineered barriers provided in the interim.

618. Detailed analysis reports of the model are presented in Appendix 24. Sample daytime result for Road ID 5130 is presented in Figure VI-2 and Figure VI-3.

Figure VI-2 Scenario 1: Heat map for daytime noise modelling for existing condition with no project scenario

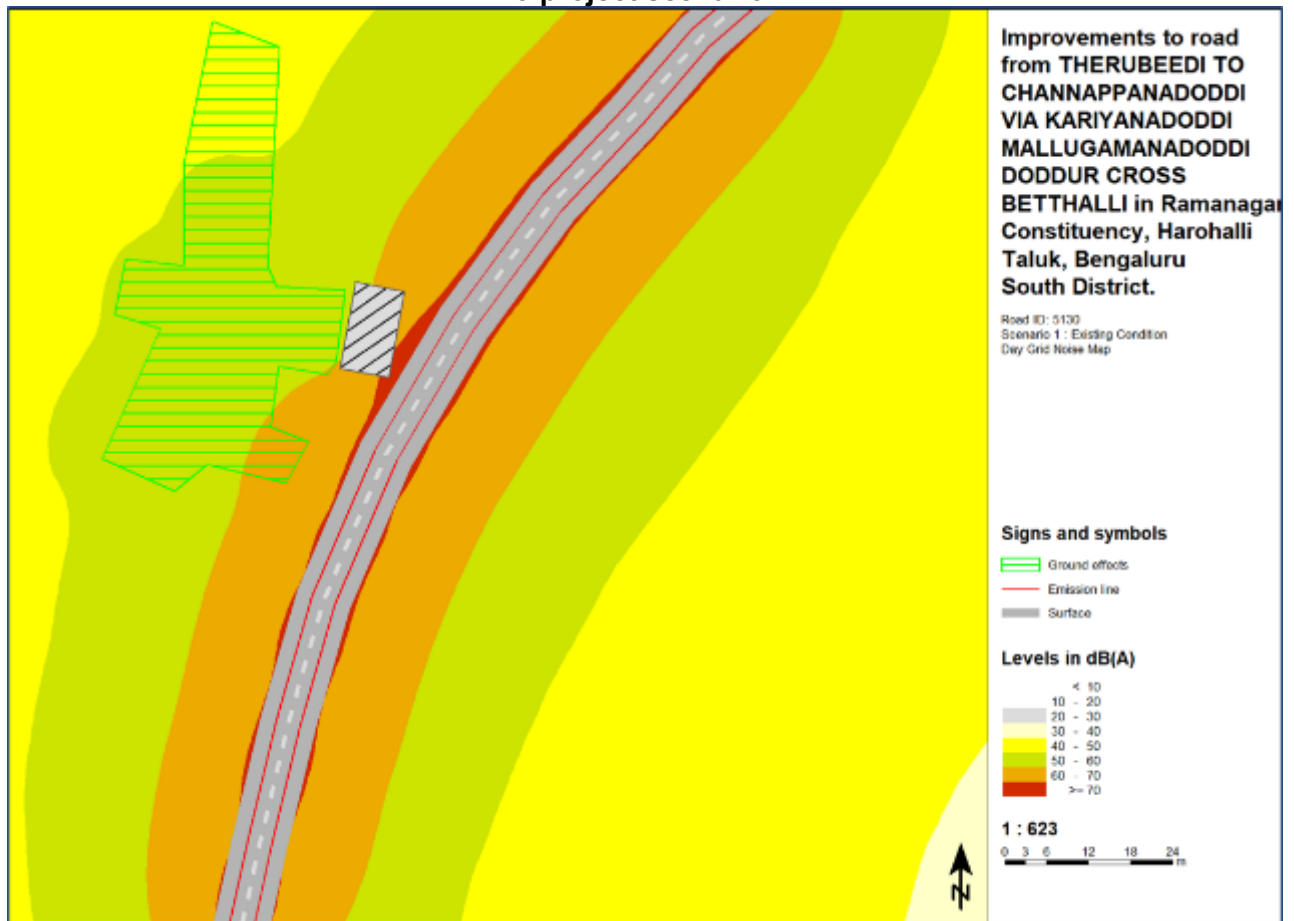
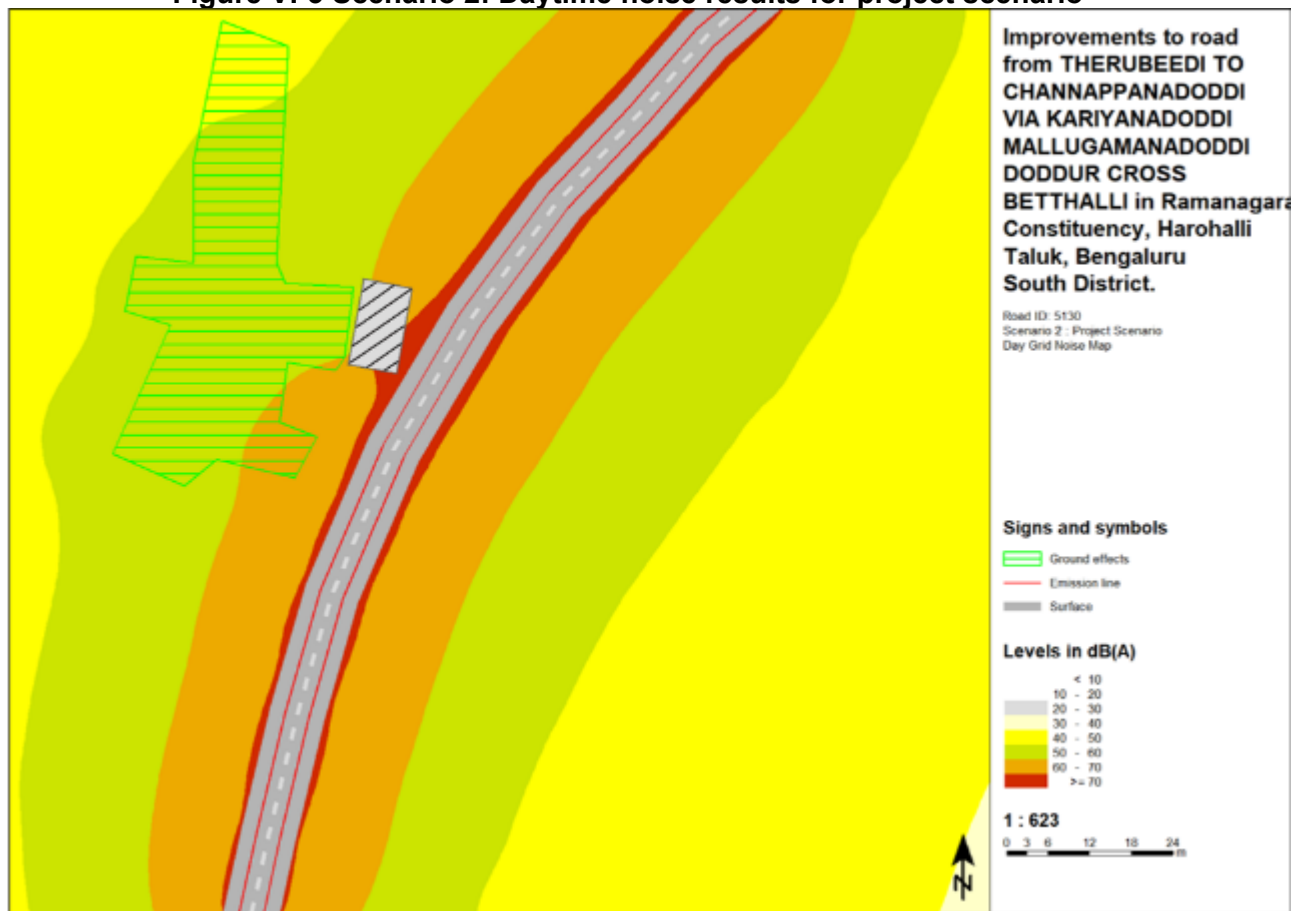


Figure VI-3 Scenario 2: Daytime noise results for project scenario



619. **Anticipated Impacts-** Table VI-11 below presents impact matrix of impacts of noise during operation phase.

Table VI-11 Aspect impact of noise environment during operational phase

Aspect	Impacts
Impact Description	Impact due to noise from vehicle movement
Receptor Importance/ Sensitivity	High
Extent	Core Zone
Duration	Permanent
Frequency	Permanent
Likelihood	Certain
Reversibility	Reversible
Magnitude/ Severity	Medium
Effect	Negative
Direct/ Indirect	Direct
Significance	Moderate
Additional Mitigation (Y/N)	Y
Residual Significance	Minor

d. **Potential residual impact after mitigations**

620. Residual exceedance of CPCB silence-zone limits may remain slightly above standards, especially at night, at many sensitive receptors even after barriers.

e. Mitigation Measures

621. **Additional Mitigation Measures (ADM)-** Following ADM will be applicable to mitigate the impacts.

ADM	Description
AN4	Mitigating the impact of increased noise levels at the sensitive receptor locations includes posting of signs prohibiting the use of horns, speed restrictions, traffic calming, and dense roadside plantations.

5. Surface and Ground Water Quality

a. Construction

622. **Description-** Road construction in general can generate a significant amount of pollution to nearby waterbodies as construction often involves extensive clearing, grading, and embankment formation, which exposes soil to erosion. It can result in the deposition of sediment that can be harmful for aquatic habitats and clog waterways. Sediments enter waterbodies primarily due to:

- Excavation, cut-and- fill operations, and removal of vegetation accelerating erosion.
- Exposed soils easily wash into nearby rivers, lakes, and reservoirs.
- Disturbance of existing vegetation area can aggravate the poor water quality.

623. The impact on surface water environment due to construction activities include increased turbidity, affecting photosynthesis in aquatic plants, harming fish and invertebrate populations. It also will reduce storage capacity of ponds and reservoirs due to silt deposition.

624. In a number of villages, local population is dependent on the available local surface water resources, like streams, canals, ponds, tanks or lakes for meeting water needs for irrigation of farmlands and as water source for cattle.

625. Domestic needs are predominantly fulfilled by groundwater resources. More than 75% of Karnataka households including more than 50% villages have water supply from Jal Jivan Mission scheme by Government of India⁹³, which utilizes groundwater resources where possible.

626. **Assessment-** Approximately 500 rural roads, in the project traverses through streams, canals, seasonal drains, or are along the tanks or local ponds. During the improvement works and construction of new culverts, some amount of drainage alteration and downstream erosion/siltation is anticipated. Some of these alterations may be because of construction of temporary traffic detours/diversion. Except for these temporary works, in almost all cases there should be an improvement in the drainage characteristics of the surrounding area due to improved design and added culvert/ditch capacity.

⁹³ <https://ejalshakti.gov.in/jjmreport/JJMState.aspx> (accessed on 22 June 2026)

627. Siltation of surface water bodies is anticipated due to construction works, where these are crossing the roads or are located adjacent to the project roads. The temporary pollution of water bodies from spillage of chemicals and oil at construction sites and waste from construction camps may occur. Accidental oil and chemicals spills can contaminate the ponds close to alignment, and groundwater if not cleared for a long time.

628. Coastal and western ghats districts of Karnataka where higher rainfall and better recharge conditions support safer groundwater conditions. Wherein, northern, northeastern and southeastern dry districts exhibit higher extraction pressures due to lower recharge, hard rock aquifers, intensive agriculture and urban demand. A number of project roads are concentrated in over-exploited and critical groundwater zones. Extraction of groundwater resources for construction, in critical and over-exploited areas will impact water availability for the local community.

629. Groundwater quality in Karnataka majorly meets drinking water standards. Continuous leaching of contaminants during construction may add pollutants to groundwater resources.

630. **Anticipated Impacts-** The contamination of water and siltation may occur if any streams running parallel to the project alignment or crossing the alignment due to various construction activities including scarification, staking of materials, machines (Oil spillage etc.,). It is observed that typical cross section of the existing project roads is a combination of carriageway and earthen shoulder. Surface water bodies in the hilly terrain are more prone to contamination during construction due to the slope.

631. Accidental spillage during construction, if not cleared for a long time can seep into the groundwater and contaminate the resource.

632. Table VI-12 below presents the impact matrix for anticipated impacts on surface water quality.

Table VI-12 Impact matrix for anticipated impacts on surface water quality

Aspect	Impacts		
Impact Description	Impact on water quality and siltation	Impact due to drainage alteration	Impact on Ground Water Quality
Receptor Importance/ Sensitivity	High	High	Low
Extent	Buffer Zone	Buffer Zone	Buffer Zone
Duration	Temporary	Temporary	Temporary
Frequency	Single event	Single event	Single event
Likelihood	Likely	Likely	Likely
Reversibility	Reversible	Reversible	Reversible
Magnitude/ Severity	Medium	Medium	Medium
Effect	Negative	Negative	Negative
Direct/ Indirect	Direct	Direct	Direct
Significance	Moderate	Moderate	Moderate
Additional Mitigation (Y/N)	Y	Y	Y
Residual Significance	Minor	Minor	Minor

b. Mitigation Measures

633. **Embedded Mitigation Measures (EDM)-** EDMs applicable to the project are provided in Chapter 3 of this report. Following EDMs are applicable to mitigate the impacts on water quality.

EDM	Description
EDM22	Contractor shall ensure that no spillage of spoil material in surface water bodies directly or indirectly. (Refer to Appendix 3-Waste Management Plan). Contractor shall ensure that no untreated discharge should enter into surface water bodies. Any discharges into environment should follow environmental standard. Install temporary silt traps or sedimentation basins along the drainage leading to the water bodies. Soak pit and septic tank will be provided to be constructed by the Contractor. Contractor shall prepare impervious surface at fuel refilling station, work shop area and material storage area. The fuel refilling station and workshop area should be provided with shed for sun and rain. Precaution should be taken to ensure that the impervious surface is not located on natural and critical habitats.
EDM23	Contractor shall obtain permission for withdrawal of surface or ground water and consult with the community and ensure that villager's user right is protected. Contractors shall provide for dedicated sources or supplementary supply where reliance on local systems is not feasible. Surface flow shall be diverted or construction activities shall be isolated from the surface flow in a manner acceptable to PIU. Any diversion / bund/isolation constructed for bridge/culvert work shall be removed by Contractor as soon as utility of those are over. Installation of slit fencing with planting vegetated swales at the mouth of the nearest water body to prevent any residual sediments from entering the water body.
EDM24	To prevent runoff and surface waters from entering agricultural fields or infiltrating the ground, the drainage system shall be kept in good condition as part of pre-monsoon maintenance. Rejuvenation of the drainage system by removing encroachments/ congestions will be regularly conducted.

634. **Additional Mitigation Measures (ADM)-** In addition to the EDMs mentioned above, following ADMs will be applicable to mitigate the impacts.

ADM	Description
WQ1	Precast pipe culverts shall be installed wherever applicable.

c. Operation

635. **Description-** The operation phase of roads will likely impact the surface water sources near the project primarily from run off contaminants carrying accidental oil spillage. However, it can be noted that the deterioration of water quality during operation phase is very less when compared to construction phase.

636. **Assessment-** The impact from surface run-off will be minimal as probability of accidents with heavy vehicles carrying oil or other hazardous material is less. However, with the drainage proposed along the project roads, the extent of pollution will be contained within the project stretch. However, wherever earthen drains are provided, potential of contamination of groundwater is anticipated. Additionally, discharge from the concrete drains will also be directed to nearby surface water bodies. Impacts on groundwater resources are not anticipated during operation phase.

637. **Anticipated Impacts-** Aspect impact table of water environment during operation phase Table VI-13.

Table VI-13 Aspect impact table of water environment during operation phase

Aspect	Impacts
Impact Description	Contamination of surface water due to spillages
Receptor Importance/ Sensitivity	Medium
Extent	Core Zone
Duration	Short term
Frequency	Single Event
Likelihood	Likely
Reversibility	Reversible
Magnitude/ Severity	Minor
Effect	Negative
Direct/ Indirect	Direct
Significance	Negligible
Additional Mitigation (Y/N)	N
Residual Significance	-

d. Mitigation

638. **Embedded Mitigation Measures (EDM)-** EDMs applicable to the project are provided in Chapter 3 of this report. Following EDMs are applicable to mitigate the impacts on water quality.

EDM	Description
EDM24	To prevent runoff and surface waters from entering agricultural fields or infiltrating the ground, the drainage system shall be kept in good condition as part of pre-monsoon maintenance. Rejuvenation of the drainage system by removing encroachments/ congestions will be regularly conducted.

6. Biodiversity

a. Construction

639. **Description-** Improvement of rural road infrastructure is likely to have localised and short-term impacts on biodiversity during the construction phase. Impacts include limited loss of natural and critical habitat where additional land is required, vegetation clearance along the RoW, habitat fragmentation, accidental introduction of alien invasive species, opening of additional quarry or borrow sites for sourcing of construction material, and indirect impacts from air, water, and soil contamination. Critical habitat assessment has been undertaken for the Project. The preliminary outcomes of the critical habitat assessment based on summer season surveys in March to May 2026 have led to the identification of ecologically appropriate areas (EAAAs) that serve as critical

habitats. The EAAAs have been designated as critical habitats for threatened as well as range-restricted mammals and reptiles. While the EAAA boundaries themselves may not require revision as data are collected during post-monsoons and winter surveys, the list of critical habitat triggering species may be revised. For example, threatened and range-restricted amphibian species may be added to the existing list of critical habitat triggers in the EAAAs. The CHA is slated for completion in April 2027. The EIA report will undergo revisions, as may be necessary, based on the outcomes of the CHA. The assessment undertaken at this stage may be revisited in case the extents of the EAAAs are revised. The impact assessment performed herein also determines the residual impacts post-mitigation. The residual impacts to natural and critical habitats will be mitigated through the Biodiversity Action Plan (Appendix 19) that is being developed in line with the CHA.

640. **Assessment-** All project activities will be largely confined within the existing RoW (EDM-1). Primary surveys suggest that the areas inside the RoW are compacted or bare ground, with little to no vegetation growth. However, this observation is based on surveys during the dry season in March and May 2026. Vegetation, particularly herbs and grasses, may grow along the RoW edges during and after the monsoons. Whether vegetation grows along the RoW edges will be determined during the monsoon and post-monsoon surveys. This vegetation along the RoW edges will be lost or degraded during the construction phase leading to localized loss of biodiversity. The requirement of 0.748 hectares of additional forest land for one project road (4817) has been indicated in the data shared by KRRDA.

641. The vegetation growth along the RoW as mentioned in the preceding point may be utilised by birds for nesting. Clearing the vegetation will lead to a reduction in the breeding success of the nesting birds and may negatively impact the biodiversity.

642. Habitat fragmentation occurs when greenfield linear infrastructure projects are proposed to pass through natural habitat patches, thereby fragmenting the habitat patch into two or more patches. The proposed Project deals with the improvement of existing roads (EDM-1); thereby employing avoidance measure as part of the mitigation hierarchy. The impacts of habitat fragmentation would have been the most significant when the roads were constructed in the past. These impacts have likely been attenuated over time. It is thereby unlikely for the proposed Project to cause significant incremental fragmentation from improvement of road conditions. Any incremental fragmentation is likely to be attenuated over time through altered faunal responses and behaviours, and the impact is deemed to be not significant.

643. None of the roads fall within the elephant or tiger corridors, as indicated by the maps sourced from authentic sources. Impacts to elephant and tiger corridors are thereby unlikely.

644. Movement of machinery, storage of materials, and use of temporary diversion routes may lead to further degradation of adjacent habitats through compaction and introduction of alien invasive species.

645. Establishment of construction and labour camps is not envisaged in the Project design, as local labourers from the villages benefitting from the rural roads development will be employed. However, if establishment of construction and/or labour camps is required, establishing the same in natural and/or critical habitats will lead to habitat loss and degradation.

646. Given the presence of threatened, range-restricted, and critical habitat triggering species, as well as the siting of 591 roads within critical habitats, the sensitivity of receptors has been deemed to be high. However, since the project design avoids and minimises most impacts from

road improvements and the impacts will be localized, and likely to be attenuated after the end of the construction phase, the impact magnitude is deemed to be low. The impact significance is thereby deemed to be medium (refer Figure VI-1).

647. **Anticipated impacts-** Removal of roadside vegetation growing along the RoW prior to the construction.

648. Lowered breeding success for birds nesting in the vegetation that will be cleared prior to construction.

649. Accidental introduction of alien invasive species due to the movement of machinery, equipment, and construction vehicles during the construction phase,

650. Loss or degradation of habitats adjacent to the RoW during construction due to the temporary diversion of traffic, establishment of labour and construction camps, where required.

651. Further fragmentation of habitats is not envisaged given that these are existing, low-volume rural roads, and that the project activities will be restricted to the RoW.

652. Construction activities may lead to short-term and localised impacts to air, water, and soil quality. Sedimentation, runoff, and contamination may occur along the minor bridges and/or roads in proximity to the streams, rivers, and other waterbodies. This will lead to alteration of physico-chemical parameters of the waterbodies, impacting the aquatic and semi-aquatic or amphibious biological values not just *in-situ*, but downstream as well. The impacts will be of higher significance in natural and/or critical habitats. The impact significance for these impacts has been dealt with in previous sections (AA, AN, WQ), even from a biodiversity perspective. Mitigation measures provided therein have been designed by taking impacts to biodiversity into account and are not reiterated here to avoid duplication and redundancy. Further, EDM-3 states that the DPR includes hydrology-based cross-drainage design and provides for replacement of damaged culverts and addition of new culverts where drainage crossings require intervention. This allows runoff to pass along natural drainage paths instead of getting obstructed by the road. Additional mitigation measures have been included.

653. Based on the outcomes of the CHA and EIA, net reduction in the threatened or critical habitat triggering species is unlikely. However, the EIA may be revised in case after the finalisation of the CHA, it is concluded that the Project may lead to net reduction in the population of threatened or critical habitat triggering species.

Table VI-14 Aspect Impact table for Biodiversity

Aspect	Impacts				
Impact Description	Vegetation clearance along the RoW	Impacts to birds nesting in vegetation to be cleared	Introduction of alien invasive species	Habitat Degradation and Disturbance to Flora and Fauna	Impact to aquatic ecosystems
Receptor Importance/ Sensitivity	High	Low	Medium	High	High
Extent	Core Zone	Core Zone	Buffer Zone	Buffer Zone	Buffer Zone
Duration	Permanent	Permanent	Permanent	Temporary	Temporary

Aspect	Impacts				
Frequency	Single event	Single event	Single event	Single event	Single event
Likelihood	Likely	Likely	Likely	Likely	Likely
Reversibility	Irreversible	Irreversible	Reversible	Reversible	Reversible
Magnitude/Severity	Low	Low	Low	Low	Low
Effect	Negative	Negative	Negative	Negative	Negative
Direct/Indirect	Direct	Direct	Direct	Direct and indirect	Direct and indirect
Significance	Moderate	Moderate	Moderate	Moderate	Moderate
Additional Mitigation (Y/N)	Y	Y	Y	Y	Y
Residual Significance	Minor to moderate	Minor	Minor	Minor	Minor

b. Mitigation Measures

654. **Additional Mitigation Measures (ADM)-** Following ADMs will be applicable to mitigate the impacts.

ADM	Mitigations
BD1	Vegetation on both sides of the road should not be cleared at the same time. Vegetation should be cleared in a phased manner, i.e., vegetation on one side of the road should be cleared first and then the vegetation on the other side. This will allow faunal components time to escape the construction area.
BD2	Invasive alien species disposal sites should be identified prior to the start of construction. The sites should not be in natural and/or critical habitats. In case signs of accidental introduction of invasive alien species is noted, the same should be eradicated and disposed at dedicated at the pre-identified disposal sites.
BD3	The contractor should ensure that creation of alternative routes for vehicular movement is prohibited in natural and/or critical habitats. This can be ensured either by keeping the road shut for traffic until the improvement is over or by allowing partial flow of traffic through sections where improvements have already taken place or are yet to begin.
BD4	Existing quarry and borrow sites should be used for sourcing construction material. In case opening of quarry or borrow sites is required, such sites should be located outside protected areas, forest lands, and natural or critical habitats.
BD5	Habitats adjacent to the RoW that may be impacted must be restored after the construction phase is over.
BD6	Improvement of bridges is proposed on season streams based on the data provided by KRRDA and DPR consultants. Improvement works of bridges should be done in dry season when the perennial rivers have minimal flows. Any riverbed substrate impacted should be restored.
BD7	Hunting, poaching, trapping of wild animals as well as collection of firewood or other natural resources from inside the forest lands or legally protected areas as well as natural habitats should be prohibited by the contractor.
BD8	Construction should be restricted to the daytime, i.e., between 7:00 and 18:00. Nighttime construction should be discouraged.
BD9	Good housekeeping practices should be followed at construction sites and camps. Food and other wastes that may attract animals should be discarded appropriately. Food waste should not be disposed in a manner that will attract wild animals. (Refer to Appendix 3-Waste Management Plan)

ADM	Mitigations
BD10	Construction workers should be trained about the forest and wildlife laws and acts in India. They should be sensitized about the dos and don'ts in ecologically sensitive areas.
BD11	Construction waste should be disposed of at designated places which are not in forest lands, legally protected areas, natural and/or critical habitats. Construction waste should not be disposed in culverts or drainages.
BD12	For roads in critical and/or natural habitats, roadkill hotspots should be identified prior to the construction. Speed breakers and signages indicating road users to slow down as covered in EDM-14 should be additionally installed in such areas.
BD13	Residual impacts to natural and critical habitats will be mitigated through the BAP. The BAP includes actions for restoration of habitats at offset sites identified by the Karnataka Forest Department over an area equivalent to the amount of area of vegetation clearance/habitat loss and degradation, as is determined during the construction phase.

c. Potential residual impacts after mitigation measures

655. Vegetation clearance in critical and/or natural habitat during the construction phase may lead to loss of or impacts to natural and/or critical habitats beyond *in-situ* restoration. The BAP provides for the calculation of actual habitat area lost and compensation or offset of those habitats to achieve no-net loss followed by net gains in natural and critical habitats, including the 591 roads that have been determined to be in critical habitats.

d. Operation

656. **Description-** During the operational phase, increased traffic volume and speed on the widened roads are likely to result in higher incidences of wildlife-vehicle collisions, particularly in areas identified as critical habitats for threatened or endemic species such as herpetofauna and small mammals. The embedded speed calming measures proposed to be implemented as part of the Project are expected to lead to a reduction in the number of collisions and mortalities.

657. **Assessment-** Given that the roads are in critical habitats for threatened and range-restricted species, any on-road mortalities of critical habitat triggering species as well as threatened, range-restricted, and protected species is likely to constitute major residual impact. However, although biodiversity may benefit from the speed calming measures embedded in the project design as well as from strengthening and improving culverts, or having speed-breakers installed, as described in BD7, additional mitigation measures during the operations phase have been recommended.

658. During the primary surveys, it was observed that seasonal puddles formed after showers at places on the road where potholes were present to be occupied by amphibians. Although the primary observation was restricted to *Hoplobatrachus tigerinus*, the utilization of such puddles by threatened and/or range-restricted amphibians is likely.

659. Owing to the presence of threatened, range-restricted, and critical habitat triggering biological values that may be impacted, the receptor sensitivity is deemed to be high; however, since the impact is ongoing since the roads are existing, and the localized nature of the impact, the magnitude is deemed to be low, resulting in a moderate significance value.

660. **Anticipated Impacts:** Refer Table VI-15 below

Table VI-15 Aspect Impact Table for impact due to higher incidences of wildlife-vehicle collisions

Aspect	Impacts
Impact Description	Incremental on-road mortalities from collision with vehicles
Receptor Importance/ Sensitivity	High
Extent	Core Zone
Duration	Permanent
Frequency	Recurring
Likelihood	Likely
Reversibility	Irreversible
Magnitude/ Severity	Low
Effect	Negative
Direct/ Indirect	Direct
Significance	Moderate
Additional Mitigation (Y/N)	Y
Residual Significance	Minor

e. Mitigation Measures

661. **Additional Mitigation Measures (ADM)-** Following ADM will be applicable to mitigate the impacts.

ADM	Mitigations
BD14	The roads should be inspected for potholes regularly during the monitoring phase, especially prior to the monsoons. Any potholes on the roads must be repaired prior to the start of the monsoons. This is to ensure that amphibians which may use the potholes during the monsoons are safeguarded.

f. Potential residual impacts after mitigation measures

662. Residual impacts are likely to be insignificant to minor owing to the implementation of EDMs- 3, 4, 13, and 14, as well as the ADMs BD12 and BD13.

7. Heritage and Archaeology

a. Construction

663. **Description-** Karnataka has over 1000 sites of archaeological, heritage and cultural significance, protected by UNESCO, ASI and Department of Archaeology, Museums and Heritage, Government of Karnataka.

664. **Assessment-** Total of six project roads (Road IDs 1430, 1679, 2895 and 2611, 4446 and 3381) pass within 300 m vicinity of the sites of cultural and archaeological significance, at local, national or global level. ASI defines prohibited and regulated areas where construction activities are completely prohibited and are allowed with prior permission from the regulatory body of the monument.

665. Road ID 4446 is confirmed to fall within the regulated areas of the ASI monuments and need to consult the Competent Authority under the Ancient Monuments and Archaeological Sites

and Remains Act, 1958, through the National Monuments Authority framework prior to commencement of any construction activities within the prohibited or regulated area of a Centrally Protected Monument. KRRDA has initiated the application process for obtaining permission for road improvement works from the Hampi World Heritage Area Management Authority (HWHAMA) and Tourism department.

666. However, certain impacts are anticipated on the archaeological structures during construction and operation phases of the roads.

667. **Anticipated Impacts-** Impact matrix is presented below (Table VI-16).

Table VI-16 Aspect impact table of impact on cultural and heritage sites for construction phase

Aspect	Impacts		
	Ground vibration	Physical harm	Impact of pollution
Receptor Importance/ Sensitivity	Medium	Medium	Medium
Extent	Core Zone	Core Zone	Core Zone
Duration	Temporary	Temporary	Temporary
Frequency	One time	One time	One time
Likelihood	Likely	Likely	Likely
Reversibility	Reversible	Reversible	Reversible
Magnitude/ Severity	Medium	Medium	Medium
Effect	Negative	Negative	Negative
Direct/ Indirect	Direct	Direct	Direct
Significance	Moderate	Moderate	Moderate
Additional Mitigation (Y/N)	Y	Y	Y
Residual Significance	Minor	Minor	Minor

b. Mitigation Measures

668. **Embedded Mitigation Measures (EDM)-** EDMs applicable to the project are provided in Chapter 3 of this report. Following EDMs are applicable to mitigate the impacts on heritage and archaeology.

EDM	Description
EDM25	Conduct a heritage/archaeological field surveys before start of the construction work. If surveys find resources, map them and define buffers/avoidance. Implementation of Chance Find Procedure (Appendix 4) including standard “stop-work — secure — notify — assess — conserve or salvage” sequence: stop work if finds occur, cordon off, notify competent authorities and project authorities, assess significance, implement approved conservation/salvage or reburial, document finds, then resume works only after clearance. Any shifting of cultural assets like idols of local importance will be done in consultation with the local community. Educate workers about heritage sensitivity. Install speed breakers or rumble strips before approaching heritage, cultural or archaeological structures.

669. **Additional Mitigation Measures (ADM)**- In addition to the EDMs mentioned above, following ADMs will be applicable to mitigate the impacts.

ADM	Mitigation
HA1	Predict vibration levels from construction activities for cultural and heritage structures, along the RoW, against peak particle velocity limits set for each structure category in accordance with DIN 4150-3 or equivalent, with defined work-suspension triggers and use low vibration equipment where applicable. Install real time vibration sensors and define threshold limit. Stop work if threshold is exceeded. Use trenches to dissipate vibration, as applicable.
HA2	Mark ‘no-entry’ zone for heavy equipment near the heritage structures.
HA3	Regularly sprinkle water near heritage structures and use dust screens where possible.

c. Operation

670. **Description**- Cultural, archaeological and heritage structures along the project roads are prone to hitting by speeding vehicles on the project roads.

671. **Assessment**- Improvement of project roads will increase volume of vehicles on these roads, as well as speed of vehicles will also increase. This increase in speed, in case of losing control over the vehicle by rider or driver, can lead to crashing of vehicles into the structures, causing structural damage to the structures.

672. **Anticipated Impacts**- Impact matrix is presented below (Table VI-17).

Table VI-17 Aspect impact table of impact on cultural and heritage sites for operation phase

Aspect	Impacts
Impact Description	Physical harm to structures
Receptor Importance/ Sensitivity	High
Extent	Buffer Zone
Duration	Permanent

Aspect	Impacts
Frequency	Continuous
Likelihood	Likely
Reversibility	Reversible
Magnitude/ Severity	Medium
Effect	Negative
Direct/ Indirect	Direct
Significance	Moderate
Additional Mitigation (Y/N)	N
Residual Significance	-

d. Mitigation Measures

673. **Embedded Mitigation Measures (EDM)-** EDMs applicable to the project are provided in Chapter 3 of this report. Following EDMs are applicable to mitigate the impacts on heritage and archaeology.

EDM	Description
EDM25	Install speed breakers or rumble strips before approaching heritage, cultural or archaeological structures. Define low speed limit where road is around the heritage, cultural or archaeological structures. Install crash barriers or stone masonry buffers between road and heritage, cultural or archaeological structures. Provide warning signs for 'heritage, cultural or archaeological structure ahead', 'slow down'. Provide reflective road marking for night time around heritage, cultural or archaeological structures.

e. UNESCO Recognised Western Ghats

674. A total of 187 roads are in in Western Ghats, therefore the Project has assessed the implications of related to UNESCO World Heritage context. There are four key requires of UNSECO for Western Ghats, and the compliance is provided below Table VI-18.

Table VI-18: UNESCO Requirements and Project Compliance for Western Ghats

UNESCO Requirements	Description	Project Compliances
Do not damage the Outstanding Universal Value of the Western Ghats	Outstanding Universal Values are - Geographical importance that has role in biophysical and ecological process, - influence of Indian monsoon, - exceptionally high level of biodiversity and endemism, presence of at least 325 globally threatened species, - Evolutionary Ecotone demonstrating key evolutionary and speciation processes and - exceptional plant and animal diversity, endemism, and	- Restricting all works to the existing RoW and avoid realignment, hill cutting, quarrying, camps, stockyards, and spoil disposal in ecologically or geologically sensitive areas. - Maintain natural drainage, slope stability, and monsoon runoff through adequate culverts, drains, slope protection, and sediment-control measures.

UNESCO Requirements	Description	Project Compliances
	threatened habitats such as Shola forests and Myristica swamps	• Undertake biodiversity screening and implement the Biodiversity Action Plan for sensitive Western Ghats road sections. • Avoid impacts on threatened, endemic, and range-restricted species by limiting vegetation clearance and applying the mitigation hierarchy. • Maintain habitat connectivity and reduce wildlife mortality through roadside vegetation retention, culverts, signage, and speed-control measures. • Use native Western Ghats species for restoration, compensatory plantation, slope stabilization, and roadside habitat enhancement. • Control construction disturbance by restricting night works, blasting, lighting, dust, noise, waste disposal, and unnecessary vehicle movement in sensitive stretches. • Monitor vegetation loss, erosion, drainage, invasive species, wildlife movement, roadkill, and restoration success, with corrective action by PIU/PMU.
Notify the World Heritage Committee early if major works may affect the property	Paragraph 172, as quoted in UNESCO's Policy Compendium ⁹⁴ , says States Parties should inform the Committee of their intention to undertake or authorize major restorations or new constructions in an area protected under the Convention which may affect the Outstanding Universal Value of the property, and that this notice should be given before making decisions that would be difficult to reverse.	The proposed rural road works involve improvement and strengthening of existing roads within the available right of way and do not involve major restoration or new construction within the World Heritage property. The project has also applied avoidance measures, ecological screening, and OUV-specific safeguards to ensure that the Outstanding Universal Value of the Western Ghats is not adversely affected. Therefore, notification to the World Heritage Committee under Paragraph 172 is not triggered.
Carry out an impact assessment in a World Heritage context	where the improvement may affect the property's OUV, the UNESCO/IUCN material supports carrying out an impact	Reference to Guidance and Toolkit for Impact Assessment, 2022, the impact assessment is required

⁹⁴ <https://whc.unesco.org/en/compendium/172>

UNESCO Requirements	Description	Project Compliances
	assessment in a World Heritage context: • UNESCO Decision 36 COM 8B.10⁹⁵ requests that any proposed infrastructure developments be subject to rigorous prior impact assessments. • IUCN's World Heritage guidance says that effective impact assessments are critical to ensure that the potential adverse impacts on OUV, and alternatives to the proposal, are fully considered in decision-making. • The 2022 UNESCO/ICCROM/ICOMOS/IUCN guidance says impact assessment is essential to prevent damage to World Heritage and identify sustainable options for projects within and around World Heritage sites.	where the Project have reasonable affect on Outstanding Universal Value of the World Heritage property. This includes the property or its buffer zone or wider setting. In the context of the Project, it is limited to the RoW and no new land acquisition is required in western ghat. So, the Heritage Impact Assessment is not required. The Project has undertaken environmental assessment through the EIA/IEE process in line with ADB SPS 2009, including ecological screening, critical habitat assessment, biodiversity action planning, alternatives analysis, public consultation, and EMP preparation. The proposed works are limited to improvement of existing rural roads within the available right of way and are not expected to affect the Outstanding Universal Value of the Western Ghats. Therefore, a separate World Heritage impact assessment is not considered necessary at this stage.
Respect the function of any buffer zone	Buffer zone of any heritage site in Western Ghat should be respected.	An EIA as per the SPS 2009 has been prepared. The impacts are mitigatable implementing EMPs

Note: Outstanding Universal Value, or 'OUV' is described in Paragraph 49 of the Operational Guidelines as: 'cultural and/or natural significance which is so exceptional as to transcend national boundaries and to be of common importance for present and future generations of all humanity. As such, the permanent protection of this heritage is of the highest importance to the international community as a whole'.

675. Management measure adopted in respect of Western Ghats in Karnataka and construction and operation of Project Road.

- Avoidance first: all improvements will be within the existing RoW to the extent feasible and avoiding realignment, widening, quarrying, camp siting, or stockyards inside protected areas, eco-sensitive zones, and other high-value habitats.
- Construction controls: limiting the vegetation clearing, controlling dust through water spraying, maintaining vehicles and equipment, restricting noisy works to daytime, and manage traffic movement in sensitive stretches to reduce wildlife and community disturbance.
- Slope, drainage, and sediment control: providing lined drains where needed, stabilize cut slopes, protect embankments, and prevent spoil disposal into valleys, streams, or forested areas to avoid erosion and downstream sedimentation in monsoon-prone terrain.

⁹⁵ <https://whc.unesco.org/en/decisions/4781/>

- Biodiversity safeguards: integrating biodiversity action plan for sensitive road sections, including speed control, signage, seasonal work restrictions where justified, restoration planting with native species, and monitoring of wildlife-conflict and roadkill hotspots.
- Regulatory compliance: obtain forest clearance and any other statutory permissions for stretches involving forest land or other notified areas before construction.
- Cultural heritage protection: maintaining stand-off distance from heritage assets, preventing encroachment by workers and equipment, and implement a chance-find procedure for any archaeological or cultural remains encountered during excavation. The need for heritage-sensitive management is directly supported by the screened proximity of roads to heritage sites.

8. Socio economy

a. Construction

676. **Description-** Construction phase of road projects creates immediate jobs for skilled and unskilled labor, engineers, project managers, and machinery operators. Contractors engage unskilled labour locally for construction. Wages paid to local workers stimulate local economies by increasing purchasing power. Ancillary industries such as material suppliers, equipment rentals etc grow within the region as a multiplier effect. There will be increased activities on public utilities and retail services.

677. **Assessment-** Although the construction contractors are likely to use un-skilled labour drawn from local communities, use of specialized road construction equipment will require trained personnel not likely to be found locally. Sudden and relatively short-lived influxes of construction workers to communities along the project will have the potential to 'skew' certain demographic variables and the traditional social coherence. It is anticipated that the construction labor inputs for the construction of the project roads will be in the order of about 50 to 60 persons per day. However, this number will fluctuate and the number in any particular activities will be lower.

678. Construction phases of the project roads will increase in income of the local people as some local unskilled, semiskilled and skilled persons will gain direct or indirect employment during construction phase. Since the immigration of work force during construction phase is likely to be very small, the social impacts on literacy, health care, transport facilities and cultural aspect are expected to be insignificant.

679. The preliminary design identified impact on a number of public utilities. These include water supplies, drainage system, telecommunication infrastructure and electricity supply poles and transformers. Additionally, mobility and access of people using the road for commuting, will be temporarily impacted due to civil works of the project. Temporary traffic delays are envisaged during construction period. Also, connectivity between the agricultural fields and market will be hampered for sale of the produce, if construction is scheduled during the harvesting period.

680. The relatively short-lived economic impacts of the construction phase are likely to be experienced in local communities for the duration of construction, as workers will make everyday purchases from local traders. This is likely to give a short-lived stimulus to these traders that will disappear as soon as the construction is complete. Wider, flow-on economic impacts will be experienced in other sectors of economy as a result of purchase of construction materials and the payment of wages and salaries.

681. **Anticipated impacts-** The aspect impact table for construction phase of socio-economic impact is presented in Table VI-19.

Table VI-19 Aspect impact table of socio-economic impact for construction phase

Aspect	Impacts			
	Impact due to local employment	Impact on public utilities	Influx of Construction workers	Impact on farmers livelihood
Receptor Importance/ Sensitivity	Medium	High	Low	High
Extent	Buffer Zone	Buffer Zone	Buffer Zone	Buffer zone
Duration	Temporary	Temporary	Temporary	Temporary
Frequency	One time	One time	One time	One time
Likelihood	Likely	Certain	Certain	Certain
Reversibility	Irreversible	Reversible	Irreversible	Reversible
Magnitude/ Severity	Medium	Medium	Medium	Medium
Effect	Positive	Negative	Positive	Negative
Direct/ Indirect	Direct	Direct	Direct	Direct
Significance	Moderate	Moderate	Minor	Moderate
Additional Mitigation (Y/N)	N	N	N	N
Residual Significance	-	-	-	-

b. Mitigation Measures

682. **Embedded Mitigation Measures (EDM)-** EDMs applicable to the project are provided in Chapter 3 of this report. Following EDMs are applicable to mitigate the impacts on community socio economy.

EDM	Description
EDM26	Contractors to keep community members apprised of construction schedules in readily accessible public locations. Construction schedule to be aligned with agricultural cycle to avoid harvest period, and consulted with community and farmers. A traffic management plan to be prepared for construction phase as part of the EMP. The contractors shall ensure that no inconvenience is caused to the commuters and local communities.

c. Operation

683. **Description-** After improvement of the roads, connectivity and access to the markets, agricultural fields will increase. Agricultural farms are not accessible to the big vehicles, due to existing road conditions, to carry the agricultural produce from the farmlands to markets. Hence, it takes multiple trips by the farmers in smaller vehicles to carry the produce to the market. This leads to deterioration of the quality of the produce while it is stored in open fields. The process also leads to delay in sowing of next crop in the fields.

684. **Assessment-** Improved roads will provide access to farmers to sale the produce to the local and taluka level markets. Improved and broad roads will allow access of bigger vehicles up to the farms and facilitate timely access of produce to the markets. This easy access to markets will positively impact their livelihoods.

685. Improved road conditions will facilitate access to public transport by the communities, to reach markets, and other public places.

686. **Anticipated Impacts-**Table VI-20 below presents impacts of road improvements during operation phase.

Table VI-20 Aspect impact table of socio-economic impact for operation phase

Aspect	Impacts	
Impact Description	Impact on access to markets	Impact on farmers livelihood
Receptor Importance/ Sensitivity	High	High
Extent	Buffer Zone	Buffer zone
Duration	Permanent	Permanent
Frequency	Continuous	Continuous
Likelihood	Certain	Certain
Reversibility	NA	NA
Magnitude/ Severity	High	High
Effect	Positive	Positive
Direct/ Indirect	Direct	Direct
Significance	High	High
Additional Mitigation (Y/N)	N	N
Residual Significance	-	-

687. There are no mitigation measures applicable to community socioeconomy during operation of the roads.

9. Loss of Land and Other Assets

a. Construction

688. **Description-** Since widening and improvement are confined to available RoW, extent of land acquisition is negligible. Private properties affected are either squatted or encroached. No private properties or structures are identified to be impacted by the Project. Impact on common property resources is also not identified. Though clearing RoW for the construction of road and establishing ancillary facilities will require the following:

689. Major activities to be considered at pre-construction stage:

- Diversion of forest areas
- Design of Construction of road
- Impact on Livelihoods

690. The right of way was acquired under the Pradhan Mantri Gram Sadak Yojna (PMGSY) during 2000-2010 through voluntary land donation. Currently the available average RoW is 8.96

meters that varies from 5 to 13 meters in plain terrain and, 5 to 10.50 meters in hilly terrain. The length of roads varies from 1 km to 11.37 km meters with average length of 3.60 km.

691. The total area of existing right of way is 872.37 acres and additional forest land of 0.748 hectares are required. No private land is required for the project.

692. **Assessment-** Any additional land required for expansion of the roads is available with KRRDA within the RoW. However, the additional 0.748 hectares land required to be acquired for the project comprises of land use of forest land. Diversion of forest land may result in localized loss of vegetation cover, habitat disturbance, and conversion of a limited forest area for road widening and improvement works.

693. During the construction phase of the project, access to shops and agricultural fields will be restricted for the villagers, impacting livelihood during the days of construction.

694. Depending on the extent of forest land diversion, these impacts are significant but can be mitigated through fair compensation afforestation programs, and active community engagement.

695. **Anticipated Impacts-** Table VI-21 below presents the impact matrix.

Table VI-21 Aspect impact table of impact on private assets

Aspect	Impacts	
Impact Description	Loss of Forest Land	Impact on Livelihood
Receptor Importance/ Sensitivity	High	High
Extent	Core Zone	Buffer Zone
Duration	Permanent	Temporary
Frequency	Single event	Single event
Likelihood	Certain	Certain
Reversibility	Reversible	Reversible
Magnitude/ Severity	Medium	Medium
Effect	Negative	Negative
Direct/ Indirect	Direct	Direct
Significance	Moderate	Moderate
Additional Mitigation (Y/N)	N	N
Residual Significance	-	-

696. **Mitigation.** EDM 26 mentioned above under socio economy will be applicable to the project for loss of other assets.

b. Operation

697. **Description-** There are no anticipated impacts on land use and other assets during operation phase of the project.

10. Utility Shifting

a. Construction

698. **Description-** Delay and unplanned shifting of public utilities like telephone and electrical poles, water pipelines, and Optical Fible Cable (OFC) causes disruption of utility services to local

community. Digging, shifting, and re- establishment of poles may also impair the view of community areas.

699. Electricity poles, telephone poles, water supply pipelines and water pumps installed by different government departments are present along a number of the project roads.

700. **Assessment-** According to the inventory of utilities, approximately 789 number of project roads have electric lines and/or poles are traversing within RoW. Drinking water supply to most of the villages provided by the Government, is provided by a pipeline network traversing within RoW of the project roads in a number of villages. Duration of shifting of drinking water supply infrastructure, will impact the drinking water supply in the villages.

701. **Anticipated Impacts-** Table VI-22 below presents the impact matrix for impacts during construction phase.

Table VI-22 Aspect Impact of Utility Shifting, Aesthetic and Visual Impact

Aspect	Impacts	
Impact Description	Utilities, Aesthetics and Visual Impacts	Impact on Drinking Water Supply
Receptor Importance/ Sensitivity	Medium	High
Extent	Core Zone	Core Zone
Duration	Temporary	Temporary
Frequency	Single event	Single event
Likelihood	Certain	Certain
Reversibility	Reversible	Reversible
Magnitude/ Severity	Medium	High
Effect	Negative	Negative
Direct/ Indirect	Direct	Direct
Significance	Moderate	Major
Additional Mitigation (Y/N)	N	N
Residual Significance	-	-

b. Mitigation Measures

702. **Embedded Mitigation Measures (EDM)-** EDMs applicable to the project are provided in Chapter 3 of this report. Following EDMs are applicable to mitigate the impacts on utility.

EDM	Description
EDM28	All efforts shall be made to reduce the duration of utility shifting impact and restore the disturbed facilities and access. All utilities should be shifted before start of construction. Necessary permission and payments should be made to relevant utility service agencies and individuals to allow quick shifting and restoration of utility services. Visual barriers are to be provided, as necessary, on active construction zones. Consultation with affected people prior to the start of utility shifting, presenting construction timelines and guidelines should be conducted. Local people must be informed through appropriate means about the time of shifting of utility structures and potential disruption of services, if any.

c. Operation

703. **Description-** Shifting of utilities is not anticipated during operation phase of the project.

11. Competing Resources

a. Construction

704. **Description-** Surface and ground water resources of the areas in project roads, are identified as competing resource during construction phase of the project.

705. **Assessment-** Water will be required for the construction activities during the project roads improvement. Responsibility of procuring the water will be under the scope of contractors engaged for the construction works.

706. Approximately 500 roads not only has surface water bodies within 2 km of the roads, streams or canals also crosses a number of project roads. Groundwater resources through hand pumps and borewells are also available at a number of villages.

707. Groundwater resources in Karnataka support more than 60% of irrigation and approximately 90% rural water supply. As detailed in Chapter 4 (Description of Environment) of this report, 45 groundwater assessment units fall under 'over-exploited' category of groundwater. Over-exploited and critical groundwater assessment units are concentrated particularly in Kolar, Chikkaballapura, Bengaluru region, Ramanagara, parts of Tumakuru and northern dry zones.

708. Piped water connections provided by the Government to the rural households utilizes available surface and groundwater resources in the area. Available water sources are used by local populations for irrigation, domestic and cattle consumption.

709. Use of local surface and groundwater resources for construction purpose, will deplete these resources and compete with local water requirement.

710. Additionally, Karnataka is prone to droughts, particularly in the districts of Kalaburagi, Bagalkot, Raichur, Ballari, Kolar, Tumakuru, Chikkaballapura, Ramanagara, Chamaraajanagar and Vijayapura, etc.

711. During construction activities water will become a competing resource for community and construction works. Receptor sensitivity in event of drought will be 'High'.

712. **Anticipated Impacts-** Table VI-23 below presents the impact matrix for impacts on competing resources during construction.

Table VI-23 Aspect impact table of competing resources for construction phase

Aspect	Impacts
Impact Description	Impact on surface and groundwater resources availability
Receptor Importance/ Sensitivity	Medium to High
Extent	Buffer Zone
Duration	Temporary
Frequency	One time
Likelihood	Likely
Reversibility	Reversible
Magnitude/ Severity	Medium to High
Effect	Negative

Aspect	Impacts
Direct/ Indirect	Direct
Significance	Major
Additional Mitigation (Y/N)	Y
Residual Significance	Minor

b. Mitigation Measures

713. **Embedded Mitigation Measures (EDM)-** EDMs applicable to the project are provided in Chapter 3 of this report. Following EDMs are applicable to mitigate the impacts due to competing resources.

EDM	Description
EDM23	Contractor shall obtain permission for withdrawal of surface or ground water and consult with the community and ensure that villager's user right is protected. Contractors shall provide dedicated sources or supplementary supply where reliance on local systems is not feasible. Surface flow shall be diverted, or construction activities shall be isolated from the surface flow in a manner acceptable to PIU. Any diversion / bund/isolation constructed for bridge/culvert work shall be removed by Contractor as soon as utility of those are over. Installation of slit fencing with planting vegetated swales at the mouth of the nearest water body to prevent any residual sediments from entering the water body.

714. **Additional Mitigation Measures (ADM)-** In addition to the EDMs mentioned above, following ADMs will be applicable to mitigate the impacts.

ADM	Description
CR1	The community interest and dependence on water resource will be protected through obtaining regulatory and local permissions. The contractor will obtain permission from Karnataka Ground Water Authority for abstraction of groundwater and, for other sources contractors will obtain permission from local panchayat or local governing body. In an event of drought during construction phase and/or in water scarce regions, a dedicated or supplementary water supply (e.g. tanker water) and water use restrictions shall be implemented so that community access to water resource is not compromised.

c. Operation

715. **Description-** No impact on surface or ground water resources is anticipated during operation phase of the roads.

12. Community Health and Safety

a. Construction

716. **Description-** During construction phase of the project, there will be movement of workers, construction vehicles and machinery on the project roads.

717. **Assessment-** Construction machinery and equipment will generate noise and gaseous emissions which will impact the ambient air and noise quality around the project roads, during construction. These impacts are anticipated to be comparatively higher for the sections of the roads with schools, anganwadis or settlements along the road. Magnitude of deterioration of ambient air and noise quality are discussed in the respective sections above in this report.

718. Deteriorated ambient noise and air quality will impact health of the residents and interfere in school and Anganwadi operations.

719. The congestion of the existing road during construction due to closure, road side ditches, disposal of construction spoils along the road alignment, movement of heavy vehicles without adequate warning, will have difficulty in getting in and out of the area may also increase likelihood of injuries, fatal accidents among the road users.

720. The assessment that interstate migrant workers are not expected to be used under the project is based on the package-wise and distributed nature of rural road improvement works. There will be relatively limited workforce requirement of approximately 140–150 workers per package, and the expected availability of unskilled labour from nearby villages and skilled/semi-skilled workers from nearby districts, within Karnataka. Specialized personnel may be engaged for equipment-based road construction activities where required; however, large-scale interstate labour mobilisation is not anticipated. This assumption will be verified during contractor mobilisation and reflected in the contractor's site-specific Environmental Management Plan prior to commencement of works. The above assessment is also based on the following.

721. The ECoP (Environmental Code of practices) prefers to use the local labours and avoid the migrant labour.

722. The borrower's requirement through bidding documents also recommends using the local labours.

723. Notwithstanding the above, the EIA has EMP, GRM and labour accommodation plan (Appendix 8) based on GIIP. The worker code of conduct (Appendix 10) has been developed as part of EMP of the draft EIA.

724. However, influx of labour (mainly local/intra-state) at any work location during construction, may lead to increased risk of communicable disease transmission to community, increased burden on local healthcare facilities and risk of social conflict between workers and communities.

725. **Anticipated Impacts-** Impact matrix is presented below (Table VI-24).

Table VI-24 Aspect impact table of community health and safety for construction phase

Aspect	Impacts		
	Impacts on health of local population	Health and safety of road users	Local social conflicts due to influx of labour
Impact Description			
Receptor Importance/ Sensitivity	High	High	High
Extent	Buffer Zone	Core Zone	Buffer Zone
Duration	Temporary	Temporary	Temporary
Frequency	One time	One time	One time
Likelihood	Certain	Likely	Likely

Aspect	Impacts		
Reversibility	Reversible	Reversible	Reversible
Magnitude/ Severity	Medium	High	Medium
Effect	Negative	Negative	Negative
Direct/ Indirect	Direct	Direct	Direct
Significance	Moderate	Major	Moderate
Additional Mitigation (Y/N)	Y	N	Y
Residual Significance	Minor	-	Minor

b. Mitigation Measures

726. **Embedded Mitigation Measures (EDM)-** EDMs applicable to the project are provided in Chapter 3 of this report. Following EDMs are applicable to mitigate the impacts on community health and safety.

EDM	Description
EDM11	The DPR identifies utilities that fall within the improvement corridor and provides for shifting or relocation before construction. This is an embedded design-stage mitigation because it reduces the need for ad hoc site decisions and avoids unsafe obstruction within the roadway.
EDM12	The DPR provides shoulders on both sides of the carriageway, including hard shoulder in some stretches, so that pedestrians, cyclists, and other vulnerable users can move more safely outside the traffic stream. This is a built-in safety and environmental design response for rural roads passing through inhabited areas.
EDM13	The DPR incorporates traffic signs, retro-reflective signs, pavement markings, stop lines, and zebra crossings at relevant locations. These measures are embedded because they are included as part of the road safety design and not left only to later operation-stage action.
EDM14	The DPR provides for speed management at village entries, curves, junctions, schools, and other sensitive points through measures such as speed humps, warning signs, or other traffic calming arrangements. This is an embedded mitigation because it directly responds to community safety risks created by improved road speed.
EDM15	The DPR includes crash barriers, hazard markers, delineators, guide posts, and object markers at embankments, culverts, bridge approaches, sharp bends, and other hazardous locations. These are embedded engineering safety measures incorporated into the road design.
EDM17	The DPR/EMP provisions require construction materials to be transported with tarpaulin cover and haul roads to be maintained and dust-controlled. Contractor shall sprinkle water to suppress dust as per site condition. Contractor shall maintain existing road and haul road so that vehicles can pass easily and ensure that generation of dust is minimized. The excavated earth /construction materials shall be stored properly so that it does not generate fugitive emissions. Storage area should be located downwind of the habitation area. Contractor shall install wet scrubber or any other suitable pollution control mechanism for hot mix plant and ensure that flue gas passes through the wet scrubber before releasing into ambient air. Contractor shall also ensure that wet scrubber or other filter is always operational when hot mix plant is in operation.

EDM	Description
	Although implemented during construction, these are embedded in the project documentation and therefore form part of the planned mitigation package. The setback conditions for sensitive receptor as prevailing CPCB guidelines is 500 m from human habitation, 200 m from highways, and 500 m from sensitive ecological/institutional zones. Where the setback distances specified above cannot be achieved and no alternative location is available, and subject to prior approval of the PIU/PISC, barricading with 6-meter-high GI sheets will be provided as a supplementary control. Barricading shall not be treated as a substitute for the prescribed separation distances, and avoidance of siting within the setback shall remain the first order of preference.
EDM18	The project documentation includes provisions for information boards and public communication mechanisms, including the display of project-related information and grievance redress contact details. These measures are integrated into the project's management framework and serve to enhance transparency, stakeholder engagement, and effective communication with affected communities.
EDM26	Contractors to keep community members apprised of construction schedules in readily accessible public locations. Construction schedule to be aligned with agricultural cycle to avoid harvest period, and consulted with community and farmers. A traffic management plan to be prepared for construction phase as part of the EMP. The contractors shall ensure that no inconvenience is caused to the commuters and local communities.
EDM29	Safety provisions in accordance with IRC guidelines to be implemented under the Project. These include (i) speed breakers in habitat areas to regulate speed, (ii) retro-reflective warning signboards near schools, hospitals, and religious places, (iii) proper sidewalks/pedestrian zones along roads in habitat areas and near schools, hospitals, and religious places.

727. **Additional Mitigation Measures (ADM)-** In addition to the EDMs mentioned above, following ADMs will be applicable to mitigate the impacts.

ADM	Description
CHS 1	Contractor to establish tie-up with nearest PHC/hospital and maintain emergency response plan.
CHS 2	Implement Workers' Code of Conduct and conduct cultural sensitivity training, including gender sensitivity training.
BD7	Hunting, poaching, trapping of wild animals as well as collection of firewood or other natural resources from inside the forest lands or legally protected areas as well as natural habitats should be prohibited by the contractor.
BD9	Good housekeeping practices should be followed at construction sites and camps. Food and other wastes that may attract animals should be discarded appropriately. Food waste should not be disposed in a manner that will attract wild animals. (Refer to Appendix 3-Waste Management Plan)
BD10	Construction workers should be trained about the forest and wildlife laws and acts in India. They should be sensitized about the dos and don'ts in ecologically sensitive areas.

c. Operation

728. **Description-** With increased traffic volume, communities including road users may be at risk due to road crashes.

729. **Assessment-** After roads improvement, volume of traffic will increase on the roads. In absence of adequate safety provisions and awareness amongst the community, road incidents will increase. For the roads connecting industrial and commercial areas, movement of heavy vehicles will increase on these roads. For the roads passing through settlements, there are houses with or without the boundary walls, along the road. Along with the increase in volume, speed of traffic on the roads will also increase after the improvement works, posing risk not only to the road users but also to the communities along the roads.

730. **Anticipated Impacts-** Impact matrix is presented below (Table VI-25).

Table VI-25 Aspect impact table of construction health and safety for operation phase

Aspect	Impacts
Impact Description	Increase in Road Incidents due to increase in volume and speed of vehicles
Receptor Importance/ Sensitivity	High
Extent	Core Zone
Duration	Permanent
Frequency	Continuous
Likelihood	Certain
Reversibility	Reversible
Magnitude/ Severity	High
Effect	Negative
Direct/ Indirect	Direct
Significance	Major
Additional Mitigation (Y/N)	N
Residual Significance	-

d. Mitigation Measures

731. EDM 29 mentioned above will be applicable to the project for community health and safety.

13. Occupational Health and Safety

a. Construction

732. **Description-** Construction activities during the improvement of the project roads will take approximately 140-150 number of workers per package, and approximately 10-12 months per road.

733. **Assessment-** Construction activities pose serious risks to the workers if not identified and managed. These risks lead to injuries, fatal accidents, disabilities among the workers. Without adequate safety measures, workers are exposed to various occupational hazards including handling hazardous materials, bitumen works, tree felling works, embankment stabilization works etc. The congestion of the existing road, road side ditches, haphazard disposal of construction spoils along the road alignment, movement of heavy vehicles without adequate warning, will increase likelihood of injuries, fatal accidents among workers.

734. As mentioned in 'Natural Hazard' section above, parts of Karnataka are prone to thunderstorm, landslides and cyclones. These natural hazards, during the construction activities

will pose life threatening risks to the workers. The workers will be exposed to construction activities related noise. The OSHA Daily Permissible Occupational Noise Level Exposure is provided in Table VI-26.

Table VI-26: OSHA Daily Permissible Occupational Noise Level Exposure

Sl. No.	Duration per day, hours	Sound level dB(A)
1	8	90
2	6	92
3	4	95
4	3	97
5	2	100
6	1 and ½ or 1.5	102
7	1	105
8	½	110
9	14 or less	115

735. Major health and safety issues summarized in Table VI-27:

Table VI-27: Health and Safety Activities

Sl. No.	Activities	Type of Risk	Health Issues
1	Operation of Hot mix Plant, Stone Crusher Plant, Batching Plant, material stockyards)	Exposure to dust and gaseous emissions	Health hazards, Respiratory problems
		Accident Risks	Injury/ death
2	Operation of vehicles and machineries	Accident Risks	Injury/ death
3	Excavation and Earth works	Dust generation	Health hazards, Respiratory problems
4	Concreting and masonry works	Exposure to concrete and cement	Skin Problem, respiratory problem
5	Paving works	Gaseous emission Heat generation	Health hazards, Respiratory problems Burning injury
6	Bridge works	Falling from height Accident risks	Injury due to fall from height
9	Handling of hazardous chemicals and waste	Exposure to hazardous chemicals	Chemical injury
10	Operation of Camp site	Unhygienic condition	Water borne diseases, vector diseases, snake bites
11	Working near DG sets	Exposure to Noise Pollution	Health hazards
12	Waste generation	Health hazards	Health problems

736. **Anticipated Impacts-** Impact matrix is presented below Table VI-28.

Table VI-28 Aspect impact table of occupational hazards for construction phase

Aspect	Impacts
Impact Description	Occupational health and safety
Receptor Importance/ Sensitivity	High
Extent	Core Zone
Duration	Temporary
Frequency	Continuous

Aspect	Impacts
Likelihood	Likely
Reversibility	Reversible
Magnitude/ Severity	High
Effect	Negative
Direct/ Indirect	Direct
Significance	Major
Additional Mitigation (Y/N)	N
Residual Significance	-

b. Mitigation Measures

737. **Embedded Mitigation Measures (EDM)-** EDMs applicable to the project are provided in Chapter 3 of this report. Following EDM will be applicable to mitigate the impacts of occupational health and safety.

EDM	Description
EDM30	Develop and implement occupational health and safety plan (Appendix 6). Appropriate Personal Protective Equipment (PPE) to be provided to workers engaged in construction. Daily Tool Box Talks (TBTs) to be conducted at work sites before start of construction activities. Undertake regular health and safety trainings for the workers. Develop Emergency Preparedness and Response Plan (Appendix 7) with regular on site mock drills; emergency contacts displayed at camps and worksites. A grievance mechanism shall be developed for workers. Ensure compliance with labour laws; shift scheduling; overtime monitoring with mandatory rest periods. Implement permit-to-work system for high-risk activities. Develop designated worker movement corridors with trained flagmen. Provide drinking water stations, shaded rest areas, work-rest schedules, heat stress awareness and first aid facilities. Maintain transparent wage records, compliance with labour laws, periodic audits; Establish worker grievance mechanism consistent with ADB SPS, maintain grievance register, periodic consultations with workers and evacuation procedures.

c. Operation

738. **Description-** Occupational health hazards during operation phase of the project roads will be associated with the maintenance activities. Maintenance activities will lead to same impacts as discussed in the construction section above.

739. **Assessment-** Construction activities pose serious risks to the workers if not identified and managed. These risks lead to injuries, fatal accidents, disabilities among the workers. Without adequate safety measures, workers are exposed to various occupational hazards including

handling hazardous materials, bitumen works, tree felling works, embankment stabilization works etc. The congestion of the existing road, roadside ditches, haphazard disposal of construction spoils along the road alignment, movement of heavy vehicles without adequate warning, will increase likelihood of injuries, fatal accidents among workers.

740. As mentioned in 'Natural Hazard' section above, parts of Karnataka are prone to thunderstorm and landslides. These natural hazards, during the construction activities will pose life threatening risks to the workers.

741. **Anticipated Impacts-** Impact matrix is presented below Table VI-29.

Table VI-29 Aspect impact table of occupational hazards for construction phase

Aspect	Impacts
Impact Description	Occupational health and safety
Receptor Importance/ Sensitivity	High
Extent	Core Zone
Duration	Temporary
Frequency	Continuous
Likelihood	Likely
Reversibility	Reversible
Magnitude/ Severity	High
Effect	Negative
Direct/ Indirect	Direct
Significance	Major
Additional Mitigation (Y/N)	N
Residual Significance	-

d. Mitigation Measures

742. **Embedded Mitigation Measures (EDM)-** EDMs applicable to the project are provided in Chapter 3 of this report. Following EDM will be applicable to mitigate the impacts of occupational health and safety.

EDM	Description
EDM30	Develop and implement occupational health and safety plan (Appendix 6). Appropriate Personal Protective Equipment (PPE) to be provided to workers engaged in construction. Daily Tool Box Talks (TBTs) to be conducted at work sites before start of construction activities. Undertake regular health and safety trainings for the workers. Develop Emergency Preparedness and Response Plan (Appendix 7) with regular on site mock drills; emergency contacts displayed at camps and worksites. A grievance mechanism shall be developed for workers. Ensure compliance with labour laws; shift scheduling; overtime monitoring with mandatory rest periods. Implement permit-to-work system for high-risk activities. Develop designated worker movement corridors with trained flagmen. Provide drinking water stations, shaded rest areas, work-rest schedules, heat stress awareness and first aid facilities. Maintain transparent wage records, compliance with labour laws, periodic audits; Establish worker grievance mechanism consistent with ADB SPS, maintain grievance register, periodic consultations with workers and evacuation procedures.

E. Cumulative Impact

743. The cumulative impact assessment evaluates the combined effects of KRRIP road improvement works and ongoing/planned rural drinking water supply project under the Jal Jeevan Mission (JJM) scheme by Department of Drinking Water and Sanitation, Government of India and agriculture activities. According to the data available on Jal Jeevan Mission Dashboard⁹⁶, out of total 26,589 villages in Karnataka, 16,476 villages have received household level water connections, and work is in progress in 9,813 villages. JJM work is yet to start in 300 villages. Data on overlapping of villages under KRRIP and ongoing and planned works under JJM is not available.

744. In cases where construction works for KRRIP overlaps with JJM, cumulative impacts are anticipated for the duration of construction period and only near the village sites identified by the Department of Drinking Water and Sanitation for JJM. Table VI-30Table VI-30 below compiles cumulative impacts of KRRIP and JJM.

⁹⁶ <https://ejalshakti.gov.in/jjmreport/JJMState.aspx> (accessed on 26 July 2026)

Table VI-30 Potential cumulative impacts

Projects Identified Impacts	Significance of impacts of KRRIP	Significance of impacts of Ongoing and planned JJM works Impact Level	Significance of impacts of Agricultural Activities	Cumulative Impact Level	Assessment of Impacts
Ambient Air and noise quality	Moderate	Medium	Low	Medium	- The construction work of the KRRIP and JJM works will not be taken up at the same time. - EMP covers the mitigation measures of Ambient Air and Noise Level
Water resources	Moderate	Medium	Medium	High	- Dependence on local water resource for construction works by both KRRIP and JJM will be competing resource and add stress to community water resources - A permission will be obtained before abstraction of water.
Biodiversity and ecosystem services	Moderate	Moderate	Low	Medium	- Construction of roads and JJM trenches need clearance of vegetation in RoW. - BAP has been prepared for the biodiversity risk of the KRRIP.
Impacts on Community access roads and common areas	Moderate	Medium	Medium	Medium	- Disturbance to local access being used by the community - A Sample Traffic Management plan has been prepared and included in the Annexure-11 to address any access related risks.
Labours risk	Moderate	Medium	Low	Medium	- Local conflicts between community and labour, communicable diseases and stress on public utilities - The KRRIP will use the

Projects Identified Impacts	Significance of impacts of KRRIP	Significance of impacts of Ongoing and planned JJM works Impact Level	Significance of impacts of Agricultural Activities	Cumulative Impact Level	Assessment of Impacts
Community health and safety	Medium	Medium	Medium	Medium	• The community health and safety impact of dust generation, noise, traffic safety has been assessed to be medium. • The EMP includes the mitigation measures of community health and safety risk. • Grievance redressal mechanism will be established.
Community Livelihood	Low	Medium	Low	Medium	• Access to agricultural field and commercial areas for livelihood may be impacted. • The EMP includes providing alternate access wherever access is impacted.

745. The mitigation measures including stakeholder engagement are provided in the Environmental Management Plan (Chapter 9).

VII. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

746. Meaningful⁹⁷ consultations are necessary steps to obtain the views of people who may be affected by development projects or may otherwise have an interest in their outcomes and to inform them about changes that could affect them. Such feedback assumes greater significance in the case of people who may be adversely affected. Since these stakeholders usually do not have a direct role in decisions about projects that affect them, consultations are an important mechanism to ensure that their concerns are considered while decisions are made.

Stakeholder Consultations

747. The Karnataka Rural Roads Development Agency (KRRDA) conducted series of consultations involving DPR consultants, ADB Project team. Stakeholders included local communities, farmers, women, schoolchildren, elderly villagers, vulnerable groups, government agencies, regulatory authorities and other key stakeholders involved in the Project. These consultations were held separately for different road sections in different districts to address specific concerns and gather localized feedback. Project information was shared with the local community through verbal communication, and feedback was actively collected from participants. The minutes of the meetings were systematically recorded. Key findings from all the public consultations part of the preparation of EIA are summarised below.

1. Public Consultation Conducted by DPR Consultants of KRRDA

748. KRRDA through its DPR consultants conducted public consultations for 1,335 project roads at 391 locations between December 2025 to June 2026. A total 9435 participants attended the consultations including 3,048 women. The consultations were undertaken at all the districts to ensure representation of all Project roads. The consultations covered all Project roads, either directly or through representative consultations. Where multiple roads shared similar geographic and socioeconomic settings, consultations were conducted at strategically selected common locations to represent all the Project roads. Participants included people from vulnerable groups such as farmers, women, school children and elderly villagers. The consultations were undertaken to share project information, obtain community feedback, and document road-specific environmental and social concerns for consideration during project planning and implementation. Recommendations addressing the issues raised during the consultations are included in Chapter 9 (Environmental Management Plan). Summary of consultations is provided in Table VII-1.

Table VII-1: Consultation Issues and Consultant Recommendations

SN	Topic	Issues Raised in Consultation	PIU response
1	Land Acquisition & Right of Way (RoW)	The participants were concerned that widening may affect private land, field boundaries, compound walls, and roadside areas, and requested clarity on additional land requirements.	Design and construction will remain within the available RoW to the extent feasible, avoid unnecessary private land impacts, and inform communities in advance of any temporary disturbance.

⁹⁷ As per ADB SPS, 2009, a process that (i) begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle; (ii) provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people; (iii) is undertaken in an atmosphere free of intimidation or coercion; (iv) is gender inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and (v) enables the incorporation of all relevant views of affected people and other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues.

SN	Topic	Issues Raised in Consultation	PIU response
2	Road Durability — Expansive Black Cotton Soil	Community noted that black cotton soil and poor drainage weaken roads during monsoon and may cause waterlogging or damage to adjoining land.	The road design will include suitable subgrade treatment, pavement design, side drains, cross-drainage, temporary drainage, and erosion control, especially before and during monsoon. Black cotton soil will be replaced for construction with suitable soil borrowed from approved borrow area.
3	Safety at Village Junctions	The participants raised concerns about speeding and accident risks near junctions, curves, schools, temples, bus stops, pedestrian areas, and livestock crossings.	The proposed project will include the provision of speed calming, warning signs, curve and hazard markers, road markings, barricading, flagmen, and safe pedestrian arrangements at critical locations.
4	Noise — Sensitive Receptors	Participants were concerned that construction noise and vibration may disturb houses, schools, health facilities, and other sensitive receptors, especially at night.	The construction equipment will be provisioned with silencers. The use of compliant DG sets will only be allowed, the nighttime construction will be avoided, and noise monitoring will be conducted.
5	Dust Deposition on Crops / Horticulture	The participants reported that construction dust may settle on crops, horticulture, houses, shops, and village areas, affecting productivity, cleanliness, and health.	Usage of regular water sprinkling, covering fine materials, maintaining good housekeeping, and increased dust control during dry and windy conditions.
6	Water Scarcity / Source of Construction Water	Communities were concerned that construction water use may increase pressure on scarce local sources and that runoff may affect ponds, tanks, wells, and drains.	Source water through approved means, avoid affecting drinking-water needs, protect nearby water bodies with silt control, and keep drainage paths functional.
7	Transport of Agricultural Produce / Access	Villagers requested uninterrupted access to homes, farms, schools, health centers, livestock routes, and agricultural transport during construction.	Maintain safe access through phased works, temporary ramps, diversions, signage, public information, dust control, and early restoration of affected access.
8	Cattle / Livestock Crossing	Residents noted frequent livestock crossings near settlements, grazing areas, and water points, with concern that improved roads may increase accident risk.	Provide warning signs, reflective devices, and speed controls at livestock-crossing locations, and avoid unsafe trenches, stockpiles, or diversions.
9	Access to / Damage of Utilities	Participants requested protection of pipelines, hand pumps, bus stops, shrines, statues, and other community assets along the road.	Verify utilities before work, coordinate protection or shifting with relevant departments, maintain access, and provide barricading or temporary access where needed.
10	Material Sourcing / Borrow & Quarry	Communities raised concerns about spoil dumping, debris disposal, borrow and quarry sourcing, transport nuisance, and impacts on fields, drains, and village roads.	Use approved borrow/quarry sources, dispose spoil only at approved sites, prevent dumping near fields or water bodies, and restore disturbed ancillary areas.

2. Consultations involving ADB Project Team

749. A series of public consultations was conducted between 6 to 11 July 2026 in the presence of representatives of the ADB Project Team, Project Implementation Unit (PIU), DPR consultants, local government authorities and community representatives in Dakshin Kannada, Kodagu,

Mysuru, Udupi and Uttara Kannada districts. The consultations covered eight representative project roads, namely Road IDs 556, 1551, 1139, 1386, 5168, 4146, 4822, 4162 and 822. A total of 232 participants attended the consultations, including residents, farmers, women's self-help groups, project beneficiaries, Gram Panchayat representatives, government officials and members of Indigenous Peoples communities. The consultations were undertaken to disclose project information, explain environmental and social safeguard requirements, obtain stakeholder feedback on the proposed road improvements, and identify key environmental and social concerns requiring consideration during project implementation. Overall, participants expressed strong support for the Project and acknowledged the anticipated benefits of improved connectivity, enhanced access to education and healthcare facilities, improved transportation of agricultural produce, reduced travel time and increased economic opportunities. The key outcomes of the consultations and corresponding project responses are presented in Table VII-2.

Table VII-2: Summary of Key Outcomes of Consultations Conducted with ADB Project Team

Topic	Key Issues Raised by Stakeholders	Recommendations
Project Support and Expected Benefits	Participants strongly supported the proposed road improvements and highlighted expected benefits including improved connectivity, safer travel, better access to schools, healthcare facilities, markets, public services and livelihood opportunities. Communities generally accepted the DPR proposals.	No recommendation
Construction-related Environmental Impacts	Concerns were raised regarding dust generation, noise pollution, traffic disruption, construction waste disposal, protection of water bodies, and inconvenience to nearby residents during construction.	These issues will be addressed through the Environmental Management Plan (EMP) (Chapter 9), including measures for dust suppression, noise control, waste management, traffic management, waterbody protection and environmental monitoring.
Drainage and Waterlogging	Participants requested adequate roadside drainage and measures to prevent waterlogging and localized flooding along the roads.	Appropriate drainage structures and roadside drains have been incorporated into the road designs based on site-specific requirements.
Road Safety	Stakeholders requested safety measures near schools, Anganwadi centers, settlements and pedestrian areas. Suggestions included speed control measures, warning signs and traffic management during construction.	Road safety provisions, including signage, road markings, traffic calming measures and construction-stage traffic management arrangements, have been included in the project design and EMP.
Access During Construction	Communities sought assurance that access to residences, agricultural fields, community facilities and tribal settlements would be maintained during construction.	Contractors will maintain uninterrupted access to residences, farmlands, public facilities and community infrastructure throughout construction.
Biodiversity and Wildlife	Participants and local officials indicated limited wildlife movement in the project areas but emphasized the need for environmental safeguards, particularly near forest areas.	Biodiversity protection measures have been incorporated through the Biodiversity Action Plan (BAP) and associated environmental management measures.
Indigenous Peoples and	Consultations with Indigenous Peoples and PVTG communities focused on livelihoods, access to resources, social	The Indigenous Peoples Plan (IPP) includes measures to protect community access and ensure Indigenous Peoples

Topic	Key Issues Raised by Stakeholders	Recommendations
Vulnerable Groups	conditions and potential construction impacts. Communities requested uninterrupted access to settlements and livelihood resources.	benefit from the Project without adverse impacts.
Protection of Community Assets and Properties	Stakeholders sought clarification on potential impacts to houses, shops, religious structures, community assets and private properties.	The Project has been designed largely within the available Right-of-Way (RoW) to avoid or minimize impacts on private and community assets.
Information Disclosure and Stakeholder Engagement	Participants were informed about project disclosure arrangements and requested continued communication and consultation during project implementation.	Environmental assessment documents will be disclosed in accordance with ADB requirements, and stakeholder engagement will continue throughout project implementation.
Grievance Redress Mechanism (GRM)	Communities requested a transparent mechanism for addressing concerns related to construction, environmental impacts, safety and access.	A three-tier GRM comprising field-level, PIU-level and PMU/ADB-level grievance handling arrangements will be implemented and widely publicized.

3. Addressing the Concerns Raised in the Public Consultation

750. Based on the issues raised in the public consultation and the response provided the following provisions have been made in the DPR and EMP of the EIA.

- All the improvement work is limited within the available right of way except one road in Belagavi where additional forest land is required for Road ID 4446.
- Black cotton soil will be replaced for construction with suitable soil borrowed from approved borrow area.
- Monsoon season will be avoided for the construction work.
- A roads safety study has been conducted and safety measures as per the IS codes are provided in the DPR.
- The contractor will manage the noise at the construction site. Wherever required, temporary noise barrier will be provided. The equipment and machineries will be maintained in good condition. Nighttime work will be avoided in the residential area.
- The contractor will be also providing dust suppression measure by sprinkling of water.
- Water will be sourced from the approved sources, and prior approval will be obtained from the applicable authority. In case of village sources, a permission from the local governing body will be obtained. This provision has been made in the EMP.
- The contractor will maintain safe access to the local community throughout the construction period. In case of any disturbance, an alternative access will be provided, and prior notice will be given to the community before any disturbance to the access.
- A utility relocation will be done in consultation and approval of the concerned department. In case of any disturbance to water supply, an alternate arrangement will be done.
- A waste management plan has been prepared for the management of any construction waste or waste from the worker accommodation camp.

- Potential impacts on biodiversity and wildlife movement, particularly in road sections located near forest areas and human- wildlife conflict have addressed in Biodiversity Action Plan (BAP).
- Potential impacts on Indigenous Peoples (IPs), PVTGs, and other vulnerable groups, including access to settlements, resources, and livelihoods have been addressed in Indigineoup People Plan.
- Stakeholder consultation will continue during the construction and operation phase. A consultation plan has been included in the EMP.
- A grievance redressal mechanism will be established to address any complaints filed by the community.

B. Information Disclosure

751. As the Project is classified Category A for environment, ADB SPS 2009 (para. 53) and the Access to Information Policy require the draft EIA to be posted on the ADB website at least 120 days before Board consideration of the loan. The draft EIA will accordingly be disclosed on the ADB website, and in-country by KRRDA, within this timeline. To keep more transparency in planning and for further active involvement of affected persons (APs) and other key stakeholders the project information including EIA report is planned to be posted on the ADB website by 31 July 2026. ADB will share the draft EIA with KRRDA by 28 July 2026 to seek its concurrence for disclosure, following which KRRDA will also disclose the draft EIA on its web portal by 30 July 2026. Upon disclosure, KRRDA will publish an article in a local Kannada-language newspaper to inform communities that the EIA is available for review and that suggestions, if any, are welcome. KRRDA will subsequently prepare a two-page executive summary of the EIA in Kannada and share it with each gram panchayat office by 10 August 2026.

752. Consultation with the community will continue during the construction phase, a consultation plan has been provided in the EMP. Necessary information will be disclosed through these consultations. A grievance redressal mechanism will be established to address the issues raised by the community. This GRM will resolve the concerns raised by the community and resolutions will be communicated in a time bound manner.

753. A semi-annual environmental monitoring report is planned to be prepared during the construction phase covering all the project's environmental compliances and project progress and consultation conducted during each monitoring report. The Semi-annual monitoring report will be disclosed o ADB website and KRRDA website.

754. The document disclosure plan is provided in the Table VII-3.

Table VII-3: Document Disclosure Plan

Documents	format	Language	Disclosure platform	Timeframe	Responsible party
Environmental Impact Assessment Report	Electronic version of PDF	English	Draft EIA report will be posted on ADB website. It will be disclosed on web portal of KRRDA.	After approval of ADB within one week after ADB clearance of the report (31. July. 2026)	PMU
Executive Summary	Electronic version of PDF	English, Kannada	Each Gram Panchayat Office	10 August 2026	PMU

Documents	format	Language	Disclosure platform	Timeframe	Responsible party
Quarterly Environmental Monitoring Report (from the date of project effectiveness until the issuance of ADB's Project Completion Report.)	Electronic version of PDF	English	Website of KRRDA	Every quarterly within 1 week after ADB clearance of the report	PMU
Semi-annual External Environmental Monitoring Report	Electronic version of PDF	English	KRRDA	After approval of ADB within one week after ADB clearance of the report	PMU
External Monitoring Report- Environment	Electronic version of PDF	English	External Monitor- Environment	After approval of ADB within one week after ADB clearance of the report	PMU through External Monitor
External Monitoring Report- Biodiversity	Electronic version of PDF	English	External Monitor- National Biodiversity Specialist	After approval of ADB within one week after ADB clearance of the report	PMU through External Monitor
In person community consultation	Disclosure of project details to the illiterate persons and those who cannot access the reports will be done in person community consultation meetings	Local language	In person meetings near the project site.	One in pre-construction stage and other during construction stage.	PMU and PIU

VIII. GRIEVANCE REDRESS MECHANISM (GRM)

755. KRRDA operates under the Rural Development and Panchayat Raj (RDPR) Department, Government of Karnataka. Accordingly, project-related grievances associated with rural roads are managed through the existing grievance redress framework of the RDPR Department using the Integrated Public Grievance Redressal System (IPGRS) portal (Panchamitra).⁹⁸ The system enables members of the public to register complaints related to rural road and bridge infrastructure, including road or bridge damage, inadequate maintenance, delays in construction activities, abandoned works, and concerns regarding construction quality. Submitted grievances are forwarded to the relevant implementing authority for review, corrective action, and closure in accordance with the established government grievance redress procedures.

756. The KRRDA will also ensure that a Project specific grievance redress mechanism (GRM) is established to support the resolution of environmental and social safeguards related issues during implementation of the project. The GRM will receive, evaluate and facilitate the resolution of affected people's concerns, complaints and grievances about the environmental and social issues of the Project. The GRM will aim to provide a time-bound and transparent mechanism to voice and resolve social and environmental concerns linked to the project. The project-specific GRM is not intended to bypass the government's own process, rather it is intended to address affected persons' concerns and complaints promptly, making it readily accessible to all segments of the affected persons and is scaled to the risks and impacts of the project. The GRM will be gender responsive and culturally appropriate, and will be accessible to affected persons at no cost and without retribution to the person or group that originated the complaint or concern. The complainant may access the formal legal system at any time regardless of the outcome of the grievance redressal through GRM.

757. The GRM shall operate throughout the project lifecycle (design, construction, and operation phases) and shall complement but not replace existing legal or judicial remedies available under national legislation.

758. The key objectives of the GRM shall include:

- To provide an accessible platform for stakeholders to register grievances related to project activities;
- To ensure timely, transparent, and fair resolution of grievances;
- To enhance accountability and responsiveness of the implementing agencies;
- To improve environmental and social performance through continuous feedback; and
- To prevent escalation of disputes through early-stage resolution.

759. For the KRRIP, KRRDA proposes to adopt a three-tier grievance redress mechanism (**Error! Reference source not found.**) through formation and functioning of Grievance Redress Committees (GRC) at three level (Figure 8-1); 1st level at the Site Level, 2nd at PIU level and the 3rd at PMU (State) level. Efforts will be made to resolve the grievances at local field level.

- Tier 1: Site-Level Grievance Redress Committee (GRC)
- Tier 2: District-Level/ PIU GRC

⁹⁸ Rural Development and Panchayat Raj Department (RDPR), Government of Karnataka, Panchamitra – Integrated Public Grievance Redressal System (IPGRS): Grievance Categories for Rural Roads, Bridges and Panchayat Services. Available at :https://panchamitra.karnataka.gov.in/Home/RDPR_Grievances_via_IPGRS_Portal

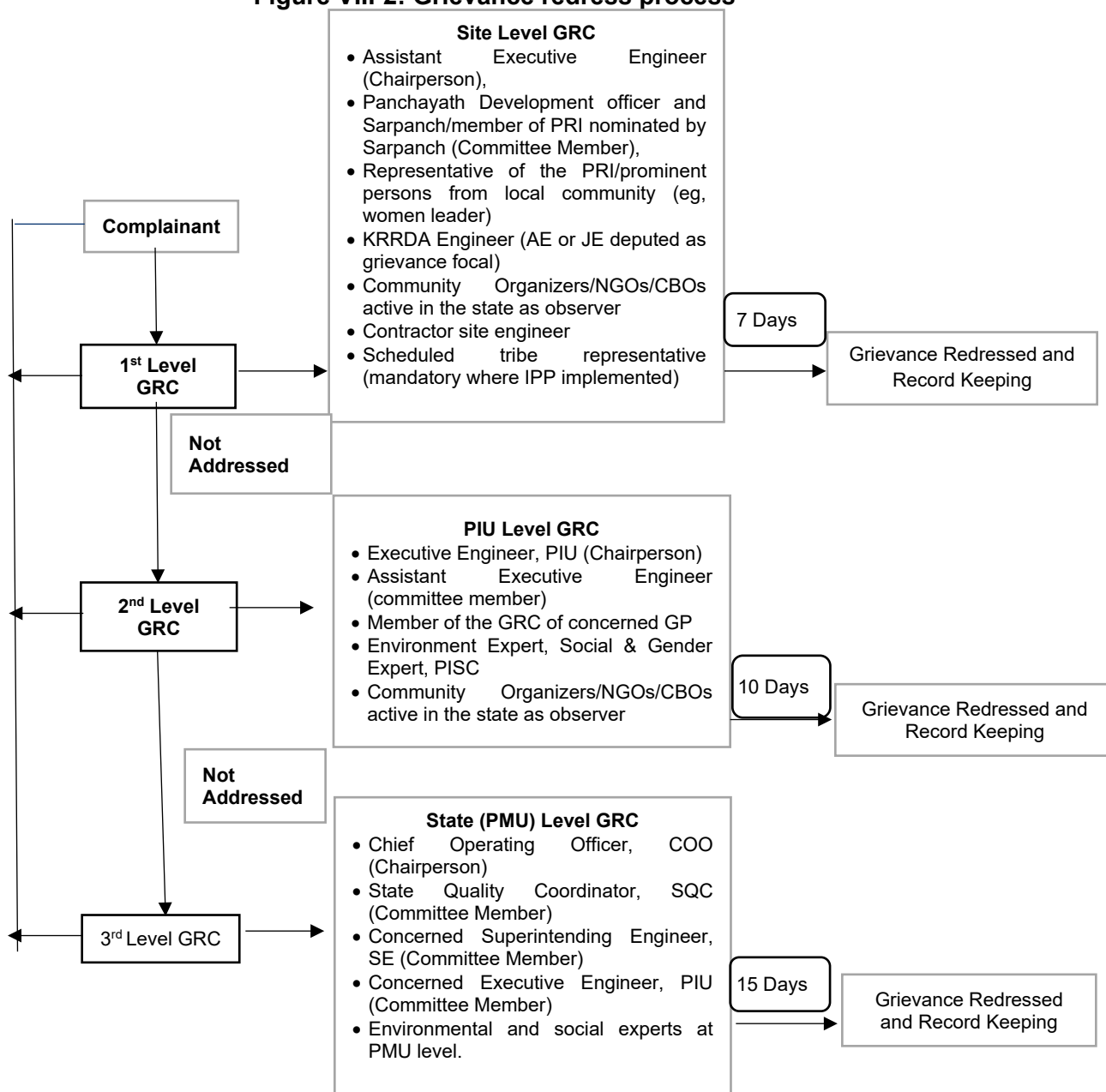
- Tier 3: State-Level / PMU (KRRDA) GRC

760. KRRIP will also have an offline grievance filing system for those who do not have access to the internet. Each construction site will maintain a complaint register specific for lodging concerns, complaints, and grievances about the social, land, and environmental issues or concerns by stakeholders and affected persons (if any). The grievance redress mechanism will be accessible to people throughout the length of the road, proposed for improvement, under the KRRIP. The Environment and Social Safeguard Experts at Project Management Unit (PMU) level (from PMC) and Environment and Social Safeguard Experts at project implementation unit (PIU-PISC) will follow-up on the grievances registered until resolved. The PMU will have a regular review to ensure that all grievances are resolved in time-bound and through a transparent mechanism. Grievances may be lodged in person, in writing through the complaint registers/drop boxes at site offices, by telephone, or by email, and anonymous grievances will also be accepted and acted upon.

761. The grievance redress committee along with members at different levels and grievance redress process is presented in Figure 8-1 and Figure VIII-2 respectively.

Figure 8-1: Grievance Redress Committee at Different Level

Site Level GRC	District (PIU) Level GRC PIU Level GRC	State (PMU) Level GRC
• Assistant Executive Engineer (Chairperson), • Panchayath Development officer and Sarpanch/member of PRI nominated by Sarpanch (Committee Member), • Representative of the PRI/prominent persons from local community (eg, women leader) • KRRDA Engineer (AE or JE deputed as grievance focal) • Community Organizers/NGOs/CBOs active in the state as observer • Contractor site engineer • Scheduled tribe representative (mandatory where IPP implemented)	• Executive Engineer, PIU (Chairperson) • Assistant Executive Engineer (committee member) • Member of the GRC of concerned GP • Environment Expert, Social & Gender Expert, PISC • Community Organizers/NGOs/CBOs active in the state as observer	• Chief Operating Officer, COO (Chairperson) • State Quality Coordinator, SQC (Committee Member) • Concerned Superintending Engineer, SE (Committee Member) • Concerned Executive Engineer, PIU (Committee Member) • Environmental and social experts at PMU level.

Figure VIII-2: Grievance redress process

Note: For grievances regarding landownership or any matter exclusively under the purview of the Honorable Courts, project affected persons file the legal petition at any point in time.

A. Grievance Redress Arrangements and Role Functions

762. A three-tier GRM will be established with formation of Grievance Redress Committees (GRC) at three levels: i.e. Site level, PIU level and State (PMU) level. Responsible persons and agencies/offices are identified to address grievances and seek appropriate advice at each stage, as required. Institutional arrangements, including constitution of grievance redress committees (GRC) at various levels, will be ensured to function throughout the project duration. The PMU

shall ensure the constitution of these committees and oversee the implementation of grievance redress processes, including adherence to time limits, record keeping, and documentation at each level. Representation of ST people in the site-level GRC will be ensured for all road subprojects passing through or located adjacent to ST habitations. Furthermore, the GRM will be established and fully disclosed along the entire stretch of road subprojects where ST communities are present in order to establish a culturally appropriate and gender inclusive grievance mechanism. Information on the GRM, including the grievance registration process, contact details of grievance focal points, and resolution timelines, will be disclosed to all affected communities in Kannada and English through site notice boards, gram panchayat offices, and public consultations for all road subprojects. The GRCs at all three levels will be constituted prior to commencement of civil works, and the costs of GRM implementation will be included in the project cost.

763. Site Level: The first level of the GRM will function at the project location/site. The GP-level arrangement will consist of ground implementation staff led by the Assistant Executive Engineer, Panchayat Development Officer, village Sarpanch, PRI/prominent persons from local community (eg, women leader), KRRDA Engineer (AE or JE deputed as grievance focal), Contractor site engineer, community organizers/NGOs/CBOs active in the state as observer and Scheduled tribe representative (mandatory where IPP implemented). All minor issues and those perceived as immediate and urgent by the complainant will be resolved at the field level itself (within 7 days). In cases of larger issues that cannot be resolved at the field level, the matter will be escalated to the district PIU level GRC, the second level arrangement. A summary of grievance records will be submitted to the PMU monthly. The PIU level Environment and Social Specialist of PISC will monitor and provide guidance and support to the field staff in grievance redress and its record-keeping. All grievances received will be recorded in the grievance register and acknowledged to the complainant within three (3) days of receipt. Grievances of a sensitive nature, including those related to sexual exploitation, abuse, and harassment, will be handled confidentially through a survivor-centred approach.

764. District (PIU) Level: The second GRC will be established at the PIU level, headed by the Executive Engineer (EE). The AEE of concerned district will be the committee member along with representatives of site level GRC, PISC Social & Gender Expert and Environment Expert and local NGO/CBOs and social /environment expert of supervision consultant. All grievances that cannot be resolved at the field level and those directly registered at this level will be addressed by this body within 10 days of complaint receipt. Proper documentation of grievances (including records of grievances redressed at the field level) will be maintained by the PIU. In cases where the GRC at this level is unable to resolve a grievance within the stipulated period, the case will be escalated to a higher level for resolution. The PISC will also maintain follow-up for each grievance, periodically disseminate information to complainants on the status of their grievance and record their feedback (satisfaction/dissatisfaction and suggestions).

765. State (PMU) Level: The arrangement at the highest level will involve the constitution of a project level grievance redressal committee headed by the Chief Operating Officer, (COO) of the PMU as the chairperson. The SQC, Environmental and social experts at PMU level, SE and EE of concerned PIU will be the committee members. The committee will receive support from the Social Safeguard Specialist/Environmental Safeguard Specialist of PMU (PMC) to report the grievances. Representative of line departments will be nominated as required based on the type of grievance. All grievances that cannot be resolved by the field and district level GRC will be brought to the attention of this body, seeking its advice or referral for resolution at this level. Grievances received or referred to this committee will be resolved within 15 days. Periodic information will be provided to complainants on the resolution status of their grievance. The Environment and Social Safeguard Specialist will be responsible for compiling grievance redress

records, including project-level documentation and reporting. A sample grievance registration form is given in Appendix 15. The status of grievances received, resolved, and pending will be reported to ADB through the semi-annual environmental and social monitoring reports.

766. The affected person/complainant shall have access to the country's legal system at any stage. Furthermore, accessing the country's legal system can run parallel to accessing the GRM and is not dependent on the negative outcome of the GRM.

B. ADB Accountability Mechanism

767. If the established GRM is not able to resolve a grievance, the affected person can also use the ADB Accountability Mechanism through directly contacting (in writing) the Complaint Receiving Officer at ADB headquarters or the ADB India Resident Mission (INRM). The ADB Accountability Mechanism is independent of the project-level GRM and the GRCs and does not supersede or replace project-level grievance redress arrangements. Before submitting a complaint to the Accountability Mechanism, affected/aggrieved person/s should make a good faith effort to solve the problem by working with the concerned ADB operations department. Only after doing so, and if they are still dissatisfied, will the Accountability Mechanism consider the complaint eligible for review.⁹⁹ The complaint can be submitted in any of the official languages of ADB's developing member countries. The ADB Accountability Mechanism information will be included in the project-relevant information to be distributed to the affected communities, as part of the project GRM.

⁹⁹ Accountability Mechanism. [https://www.adb.org/who-we-are/accountability-mechanism'](https://www.adb.org/who-we-are/accountability-mechanism)

IX. ENVIRONMENTAL MANAGEMENT PLAN

A. Introduction

768. The Environmental Management Plan (EMP) has been prepared to address site-specific environmental considerations by identifying and managing project activities and their anticipated environmental impacts throughout the Project lifecycle.

769. The EMP serves as a key environmental management and implementation instrument for the Contractors, Project Management Unit (PMU), Project Implementation Units (PIU), and Project Implementation Supervision Consultants (PISC), facilitating the environmentally sustainable delivery of the Project. It provides a structured framework for identifying potential environmental impacts arising from project activities and ensures the timely implementation of appropriate mitigation, monitoring, and management measures to effectively address such impacts throughout the Project lifecycle.

770. The EMP provides guidance to ensure environmentally sound construction of the Project roads and ensure efficient lines of communication and co-ordination between the PMU, Contractors, and PIU. Each contractor will prepare a site-specific EMP (SEMP) in line with this EMP, which KRRDA/PMC reviews and clears before any site access is allowed. The site specific EMP (SEMP) (covering proposed sites/locations for construction work camps, stack/ storage areas, debris disposal, workforce camps, and construction plants, etc.) shall be prepared by all respective civil works contractors; and to be approved by PISCPIUs before commencement of works under the Project. Without SEMP approval, the works shall not be commenced under the Project. A copy of the updated EMP / SEMP shall be always kept on-site during the construction period. The EMP will be included in bids and contracts, and implementation shall be binding on contractors. Further, the latest EMP (as provided in this EIA report) shall be followed by respective contractors during implementation of the Project.

771. No civil works will commence in forest, legally protected areas, eco-sensitive zone, CRZ, ASI-regulated or confirmed critical-habitat stretches until applicable statutory clearances, permissions, NOCs, updated safeguard documents and relevant site-specific management measures are in place.

772. This EMP has been organized into three stages based on Project roads construction activities i.e., (i) Pre-construction Stage; (ii) Construction Stage; and (iii) Operation Stage. EMP for roads list have been prepared and various guidelines, checklists and reporting formats for implementation of EMP are given as Appendix 14.

773. The EMP and safeguard requirements are incorporated into the bidding documents and civil works contracts. EMP costs are built into the BoQ/rates while the BAP and monitoring costs are separately provisioned. KRRDA reserves the right to suspend works or payments for non-compliance with the EMP/SEMP.

774. The Contractor shall be responsible for the effective implementation of the EMP during the pre-construction and construction stages of the Project. The operation-stage environmental management and monitoring measures shall be implemented by the respective PIUs to ensure continued environmental compliance and sustainability of the Project.

775. The Contractor shall be deemed to be in non-compliance with the EMP if: (i) activities within the Project site, ancillary facilities, site extensions, haul roads, or access roads are undertaken in contravention of the EMP requirements; (ii) there is evidence of non-compliance with any EMP provision or contractual environmental obligation; (iii) environmental damage occurs as a result of negligence, omission, or improper implementation of mitigation measures; (iv) the Contractor fails to implement corrective actions or comply with instructions issued by the PMU, PIUs, or PISCs within the specified timeframe; or (v) the Contractor fails to adequately respond to, address, or resolve environmental complaints and grievances raised by affected communities or other stakeholders.

B. Institutional Arrangements for Environmental Management

776. The Karnataka Rural Road Development Agency (KRRDA) is a state-level nodal agency responsible for planning, implementation, monitoring and management of rural road development programmes in Karnataka.

1. Existing Institutional Arrangement

777. The Executing Agency (EA) for the project is Rural Development & Panchayat Raj (RDPR) Department, Government of Karnataka, through its implementing body, the Karnataka Rural Roads Development Agency (KRRDA). KRRDA is headed by Chief Operating Officer and supported by State Quality Coordinator. The SQC is supported by one (01) Environmental Engineer, two (02) Executive Engineers (EE), four (04) Assistant Executive Engineer (AEE). There are twelve (12) sanctioned positions comprising eight (08) Assistant Engineers (AE) and four (04) Junior Engineers (JE), of which currently eight (08) positions are filled. The projects of KRRDA are implemented by District Level Project Implementing Agency (PIU), currently 29 PIUs are established in Karnataka.

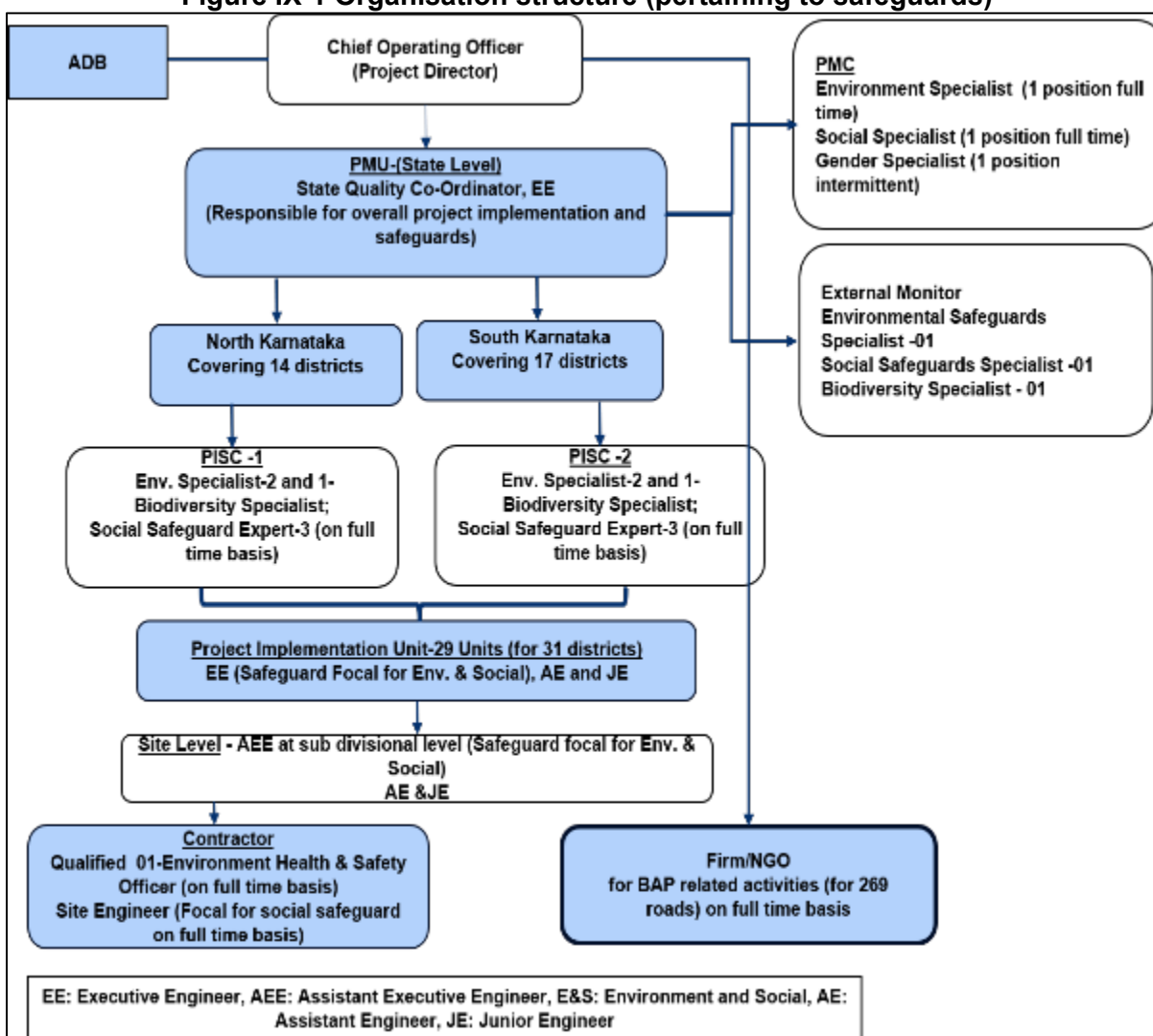
2. Institutional Arrangement for the Project

778. KRRDA will be the PMU, where the COO will be the Project Director. The Project Director will be supported by State Quality Coordinator (SQC). The SQC will further be supported by Executive Engineer, an Environment Specialist Project Management Consultancy (PMC)¹⁰⁰ under the KRRIP.

779. PMU will act as central coordinating body established within the executing agency of an ADB project. Its main role is to oversee the entire project lifecycle, ensuring effective management, compliance with ADB policies, and coordination across stakeholders (including PIUs, government departments, consultants, and ADB). The details of organisation structure (pertaining to safeguards) is given in Figure IX-1.

¹⁰⁰ There will be a full-time Environment Specialist within the Project Management Consultancy (PMC) under the KRRIP. The PMC will support the PMU and PIUs in implementation of EMP and BAP during implementation and operation stages of the Project.

Figure IX-1 Organisation structure (pertaining to safeguards)



780. There are twenty-nine (29) dedicated district level Project Implementation Unit (PIUs) established under the KRRIP. Every PIU is headed by one (01) EE who will be supported by AE/JE. Under each PIU, there will be a sub-divisional office that administers one or more talukas, serving as the focal unit for coordinating and overseeing project implementation at the sub-district level, headed by Assistant Executive Engineer (AEE). The PMU will have overall responsibility of the project. The environment compliance of the Project will be overseen by AE at site level, EE at PIU level who will report to Environmental Specialist, PMC at PMU. The environmental and social (E&S) monitoring reports will be reviewed and endorsed by the COO prior to their submission to ADB.

781. Description of key responsibilities of various agencies and parties for implementing safeguards are provided in Table IX-1.

Table IX-1: Implementation Agencies and Key Responsibilities

Key Agency	Responsibility
Head office of KRRDA (Project Management Unit (PMU))	The Head office of KRRDA will act as PMU and it is headed by a Chief Operating Officer acting as Project Director and supported by a State Quality Coordinator, two executive engineers, four assistant executive engineers, eight assistant and four junior engineers. The key responsibilities of the PMU are given below. • Provide central leadership and coordination for all project activities at national/state level. • Oversee planning, budgeting, implementation, monitoring, and reporting. • Serve as the main point of contact with ADB, Government authorities, and development partners. • Monitor milestones, procurement, disbursement progress, and compliance with project targets. • Review, consolidate, and submit progress reports to ADB (e.g., quarterly, semi-annual, annual). • Ensure compliance with ADB policies and loan covenants. • Coordinate compliance with environment, social, gender, and other safeguard policies. • Lead reporting on safeguard implementation and risk mitigation. • Facilitate procurement processes, ensure conformity with ADB procurement rules, and review contracts. • Support financial management and fiduciary oversight, including budget allocations and disbursement tracking. • Recruit and manage consultants and specialists to support project functions (financial, procurement, safeguards, etc.).
Project Implementation Unit	At the district level, the Project Implementation Unit (PIU) will function of overall responsibility for supervising the contractor's implementation of the environmental management plan (EMP), Biodiversity Action Plan (BAP) environmental monitoring plan. The Key responsibilities are provided below. • Execute project activities at the operational level. • Monitor fieldwork, supervise contractor performance, and ensure technical compliance of works. • Coordinate with local stakeholders and agencies for project execution. • Manage contract administration including variations, payments, and completion documentation. • Provide regular progress updates to the PMU. • Prepare technical, financial, and safeguards documents as needed. • Ensure implementation of social and environmental safeguards per ADB requirements. • Support monitoring of gender action plans, environmental management plans, etc. • Liaise with contractors, beneficiaries, local authorities, and communities. Facilitate field inspections and technical verification of project outputs. Specific Environmental Responsibility • Review the EIA, EMP and BAP to understand the background environmental issues of the respective subproject. • Review and approve the revised EMP and other required sub-plans such as traffic management plan, health and safety plan, waste management plan etc. prepared by the contractor. • Conduct regular site inspections and monitor implementation of the EMP, BAP and EMOP by the contractor

Key Agency	Responsibility
	• Provide on-site training and technical guidance to the contractor workers as necessary • Review the monthly/quarterly/annual reports prepared and submitted by the
Project Management Consultancy (PMC)	Project implementation support, including environmental safeguards implementation, will be provided to the PMU by the Project Management Consultancy. The Consultancy team will include an Environmental Specialist whose role to support the PMU in implementation and monitoring environmental safeguards under the project. The Project Management Consultancy Team will also carry out capacity building activities on the implementation of environmental safeguards through training workshops and on-site training for the PMU, AEE, and contractor, as necessary. Responsibilities of Project Management Consultancy are precisely outlined below. The TOR of Environment Specialist PMC is given in Appendix 25. • Review subproject to identify environmental risks and impacts (borrow areas, drainage, tree cutting, water bodies, sensitive receptors). • Assist in preparation/review of site-specific EMPs ensuring mitigation measures are practical and measurable. • Integration of BAP Measures into Design and Contracts • Integrated into DPRs and drawings (e.g., drainage structures, slope protection, avoidance of habitat fragmentation) • Included in EMP, BoQs, technical specifications, and contract clauses • Verify that biodiversity-related obligations are clearly assigned to contractors and supervision staff. • Ensure compliance with applicable ADB, GoI and GoK environmental laws and rules relevant to rural roads (e.g., tree felling permissions, quarry/borrow area approvals, waste management). • Track and support timely statutory clearances, permits, and NOCs, where applicable. • Maintain an environmental compliance register for all subprojects. • Review DPRs and drawings to ensure environmental considerations are integrated (drainage design, slope protection, climate resilience, road safety interfaces). • Ensure EMP provisions are embedded in bidding documents and contracts, including BoQs, technical specifications, and environmental clauses. • Support PMU in responding to ADB comments at procurement stages related to safeguards. • Conduct regular field inspections to verify contractor compliance with EMPs, including: • Borrow area and quarry management • Spoil and waste disposal • Erosion and sediment control • Protection of water bodies and roadside trees • Camp sanitation, pollution control, and worker health & safety • Identify non-compliances, recommend corrective actions, and follow up on closure. • Guide PIUs and contractors on good environmental practices for rural road works. • Conduct training sessions for PMU, PIU staff, and contractors on: • EMP implementation • Environmental monitoring and reporting • Incident management and emergency response

Key Agency	Responsibility
	• Prepare and consolidate Semi-Annual Environmental Monitoring Reports (EMRs) for submission to ADB through PMU. • Contribute to Quarterly Progress Reports (QPRs) with environmental status and risk updates. • Support PMU during ADB review missions, site visits, and mid-term reviews. • Maintain organized environmental records and photo documentation. • Support PIUs in addressing environment-related grievances through the project GRM. • Participate in community consultations related to environmental issues and mitigation measures. • Work closely with Social Safeguards and Gender Specialists to ensure coordinated management of cross-cutting issues (labor camps, OHS, community safety). • Ensure environmental actions align with labor and OHS provisions monitored under social safeguards.
Project Implementation Support Constantans (PISC)	The PISC team shall work under the PIU's and PMU's guidance to ensure completion of tasks assigned in a professional and time-bound manner. The PISC team's scope of services shall include, but not be limited to the following: a. Assisting in reviewing the Detailed Project Report (DPR) before the commencement of civil works to ensure the quality so that the works can be carried out smoothly. b. Providing engineering support if required in designing various components (including road safety) required for execution of the project, c. Assisting the Circle Officers and PIUs in preparing and implementing project activities. d. Assisting the PIU in planning, monitoring reporting and managing finances, including project framework techniques for planning, training and financial monitoring during project implementation. e. Assisting and advising the PMU and PIU in administration of contracts. f. Providing advice to the Project Manager on contractual matters. g. Assisting the PIU in planning and implementing voluntary land donation scheme, where applicable and reporting and documenting; implementation of environmental management plan (EMPs) including biodiversity action plans (BAP) and updating of environmental impact assessment (EIA) including EMPs, if required and initial gender assessment for the project; poverty and social assessment for the project; modifying designs and practices to avoid land acquisition and mitigate the impacts, gender action plans (GAPs), social development plans (SDPs) and social mitigating plan; preparing monthly, quarterly and final reports including the draft project completion report that include a section on gender results, safeguards monitoring; preparing separate semi-annual safeguards (environmental and social) monitoring reports since loan effectiveness to closure of the Project; and annual EMR during operation stage till issuance of Project completion report by ADB under the Project. h. Integrate safety across design, construction and O&M: carryout stage-wise road safety audit (design, during construction and pre-opening) and temporary traffic management plan approvals as per IRC standards; i. Assisting the PIU in preparation of overall project management plan, annual work plan including budget disbursement plan, and in preparing withdrawal applications to ADB. j. Assisting the PIU in reviewing existing monitoring system and suggesting improvements on the monitoring system. k. Assisting the PIU in organizing semi-annual review meetings of the project.

Key Agency	Responsibility
	l. Preparing a Draft Completion Report at the end of the five-year maintenance activities of the project. This report shall include, among other requirements, the traffic related survey on the newly constructed roads, pavement condition report. The data shall form the basis of future maintenance requirements after completion of the civil work contracts. The Completion Report should be finalised after verification of the presented data and facts. m. Supervise habitat restoration works at the offset sites determined with the help of Karnataka Forest Department and supported by KRRDA. n. Monitor the offset sites semi-annually to evaluate the progress of the sites against the Key Performance Indicators and the set targets for Biodiversity No-Net Loss of Biodiversity. o. Prepare a Final Biodiversity Monitoring and Evaluation Report at the end of the 5-year maintenance period to evaluate Biodiversity No-Net Loss, and potentially, Net Gains. p. Recommend additional or course-correction actions in case the actions at the offset site do not follow the planned trajectory towards Biodiversity No-Net Loss or Net Gains. q. Preparing a Final Evaluation Report on the construction and 5-year maintenance activities. r. Assisting the PIU in implementing the GAP and SDP including compliance monitoring; and preparing all social and gender related reports and other technical reports as necessary. s. For smooth implementation of the project, the PISC is expected to perform any additional tasks/duties identified and assigned by the Chief Operating Officer (C.O.O). The TORs of Environment Specialist, and Biodiversity Specialist are given in Appendix 25
Firm/NGO for implementation of BAP to be engaged by the KRRDA	The KRRDA will engage a firm/NGO working in ecological area for BAP implementation. The scope of works includes BAP implementation in Project roads of 591 roads falling in ecologically appropriate area of analysis (EAAA) with focus on 269 roads passing through ecologically sensitive area. TOR of the Firm/NGO responsible for BAP implementation is given in Appendix 25.
EPC Contractor	The Contractor is the principal agent to implement the EMP, BAP and EMOP. The contractor will prepare and implement site-specific EMP and EMOP attached to the bidding documents. Qualified environmental health and safety (EHS) officers will be recruited by the contractor. These personnel will have presence in all construction and campsites and ensure proper day-to-day implementation of the EMP. The contractor will cooperate with the AEE, PMC and PIU to implement environmental corrective actions and corrective action plans, as necessary. Specifically, the contractor will: • Participate the site induction workshop to be organized by the PMC; • Obtain necessary environmental license(s), permits etc., from relevant agencies for associated facilities for project road works viz. borrow areas, quarries, hot-mix plant etc. prior to commencement of civil works contracts; • Implement all mitigation measures in the EMP, BAP and activities in the EMOP; • Implement Worker Code of Conduct (Refer Appendix 10) • Pollution monitoring for air, water, noise/vibration, soil will be done through NABL accredited laboratories and as approved by the AEE, in line with the monitoring plan provided in this EMP (Table IX-5). • Other EMOP items will be monitored on a monthly basis.

Key Agency	Responsibility
	○ Monitoring reports must include wildlife movement/sightings and incidence of collision if any for the sub-projects located in proximity to wildlife sanctuary ○ Submit monthly, quarterly, and annual self-monitoring reports to for approval to the AEE and further submission to PIU and PMC for final submission to PMU; ○ Ensure that all workers, site agents, including site supervisors and management participate in training sessions delivered by PMC; ○ Acquire all environmental statutory requirements (permits, NOCs etc.) and fulfill contractual obligations; ○ Collect the baseline data on environmental quality before the start of physical works and continue collection as given in the EMOP during construction and operation; ○ Participate in resolving issues as a member of the GRC; ● Respond promptly to grievances raised by the local community or any stakeholder and implement environmental corrective actions or additional environmental mitigation measures as necessary
External Monitor	The PMU will engage an Independent/ Third Party with the approval of Asian Development Bank for half yearly environmental monitoring of the projects under construction and annually during operation stage. The primary purpose of an independent third-party monitoring is to provide an objective assessment of the borrower's (or client's) compliance with ADB's SPS 2009 and the effectiveness of their Environmental Management Plans (EMP) and Biodiversity Action Plan (BAP). This includes verifying the accuracy of monitoring information submitted by the borrower. The independent monitoring helps identify any gaps or deficiencies in safeguard implementation, allowing for timely corrective actions and preventing or minimizing negative environmental and social consequences. The external monitoring will also monitor the PMU's/PIU monitoring work of compliances with the conditions of the Forest Clearance. This also includes verification of plantation survival, area coverage, and compliance with Stage-II approval conditions and provide in its report. The TOR of external monitoring agency is given in Appendix 25. ● The External Environmental Expert shall provide independent review, monitoring, and advisory support to the borrower/client and ADB to ensure that: ○ Environmental mitigation measures are implemented effectively on the ground ○ Environmental risks are identified early and managed proactively ○ Project implementation remains fully compliant with ER1 of SPS 2009, approved safeguard documents, and national environmental regulations ● Review implementation of: ○ Environmental Management Plan (EMP / ESMP) ○ Environmental Monitoring Plan ○ Any Environmental Loan Covenants ● Verify whether mitigation measures committed in the IEE/EIA are being implemented as approved. ● Identify gaps, delays, or deviations from ER1 requirements. ● Undertake periodic site inspections during construction/implementation. ● Verify on-site compliance related to: ○ Pollution prevention and control ○ Waste and spoil management ○ Borrow areas and material sourcing ○ Protection of water bodies, vegetation, and sensitive receptors ○ Occupational health and safety (environment-related aspects)

Key Agency	Responsibility
	• Validate effectiveness of mitigation measures, not just their presence. • Review: ○ Semi-annual Environmental Monitoring Reports (EMRs) ○ Incident and non-compliance reports ○ Corrective Action Plans (CAPs) • Assess the quality, accuracy, and completeness of environmental reporting. • Verify that reported compliance reflects actual site conditions. • Review environment-related grievances received through the project GRM. • Assess whether grievance handling is: ○ Timely ○ Transparent ○ Consistent with ER1 principles
District level officials	• Provide any existing socioeconomic information, maps and other related information to DPR Consultant prior to the field data/information collection activities. • Act as the local focal point of information dissemination • Execute land acquisition process
Forest Department	• Forest department is regulator for the permission of diversion of forest land, tree on the forest land. • Role of the Forest Department is stipulated below. • Forest Clearance – Scrutiny of the forest clearance proposal for road ID 4817 involving 1.02 hectares of forest land diversion, recommendation to state government for the clearance, providing stage-1 clearance and provide report on compliance with the conditions to the State Government/ MoEFCC, Implementation Monitoring and Reporting, to assist in the process of providing stage-2 forest clearance. • Karnataka State Forest Department (Territorial or Social Forestry Division) — responsible for planning, implementation, and monitoring of compensatory plantation works. The Territorial Divisions oversee regulatory forest management, protection, and enforcement, while the Social Forestry Divisions—present in every revenue district and led by a Deputy Conservator of Forests—undertake afforestation on community lands, degraded lands, and farmlands. Nodal officer/ Regional office of MoEFCC - Nodal Officer (Forest Conservation Act), in the State Forest Department. Regional Office of MoEFCC, which conducts periodic review and field verification. • Work closely with the KRRDA to determine the road stretches that will require additional forest land through GIS • Identify sites for offset, implement restoration at the offset sites towards biodiversity No-Net Loss followed by Net Gains with the support provided by KRRDA; support in the process of Biodiversity Monitoring and Evaluation Plan at the offset sites to determine progress against the set targets over the five years of maintenance. • Assist in the identification of animal crossing sites along the roads where additional mitigations such as speed-breakers and signages may be required
Community Based Organizations	• Ensure the community participation at various stages of the project • Coordination with stakeholder organizations • Assist in Monitoring the project • Providing indigenous knowledge as required

3. Capacity Building

782. PMU, KRRDA project staff have some basic knowledge and experience of ADB environment and social safeguard policies and their implementation. However, some staff and the new candidates/ recruits as safeguards officers will require training in project preparation and implementation of this Project. The PMC will be responsible for training the PMU safeguards focal (environmental and social), and PMUs engineers and the engineers and staff of PIU Offices, and contractors. The PMC will coordinate with PMUs and PIU Office, and Contractors on specific capacity development program which may include but is not limited to:

- (i) Sensitization on ADB's Policies and guidelines on environmental and social safeguards including meaningful consultations, GRM and accountability mechanism;
- (ii) Introduction to the assessment of mitigation measures, including best practices, in the design, construction, operation and maintenance of rural roads;
- (iii) Effective communication with stakeholders including elected representatives, media and general masses;
- (iv) Improved coordination within nodal departments; and
- (v) Monitoring and reporting requirements.

783. By the time PMC is appointed, PMU will be responsible for safeguard functions.

784. Indicative details of training needs placed in Table IX-2.

Table IX-2: Indicative Training Needs Assessed

Description	Target Participant and Venue	Source of Funds
1. Introduction and Sensitization to - ADB Safeguards Policy statement - Government of India and Karnataka applicable social safeguard acts - Incorporation of environment and ecology components under EMP into the project design and contracts - Monitoring, reporting and corrective action	All staff and consultants involved in the project. At PMU in Bangalore	PMU, KRRIP cost
2. Monitoring and corrective action planning - Reporting and disclosure - Timely documentation	At each PIU, Division/District level	PMU, KRRIP cost
3. Experiences and best practices sharing (1 day) - Experiences on EMP implementation - Issues and challenges - Best practices followed	All staff and consultants involved in the project All contractors. At PMU, State level	PMU, KRRIP cost

Capacity Building and its needs

Need for training

To enable the KRRDA in integrating the social and environmental issues in its day-to-day operation and in internalizing the environmental and social issues in the existing and future road development projects training is conceived. To achieve this goal, KRRDA needs training on road development and environment management and the effective implementation of the environmental issues.

Targets of planned training

The training programme will equip the environmental personnel of KRRDA to implement and supervise the EMP and expose senior members of KRRDA to environmental and social issues associated with the highway projects. Such a group of senior staff can then be given the responsibility of active dissemination of the culture of environmental/social consciousness and ethics within the rest of the organisation. Further this will also include the PMC deputed under the project.

Once the environmental staff of KRRDA and PIU have received training and have gained experience through the implementation of the EMP, they should be ready to resume leadership role within the organization in providing training and in implementing future projects. In order to disseminate environmental experience gained by the PMC, each staff would be required to maintain good records and prepare dissemination notes on specific issues and problems encountered and resolved, and how the experience gained could be integrated in future road projects.

Planned training components

The environmental training aspects of the environmental personnel of KRRDA will encompass the following:

Understanding of the relevant environmental regulations and their application to the project.

Environmental management practices in hill roads upgradation and maintenance

Main impacts of the project on the environment.

Mitigation measures as given in the EMP and their implementation through incorporation in the design, construction supervision and monitoring.

Duties and responsibilities of the Contractors, Authority Engineer and the KRRDA

Public/community consultation and its role during the implementation of the project.

Liaison with other departments and relevant agencies (such as Forestry).

Supervision of the implementation of the EMP and social issues during construction and operation.

Resolution of environmental and social issues and their reporting.

Monitoring during construction and operation.

Weekly, monthly and quarterly report preparations and submission.

Preparation of dissemination notes, holding of workshops, and training of other staff in KRRDA.

The training modules to be worked out for the project need to be of relevance to the specific context of the roads in Karnataka focussing on the following issues:

- Conservation of biodiversity
- Slope stability and vulnerability to landslides
- Siting criteria for identification of dumping sites
- Social management, gender inclusiveness
- Labour Management
- Session on SEA/SH risks mitigation
- Stakeholder engagement
- Grievance Redress Mechanism

Any other as per project's requirement pertaining to E&S monitoring

Training of Contractor's Personnel

The Contractor shall provide appropriate training to relevant Contractor's Personnel on Environmental Social (ES) aspects of the Contract, including appropriate sensitization on prohibition of Sexual Exploitation and Abuse (SEA) and Sexual Harassment (SH), and health and safety training.

As stated in the Specification or as instructed by the Engineer, the Contractor shall also allow appropriate opportunities for the relevant Contractor's Personnel to be trained on ES aspects of the Contract by the Employer's Personnel. The Contractor shall provide training on SEA and SH, including its prevention, to any of its personnel who has a role to supervise other Contractor's Personnel.

785. PMC Officers are required to be conversant with ADB safeguards policy along with the national and state laws. Environmental and social safeguards are a cornerstone of ADB's support for inclusive economic growth and environmentally sustainable growth. Approved by ADB's Board of Directors in July 2009, the Safeguard Policy Statement (SPS) builds upon the three previous safeguard policies on the environment, involuntary resettlement, and indigenous peoples, and brings them into a consolidated policy framework that enhances effectiveness and relevance. The SPS applies to all ADB-supported projects reviewed by ADB's management after 20 January 2010.

786. ADB works with borrowers to put policy principles and requirements into practice through project review and supervision, and capacity development support. The SPS also provides a platform for participation by affected people and other stakeholders in project design and implementation.

787. The above shall help to build the technical capacity of PMU/PIU officers to review the environmental documents of the project, prepared by consultants, and oversee the suggestions in EMP being implemented by the contractors and overseen by Environmental Specialist of PMC.

788. Functionaries at Project level. The EE will ensure that all project activities are complied with as per the EMP.

789. Finally, for the project roads, PIU will be responsible. The PIU, to be headed by Executive Engineer, will oversee day to day implementation of environment, health and safety plan, including on issues pertaining to tree cutting, plantation works, utility relocation and worksite safety management.

790. The Environment Health and Safety (EHS) Officer within the Contractor's team must ensure compliance with the EMP, SEMP and environmental contractual clauses and will report on progress or challenges to the PISC team, as per the requirements/obligations stated in the Contract Document.

791. The PMC will oversee the quality including environment management, health and safety related aspects. This will determine whether the project is complying with regulatory performance standards. It entails a systematic, documented and periodic review of project implementation and could be a useful tool to improve project management performance on EHS aspects. Further, a separate NGO/FIRM to be deployed by the KRRDA for implementation of BAP during construction and operation stages of the Project.

792. External Monitoring Agency – A separate external monitoring agency (covering 01- Environment Specialist, 01-Social Expert, and 01- Bio-diversity Specialist) shall be deployed by the KRRDA (on intermittent basis) during implementation and operation stages of the Project.

793. **Clause for Nonconformity to Environmental Management Plan (EMP) – Protection of the Environment.** The Contractor shall implement necessary mitigation measures for which responsibility is assigned to him as stipulated in the EMP. Any lapse in implementing the same shall attract the damage clause as detailed below:

794. Any complaints of public, within the scope of the Contractor, formally registered with the PIU and communicated to the Contractor, which is not properly addressed within the time period intimated by the PIU shall be treated as a major lapse.

795. Non-conformity to any of the mitigation measures like unsafe conditions, non-collection of excavated material (during laying of culverts) regularly and other unattended Health, Safety & Environment (HSE) issues, as stipulated in the EMP Report (other than stated above) shall be considered as a minor lapse.

796. On observing any lapses, PIU shall issue a notice to the Contractor, to rectify the same.

797. Any minor lapse for which notice was issued and not rectified, first and second reminders shall be given after ten days from the original notice date and first reminder date respectively. Any minor lapse, which is not rectified, shall be treated as a major lapse from the date of issuing the second reminder.

798. **Environmental Monitoring Plan.** The monitoring programme consists of performance indicators, reporting formats and necessary budgetary provisions. The contractors monitoring plan should be in accordance with the baseline environmental monitoring, locations provided in the Environmental impact assessment report.

799. The monitoring plan has the following objectives:

- To ensure effective implementation of EMP
- To evaluate the performance of mitigation measures provided in the EMP
- To comply with all applicable environmental, safety, labour and local legislation
- To ensure that public opinions and obligations are taken into account and respected to the required satisfaction level
- To modify the mitigation measures or implementing additional measures, if required.
- The monitoring requirement for the different environmental components have been prepared is presented in Table IX-3 below.

C. Performance Monitoring Indicators

800. Environmental components identified of significance in affecting the environment at critical locations have been suggested as Performance Indicators. For example, near the construction site, a thick layer of dust over the nearby vegetation/leaf is an indication that the dust control measures are not effective. The performance indicators will be evaluated under three heads as mentioned below:

- Environmental condition indicators to determine efficacy of environmental mitigation measures for controlling air, noise and water pollution.
- Environmental management indicators to determine compliance with the suggested environmental management measures.
- Operational performance indicators have also been devised to determine efficacy and usefulness of the mitigation measures provided for the project road.

801. The performance indicators and monitoring plan prepared for the Project roads are presented in Table IX-3. Details of the performance indicators parameters for each of the component have to be identified and reported during all stages of the implementation. The contractor must ensure that the mitigation measures comply with the requirements of organizations like the IFC and WHO for pollution prevention and occupational health and safety

management at the project site. The prepared monitoring plan aligns with the standards set by the MOEF&CC, CPCB, IFC, and WHO.

Table IX-3: Performance Indicators and Monitoring Plan

SN	Description of Item	Indicator	Stage	Responsibility
1	Verification and identification of earth borrow areas and stone quarries	Compliance of site selection Criteria	Pre-construction	Contractor
2	Identification of locations for construction camp and construction plant sites	Compliance of site selection Criteria	Pre-construction phase	Contractor
3	Progress on tree removal, as applicable	Tree cutting	Pre-construction phase	PIU
4	Location of the temporary storage areas for excavated materials to be reused in road construction, embankment and sub grade	Storage of excavated materials	Pre-construction phase	Contractor
5	Implementation of mitigation measures specified in the EMP/BMP/BAP	Prevention/ Control of Pollution	Construction phase	Contractor
6	Environmental monitoring as per the conditions stipulated in the consents/ as described in environmental monitoring plan	Environmental Conditions at Construction Sites/Plants/ Camps	Construction phase	Contractor
7	Environmental monitoring in accordance with the frequency and duration of monitoring as well as the locations as per the Monitoring plan. Before the onset of monsoon all the debris/ excavated materials will be cleaned from the work sites and disposed of temporarily stock piled debris for final disposal properly away from the water bodies	Ambient Air Quality, Ambient Noise Level, Ground and Surface Water Quality, Silting of Water Bodies.	Construction phase	Contractor through external agency and will be supervised by the Environment Specialist of PMC/ PIU
8	Monitoring work zone safety	Use of PPE and signages	Construction phase	Contractor and will be supervised by the Environmental Specialist of PMC
9	Reporting of accidents at worksites/road construction sites	Accidents Reporting	Construction phase	Contractor
10	Plantation of shrubs and grass in high embankment/ enhancement sites and incidental spaces	Land scaping	Construction and Defect Liability Period	Contractor
11	Compensatory tree plantation and Reporting of the Survival Rate. The survival rate should be monitored and reported on quarterly basis	Tree Plantation and survival rate	Construction and Operation Stage	Forest Department and PIU

SN	Description of Item	Indicator	Stage	Responsibility
12	Verification of the borrow area redevelopment as specified in the redevelopment plan and Satisfaction of the owners/IRC guidelines	Status borrow area	Construction and operation stage	Contractor and PIU
13	De-mobilization of Camps and Plant on completion of works	Clean-up and restoration of the site	De-Mobilization	Contractor and will be supervised by the Environmental Specialist of Authority Engineer/ PIU

PIU = project implementation unit

D. Monitoring Plans for Environment Conditions

802. For each of the environmental components, the environmental monitoring plan specifies the parameters to be monitored including location and duration. The monitoring plan also specifies the applicable standards, implementation and supervising responsibilities. The monitoring plan for the various environmental condition indicators of the project in construction stages is presented in Table IX-4 below. Monitoring plan does not include the requirements arising out of regulatory provisions such as obtaining consent for plant site operation.

Table IX-4: Brief Description of Measures

SN	Locations of worksite	Site safety measures
1	Construction site	Caution boards, Safety Cones, Delineators
2	Deep cutting	The construction zone shall be barricaded with G.I. Sheet or arrangement to be made as per plan approved by the PIU [Provide Safety Sign Boards and Safety Barriers marked with reflective tapes]
3	Temporary diversion (If any)	Diversion Board, Barricading [Provide 'Diversion Ahead' boards at 50m, 100m and 150m ahead of diversions with reflective tape for illumination at night at all diverted locations]
4	Safety of the workers	Helmets, Safety-Shoes, Goggles, Dusk mask. Etc.

803. Furthermore, periodic site monitoring shall be carried out by the Environmental Expert of PIU for surveillance and monitoring of road safety during the road construction. The brief description of measures has been given in Table IX-5 below.

Table IX-5 Monitoring Plan

S N	Attribute Ambient Air/Noise/Surf ace Water/Ground Water/ Soil	Timing Pre- constructio n/ Constructi on/ Operation	Parameters	Standards	Sample Size	Frequency	Duration	Location	Implementati on
1	Ambient Air Quality	Pre- construction	PM2.5, PM10, SO2, NO2& CO etc	National Ambient Air Quality Standards (NAAQS) 2009; WHO Standards	4 no in each package	The frequency should be two samples of 24 hours for one week-in pre construction stage,	24 Hours Sampling	Each Package	By EPC Contractor by hiring NABL accredited laboratory.
		Constructio n	PM2.5, PM10, SO2, NO2& CO etc	National Ambient Air Quality Standards (NAAQS) 2009; WHO Standards	4 no in each package	1 location at construction site Construction labour camps, plants sites and settlements along the work zones in downwind direction (Locations will be decided by Environment al Expert /PISC/PIU	24 Hours Sampling	Each Package	By EPC Contractor
		Operation	PM2.5, PM10, SO2, NO2& CO etc	National Ambient Air Quality Standards (NAAQS) 2009; World	1 no in each package	The monitoring shall be conducted for 24-hour continuous	24 hours sampling	1 location in each package	By EPC Contractor by hiring NABL accredited laboratory

S N	Attribute Ambient Air/Noise/Surface Water/Ground Water/ Soil	Timing Pre- construction/ Construction/ Operation	Parameters	Standards	Sample Size	Frequency	Duration	Location	Implementation
				Bank EHS Guidelines		sampling once in a year			
2.	Ambient Noise Level	Pre- construction	Level Equivalent L Day and L Night based on hourly Noise Measurements	Ambient Noise Standards, MoEF&CC Noise Rules, 2000 and World Bank EHS guidelines	4 no in each package	the frequency should be once before commencement of construction (pre construction), one day in winter and one day in summer seasons - construction (Hourly noise measurements carried out in one day)	Hourly noise measurements for one day	1 location at construction site Construction labour camps, plants sites and settlements along the work zones in downwind direction (Locations will be decided by Environmental Expert /PISC/PIU	By EPC Contractor hiring NABL accredited laboratory.
		Construction					Hourly noise measurements for one day in winter and summer seasons	1 location at construction site Construction labour camp, plants sites, settlements along the work zones (locations will be decided by Environmental Expert/PISC/PIU)	

S N	Attribute Ambient Air/Noise/Surface Water/Ground Water/ Soil	Timing Pre- construction/ Construction/ Operation	Parameters	Standards	Sample Size	Frequency	Duration	Location	Implementation
		Operation	Equivalent noise levels using an integrated noise level meter kept at a distance of 15 from edge of pavement		10 sample for each package	the frequency should be Hourly noise measurements for one day annually for 5 years after completion	Hourly noise measurements for one day annually for 5 years after construction completion.	1 location at construction site At potential abutting traffic detours and traffic diversions and major intersection near habitations.	
3.	Soil Characteristics	Pre-Construction	As per EIA and Environment Protection (Management of Contaminated Sites) Rules, 2025.	Environment Protection (Management of Contaminated Sites) Rules, 2025	2 per package	The frequency carried out during Pre Monsoon and Post Monsoon in Pre Construction and Construction	Grab Sampling	1 location in one package	Contractor hiring NABL accredited laboratory.
		Construction					Grab Sampling	1 location in one package At productive agricultural lands abutting traffic detours and traffic diversions and major intersection.	Contractor hiring NABL accredited laboratory
4.	Ground water Quality	Pre-construction	Organoleptic and Physical, Chemical & Bacteriological Parameters	Potable Water Standards (IS 10500: 2012)	3 samples per package	The frequency should be once before commencement of construction (pre	Grab sampling once	Hand Pump	Contractor hiring NABL accredited laboratory.
		Construction					Grab Sampling Once	Hand Pump Construction labour camp, plants sites,	Contractor hiring NABL accredited laboratory.

S N	Attribute Ambient Air/Noise/Surface Water/Ground Water/ Soil	Timing Pre-construction/ Construction/ Operation	Parameters	Standards	Sample Size	Frequency	Duration	Location	Implementation
						construction) ,Grab Sampling once in winter and summer seasons - construction)		settlements along the work zones (locations will be decided by Environmental Expert/PISC/PIU)	
5.	Surface water Quality	Pre-construction	101pH, BOD, COD, TDS, TSS, Pb, DO, Oil & Grease for surface water and, pH, TDS, Total Hardness, Sulphate, Chloride, Fe, Pb, As for ground water	(IS:2296-1982) for inland surface waters	3 samples per package as per availability of surface water sources in the package	The frequency should be once before commencement of construction (pre construction) ,Grab Sampling once in winter and summer seasons - construction	Grab Sampling Once		Contractor hiring NABL accredited laboratory.
		Construction					Grab Sampling Once	Natural streams in the package.	By EPC Contractor hiring NABL accredited laboratory.

¹⁰¹ These parameters along with parameters suggested in EIA Guidance Manual for Highways should be included. However, deletion or addition of any other parameters during construction phase shall be decided by Environmental Officer.

E. Monitoring Parameters and Standards

804. The environmental monitoring parameters and National Ambient Air Quality Standards are discussed below:

805. The ambient air quality parameters viz. Sulphur Dioxide (SO₂), Nitrogen Dioxide (NO₂), Carbon Monoxide (CO) and Particulate Matter (PM₁₀, PM_{2.5}) shall be monitored at the frequency, duration and locations specified in the Environmental Monitoring Plan (Table IX-5). The ambient air quality parameters shall be monitored in accordance with the National Ambient Air Quality Standards, 2009 (Table IX-6) and, where more stringent, the World Bank Group EHS Guidelines, as given in Table IX-7. The duration, the pollution parameters to be monitored, and the responsible institutional arrangements are detailed out in the Environmental Monitoring Plan.

Table IX-6: National Ambient Air Quality Standards

SN	Pollutant	Time weighted Average	Concentration in Air		
			Industrial, Residential, Rural and others	Ecologically sensitive area	Methods of Measurement
1	Sulphur dioxide (SO ₂), µg/m ³	Annual* 24 hours**	50 80	20 10	Improved West and Geake Ultraviolet fluorescence
2	Nitrogen Dioxide, (NO ₂) µg/m ³	Annual* 24 hours**	40 80	30 80	Modified Jacob & Hochhieser (Na-Arsenite) Chemiluminescence
3	Particulate Matter (size less than 10µm), or PM ₁₀ , µg/m ³	Annual* 24 hours**	60 100	60 100	Gravimetric TOEM Beta attenuation
4	Particulate Matter (size less than 2.5µm), or PM _{2.5} , µg/m ³	Annual* 24 hours**	40 60	40 60	Gravimetric TOEM Beta attenuation
5	Carbon Monoxide (CO), µg/m ³	8 hours* 1hours**	02 04	02 04	Non-Dispersive Infra-Red (NDIR) spectroscopy

*Annual arithmetic means of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals

**24 hourly or (8 hourly or 01 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

Table IX-7: World bank EHS Guidelines for Ambient Air Quality

Air Pollutant	Averaging Period	Guideline value in µg/m ³
Sulfur dioxide (SO ₂)	24-hour	125 (Interim target-1)
		50 (Interim target-2)
		20 (guideline)
	10-minute	500 (guideline)
Nitrogen dioxide (NO ₂)	1-year	40 (guideline)
	1-hour	200 (guideline)
Particulate Matter PM ₁₀	1-year	70 (Interim target-1)
		50 (Interim target-2)

Air Pollutant	Averaging Period	Guideline value in $\mu\text{g}/\text{m}^3$
	24-hour	30 (Interim target-3)
		20 (guideline)
		150 (Interim target-1)
		100 (Interim target-2)
		75 (Interim target-3)
		50 (guideline)
Particulate Matter $\text{PM}_{2.5}$	1-year	35 (Interim target-1)
		25 (Interim target-2)
		15 (Interim target-3)
		10 (guideline)
	24-hour	75 (Interim target-1)
		50 (Interim target-2)
		37.5 (Interim target-3)
		25 (guideline)
Ozone	8-hour daily maximum	160 (Interim target-1)
		100 (guideline)

806. The noise levels shall be monitored at designated locations in accordance with the Ambient Noise Quality standards given in Table IX-8. The duration and the noise pollution parameters to be monitored and the responsible institutional arrangements are detailed in the Environmental Monitoring Plan. World Bank EHS Guidelines for Noise is presented in Table IX-9 below. World Bank Group EHS noise level guidelines does not have a separate category for silence or sensitive zone guidelines, as provided under Noise Pollution (Regulation and Control) Rules, 2000. More stringent of the national and EHS values governs assessment and mitigation design and will be used for monitoring, as required by ADB SPS 2009.

Table IX-8: National Ambient Noise Quality Standards

SN	Category of Zones	Limits of Leq in dB (A) Day*	Night*
A	Industrial	75	70
B	Commercial	65	55
C	Residential	55	45
D	Silence Zone	50	50

*Daytime shall mean from 6:00am to 10:00 pm and Night shall mean from 10:00 pm to 6:00 am

**Silence zone is defined as an area up to 100 meters around premises of hospitals, educational institutions and courts, use of vehicles horns, loud speakers and bursting of crackers are banned in these zones.

Table IX-9: World Bank EHS Guidelines for Noise

Receptors	1 Hour Leq dB(A)	
	Day time 07:00 - 22:00	Nighttime 22:00 - 07:00
Residential; institutional; educational	55	45
Industrial; commercial	70	70

807. Water quality parameters such as pH, BOD, COD, DO coliform count, total suspended solids, total dissolved solids, Hardness, Conductivity etc. shall be monitored at all identified locations during the construction stage as per standards prescribed by Central Pollution Control Board specifications presented in Table IX-10. The duration, the pollution parameters to be monitored, and the responsible institutional arrangements are detailed out in the Environmental Monitoring Plan.

Table IX-10: Surface Water Standards

Designated Best Use	Surface Water Class	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	• Total Coliforms Organism MPN/100ml shall be 50 or less • pH between 6.5 and 8.5 • Dissolved Oxygen 6mg/l or more • Biochemical Oxygen Demand 5 days 20°C 2mg/l or less
Outdoor bathing (Organised)	B	• Total Coliforms Organism MPN/100ml shall be 500 or less • pH between 6.5 and 8.5 • Dissolved Oxygen 5mg/l or more • Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	• Total Coliforms Organism MPN/100ml shall be 5000 or less • pH between 6 to 9 • Dissolved Oxygen 4mg/l or more • Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Propagation of Wildlife and Fisheries	D	• pH between 6.5 to 8.5 • Dissolved Oxygen 4mg/l or more • Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	• pH between 6.0 to 8.5 • Electrical Conductivity at 25C micro mhos/cm Max.2250 • Sodium absorption Ratio Max. 26 • Boron Max. 2mg/l
	Below E	Not Meeting A, B, C, D & E Criteria

1. Supervision and Monitoring of Biodiversity Action Plan

808. KRRDA will appoint separate a NGO/FIRM who will ensure the BAP implementation under the Project. Further, the KRRDA through PISC will mobilise a qualified bio-diversity specialist for the supervision and monitoring of implementation of Biodiversity Action Plan (BAP) and update on the progress achieved in terms of Biodiversity Monitoring and Evaluation Plan.

Table IX-11: Supervision and Monitoring of Biodiversity Action Plan

SN	Supervision and Monitoring Parameters	Implementation and Monitoring Responsibility	Monitoring Responsibility	Frequency	Method of Monitoring and Corrective Actions
1	Supervision and Monitoring of BAP as per BAP prepared and provided as Appendix 19.	Biodiversity Specialist of PISC along with third-party contractors	NGO/FIRM working on BAP and PMC	Six monthly	The Biodiversity Specialist at PISC will supervise the implementation of BAP regularly and provide six monthly reporting to the PMC

2. Monitoring of Forest Compliance

809. The conditions of the forest clearance will be implemented by the forest department. The monitoring for the compliance of conditions will be performed the user agency. The monitoring plan is provided Table IX-12 below.

Table IX-12: Monitoring of Conditions of Compliances of Conditions of Forest Clearance

SN	Monitoring Parameters	Implementation Responsibility	Monitoring Responsibility	Frequency	Method of monitoring and Corrective actions
1	Compensatory Plantation/ afforestation	Karnataka Forest Department	PISC	Monthly	PISC will have physical verification and documentary verification. In case of delays or non-compliance, suitable action will be recommended and escalated to the competent authority.

F. Environmental Reporting System

810. The environmental reporting system for the suggested monitoring programme will function at two levels:

- Reporting for environmental condition indicators and environmental management indicators. Reporting for operational performance indicators at the Project level. Environmental monitoring involves of the works. It provides the necessary feedback for the project management to keep the programme on schedule for achieving the expected outcomes.
- Reporting overall environmental and social monitoring right from project to apex level shall be done in the following order as per ADB's SPS.



811. The Contractor, Authority Engineer, PISC shall operate the reporting system for environmental conditions and environmental management indicators. The reporting system is presented in **Table IX-13**. The reporting schedule for contractors has been prepared, which are on the basis of the implementation of EMP by the Contractor and monitoring by the Authority Engineer, PISC/ PMU. The reporting system will start with the Contractor who is the main executor of the implementation EMP activities.

812. The Contractor will report to the Authority Engineer, PISC who in turn will report to the PIUs/ESMU. The reporting system will comprise the following:

- The contractor shall submit monthly environmental compliance reports along with formal monthly project progress report to the Authority Engineer.
- The Authority Engineer shall submit separate quarterly environmental monitoring reports to PIUs/PMUESMU.

- Authority Engineer shall be responsible for the preparation of the targets for identified non compliances for the EMP compliance.
- Solutions for further effective implementation may also emerge as a result of the external environmental reports.
- Project Management Unit/PMC will submit the Quarterly Report to ADB for the entire pre-construction and construction period of duration about 24 months and initial operation phase.
- PMU will disclose these report on their website and keep one copy on the report in each office of PMU for the easy access to the community. The language of the report will be English.

813. The photographic records shall be kept to provide useful environmental monitoring tools. All material sources points, disposal locations, plant's locations, camp locations, crusher locations etc. shall be photographed and kept as a record. A full record of construction activities and EMP implementation shall be kept as part of normal contract monitoring system. The Reporting and Monitoring Systems for various stages of construction and related activities have been provided in **Table IX-13** for the implementation.

Table IX-13: Environmental Reporting System

Item	Contractor	Construction Supervision by the Authority Engineer		PMU/PMC	
	Implementation and Reporting to Authority Engineer	Reporting	Reporting to PMU	Oversee Compliance Monitoring	Report to ADB
Pre-Construction Stage					
Sites of camps and Plants	Weekly	Weekly	Monthly	Monthly	Quarterly
Location of borrow area	Weekly	Weekly	Monthly	Monthly	Quarterly
Location of stone quarry	Weekly	Weekly	Monthly	Monthly	Quarterly
Shifting of Community/ Cultural Structures (If Any)	Weekly	Weekly	Monthly	Monthly	Quarterly
Tree cutting and Clearing of Vegetation	Weekly	Weekly	Monthly	Monthly	Monthly
BAP Implementation	Monthly	Monthly	Monthly	Monthly	Semi annual
Construction Stage					
Monitoring of construction site and construction Camp	Regular	Regular	Monthly	Monthly	Quarterly
Establishment of BP/HMP	Monthly	Monthly	Quarterly	Half Yearly	Quarterly
Pollution Monitoring	Six Monthly	As required	In Monthly report	In quarterly report	In quarterly report
Monitoring of Enhancement	Weekly	Weekly	Monthly	Monthly	Quarterly
Top soil Preservations	Weekly	Weekly	Monthly	Monthly	Quarterly
Borrow area/ quarry area/ debris disposal area	Weekly	Weekly	Monthly	Monthly	Quarterly
Tree Plantation	Monthly	Monthly	Monthly	Monthly	Quarterly
Accident Report	As and when take place	Monthly	Quarterly	Quarterly	Quarterly
BAP Implementation	Monthly	Monthly	Monthly	Monthly	Semi annual
Demobilization of Plants					
Clean-up of plants & camps sites and Restoration of Sites	Monthly	Monthly	Monthly	Monthly	Quarterly
Operation Stage					
Environmental monitoring report till the issuance of ADB's project completion report.	None	Annually	Annually	Annually	Annually

Item	Contractor	Construction Supervision by the Authority Engineer		PMU/PMC	
	Implementation and Reporting to Authority Engineer	Reporting	Reporting to PMU	Oversee Compliance Monitoring	Report to ADB
Project Completion Report	At the completion of project	At the completion of project	At the completion of project	At the completion of project	At the completion of project

G. Consolidated Environment Management Plan

814. The consolidated Environmental Management Plan for the Roads and Bridges has been provided in Table IX-14

Table IX-14: Consolidated Environmental Management Plan for the Project Roads and Bridges

Mitigation Measure Code	Environmental Safeguard Purpose	Environmental Mitigation Measures	Sub-project/ Location	Reference	Responsibilities	
					Planning & Execution	Supervision/ Monitoring
A	Pre-construction stage					
EDM1	Reduces land acquisition, physical disturbance, and footprint-related environmental impacts.	The DPR keeps the road largely on the existing alignment and avoids unnecessary deviation. This reduces the need for fresh land take, limits disturbance to adjacent land uses, and avoids avoidable cutting, filling, and impact on roadside properties.	Throughout the road alignment / All project roads	PMGSY ECOP 1: Project Planning and Design; IRC:SP:20-2002	KRRDA/PIU	KRRDA
EDM2	Avoids resettlement, minimizes footprint, and reduces impact on private assets and agricultural land.	The DPR includes improvement within the available right of way as far as possible and avoids additional land acquisition where the existing corridor is adequate.	Throughout the road alignment / All project roads	PMGSY ECOP 1; ADB SPS 2009; IRC:SP:20-2002	KRRDA/PIU	KRRDA
EDM3	Prevents waterlogging, flooding, embankment damage, and	The DPR includes hydrology-based cross-drainage design and provides for replacement of damaged culverts and addition of new culverts where drainage crossings require intervention. This allows	At the natural drainage locations/	IRC:SP:13-2004; IRC:5-2015; IRC:SP:20-2002;	KRRDA/PIU	KRRDA

Mitigation Measure Code	Environmental Safeguard Purpose	Environmental Mitigation Measures	Sub-project/ Location	Reference	Responsibilities	
					Planning & Execution	Supervision/ Monitoring
	erosion caused by blocked drainage.	runoff to pass along natural drainage paths instead of getting obstructed by the road. The culvert outlets will be designed to minimize the soil erosion risk of water flow through the culverts and outfall to the soil erosion potential.	All project roads	PMGSY ECOP 7: Drainage		
EDM4	Controls surface runoff, prevents water stagnation, reduces shoulder erosion, and protects pavement life.	The DPR provides roadside drainage, side drains, and drainage chambers at relevant locations so that storm water is collected and safely conveyed to low points and discharge points.	Throughout the road alignment / All project roads	IRC:SP:20-2002; PMGSY ECOP 7: Drainage; MoRTH Section 300/309	KRRDA/PIU	KRRDA
EDM5	Reduces the risk of inundation, flood damage, and service interruption during heavy rainfall events.	In low-lying sections, the DPR proposes raising the embankment and maintaining freeboard above the recorded flood level. This is a climate-resilient design measure embedded in the engineering profile of the road.	At locations adjacent to water bodies/ All project roads	IRC:75-2015; IRC:SP:13-2004; climate-resilient road design practice	KRRDA/PIU	KRRDA
EDM6	Improves durability in sensitive stretches, reduces pothole formation, reduces mud and poor hygiene in built-up areas, and lowers maintenance needs.	The DPR adopts different pavement types for different stretches, including rigid pavement / cement concrete pavement in selected sections such as habitation or problem stretches and flexible pavement in others. This indicates that pavement selection has been matched to local conditions rather than applied uniformly.	Throughout the road alignment / All project roads	IRC:SP:62-2014; IRC:SP:72-2015; IRC:37-2018	KRRDA/PIU	KRRDA
EDM7	Prevention of rain cuts, slope erosion,	The DPR includes turfing and stabilization of embankment slopes and earthen shoulders after road formation. This is an embedded	Throughout the road	PMGSY ECOP 6: Slope	KRRDA/PIU	KRRDA

Mitigation Measure Code	Environmental Safeguard Purpose	Environmental Mitigation Measures	Sub-project/ Location	Reference	Responsibilities	
					Planning & Execution	Supervision/ Monitoring
	and shoulder degradation.	bioengineering measure intended to stabilize bare soil surfaces that would otherwise erode during rainfall.	alignment / All project roads	Stability and Erosion Control; MoRTH slope protection practice		
EDM8	Conserves fertile soil and supports rehabilitation of temporarily disturbed areas.	The DPR requires topsoil from borrow areas and disturbed surfaces to be stripped, stored separately, and reused during site restoration. This is an important embedded mitigation measure because the design documentation recognizes topsoil as a resource to be conserved and reused.	Borrow area locations/ All project roads	PMGSY ECOP 3: Borrow Areas; MoRTH 301/305; IRC:36-2010	KRRDA/PIU	KRRDA
EDM9	Reduces land degradation, prevents drainage interference, and restores the productive use of excavated land.	The DPR places controls on borrow area development by limiting excavation depth, maintaining distance from the embankment, and requiring rehabilitation/redevelopment of borrow areas after material extraction. This means the source area is considered part of the environmental footprint and not ignored.	Borrow area locations/ All project roads	PMGSY ECOP 3: Borrow Areas; IRC:36-2010; MoRTH 305.2.2.2	KRRDA/PIU	KRRDA
EDM10	Avoids illegal quarrying and reduces off-site environmental and regulatory risk.	The DPR provides that construction aggregates, sand, and other materials should be sourced from approved quarries and licensed sources. This is an embedded mitigation measure because it shifts the project away from informal or unregulated extraction.	All project roads	MoRTH 111.3; relevant mining permissions / SPCB consents; PMGSY good practice for material sources	KRRDA/PIU	KRRDA

Mitigation Measure Code	Environmental Safeguard Purpose	Environmental Mitigation Measures	Sub-project/ Location	Reference	Responsibilities	
					Planning & Execution	Supervision/ Monitoring
EDM11	Prevents service disruption, accidental damage, and road safety risks from utility conflicts.	The DPR identifies utilities that fall within the improvement corridor and provides for shifting or relocation before construction. This is an embedded design-stage mitigation because it reduces the need for ad hoc site decisions and avoids unsafe obstruction within the roadway.	Within RoW/ All project roads	IRC:SP:20-2002; good rural road design practice	KRRDA/PIU	KRRDA
EDM12	Improves safety for vulnerable road users and reduces shoulder edge damage.	The DPR provides shoulders on both sides of the carriageway, including hard shoulder in some stretches, so that pedestrians, cyclists, and other vulnerable users can move more safely outside the traffic stream. This is a built-in safety and environmental design response for rural roads passing through inhabited areas.	Throughout the road alignment / All project roads	IRC:103-2012; IRC:SP:20-2002	KRRDA/PIU	KRRDA
EDM13	Reduces accident risk and improves safe movement of vehicles and pedestrians through settlements and junctions.	The DPR incorporates traffic signs, retro-reflective signs, pavement markings, stop lines, and zebra crossings at relevant locations. These measures are embedded because they are included as part of the road safety design and not left only to later operation-stage action.	Within RoW/ All project roads	IRC:67-2012; IRC:35-2015	KRRDA/PIU	KRRDA
EDM14	Protects residents and sensitive receptors by reducing speed-related road safety risk.	The DPR provides for speed management at village entries, curves, junctions, schools, and other sensitive points through measures such as speed humps, warning signs, or other traffic calming arrangements. This is an embedded mitigation because it directly responds to community safety risks created by improved road speed.	Within RoW/ All project roads	IRC:99-2018; IRC:SP:55	KRRDA/PIU	KRRDA
EDM15	Reduces risk of vehicular run-off, collision at structures, and poor night visibility.	The DPR includes crash barriers, hazard markers, delineators, guide posts, and object markers at embankments, culverts, bridge approaches, sharp bends, and other hazardous locations. These are embedded	Within RoW/ All project roads	IRC:119-2015; IRC:79-2019;	KRRDA/PIU	KRRDA

Mitigation Measure Code	Environmental Safeguard Purpose	Environmental Mitigation Measures	Sub-project/ Location	Reference	Responsibilities	
					Planning & Execution	Supervision/ Monitoring
		engineering safety measures incorporated into the road design.		IRC:SP:82-2008		
EDM16	Improves drainage, roadside hygiene, and safety in built-up stretches.	In habitation or village stretches, the DPR proposes covered concrete drains and other settlement-specific treatment measures. This integrates drainage management and community safety into the village road design instead of treating the road simply as a traffic corridor.	Throughout the road alignment / All project roads	IRC:99-2018; IRC:SP:63-2004; PMGSY ECOP 7	KRRDA/PIU	KRRDA
EDM18	Improves consultation, disclosure, and grievance access during implementation.	The project documentation includes provisions for information boards and public communication mechanisms, including the display of project-related information and grievance redress contact details. These measures are integrated into the project's management framework and serve to enhance transparency, stakeholder engagement, and effective communication with affected communities.	All project roads	ADB SPS 2009 (information disclosure / consultation principle); PMGSY consultation provisions	KRRDA/PIU	KRRDA
EDM 25	Protects Cultural Heritage	Conduct a heritage/archaeological field surveys before start of the construction work. If surveys find resources, map them and define buffers/avoidance. Implementation of Chance Find Procedure (Appendix 4) including standard “stop-work — secure — notify — assess — conserve or salvage” sequence: stop work if finds occur, cordon off, notify competent authorities and project authorities, assess significance, implement approved conservation/salvage or reburial, document finds, then resume works only after clearance. Any shifting of cultural assets like idols of local importance will be done in consultation with the local community.	Outside RoW/ All project roads	Ancient Monuments and Archaeological Sites and Remains (AMASR) Act, 1958, AMASR Rules, 1959, PMGSY EcoP 15, IRC:SP:20:2002, IRC:35:2015 IRC:SP:67:2001,	PIU/ Contractors	PISC/ KRRDA

Mitigation Measure Code	Environmental Safeguard Purpose	Environmental Mitigation Measures	Sub-project/ Location	Reference	Responsibilities	
					Planning & Execution	Supervision/ Monitoring
		Educate workers about heritage sensitivity. Install speed breakers or rumble strips before approaching heritage, cultural or archaeological structures. Define low speed limit where road is around the heritage, cultural or archaeological structures. Install crash barriers or stone masonry buffers between road and heritage, cultural or archaeological structures. Provide warning signs for 'heritage, cultural or archaeological structure ahead', 'slow down'. Provide reflective road marking for night time around heritage, cultural or archaeological structures.		IRC:99:2018, IRC:119:2015		
EDM 27	Compensatory Plantation	Afforestation on land on twice area of impacted and plantation of tree in 1:2 ratio or condition provided by the Forest Department.	Outside RoW/ roads where tree cutting is applicable	PMGSY EcoP 1, 16; IRC:SP:20:2002; IRC:SP:21:2009	PIU/ Contractors	PISC/ KRRDA
EDM 28	Utility management	All efforts shall be made to reduce the duration of utility shifting impact and restore the disturbed facilities and access. All utilities should be shifted before start of construction. Necessary permission and payments should be made to relevant utility service agencies and individuals to allow quick shifting and restoration of utility services. Visual barriers are to be provided, as necessary, on active construction zones. Consultation with affected people prior to the start of utility shifting, presenting construction timelines and guidelines should be	Within RoW/ All Project roads	EMP Contract	PIU/ Contractors	PISC/ KRRDA

Mitigation Measure Code	Environmental Safeguard Purpose	Environmental Mitigation Measures	Sub-project/ Location	Reference	Responsibilities	
					Planning & Execution	Supervision/ Monitoring
		conducted. Local people must be informed through appropriate means about the time of shifting of utility structures and potential disruption of services, if any.				
EDM 29	Community health and safety	Safety provisions in accordance with IRC guidelines to be implemented under the Project. These include (i) speed breakers in habitat areas to regulate speed, (ii) retro-reflective warning signboards near schools, hospitals, and religious places, (iii) proper sidewalks/pedestrian zones along roads in habitat areas and near schools, hospitals, and religious places.	Within RoW/ All Project roads	EMP Contract IRC:35; IRC:67; IRC:79; IRC:119 And other applicable IRC guidelines	PIU/ Contractors	PISC/ KRRDA
EDM 30	Occupational health and safety and Working Conditions	Develop and implement occupational health and safety plan. (Appendix 6) Appropriate Personal Protective Equipment (PPE) to be provided to workers engaged in construction. Daily Tool Box Talks (TBTs) to be conducted at work sites before start of construction activities. Undertake regular health and safety trainings for the workers. Develop Emergency Preparedness and Response Plan (Appendix 7) with regular on site mock drills; emergency contacts displayed at camps and worksites. A grievance mechanism shall be developed for workers. Ensure compliance with labour laws; shift scheduling; overtime monitoring with mandatory rest periods Implement permit-to-work system for high-risk activities.	Construction camp and all work locations/ All project roads	Occupational Safety, Health and Working Conditions Code, 2020; PMGSY EcoP 14; IRC:35; IRC:67; IRC:79; IRC:119 And other applicable IRC guidelines	PIU/ Contractors	PISC/ KRRDA

Mitigation Measure Code	Environmental Safeguard Purpose	Environmental Mitigation Measures	Sub-project/ Location	Reference	Responsibilities	
					Planning & Execution	Supervision/ Monitoring
		Develop designated worker movement corridors with trained flagmen. Provide drinking water stations, shaded rest areas, work-rest schedules, heat stress awareness and first aid facilities. Maintain transparent wage records, compliance with labour laws, periodic audits; Establish worker grievance mechanism consistent with ADB SPS, maintain grievance register, periodic consultations with workers and evacuation procedures.				
B	Construction Stage					
Embedded Mitigation Measure (EDM)						
EDM17	Controls dust nuisance and protects roadside receptors from secondary construction impacts.	The DPR/EMP provisions require construction materials to be transported with tarpaulin cover and haul roads to be maintained and dust-controlled. Contractor shall sprinkle water to suppress dust as per site condition. Contractor shall maintain existing road and haul road so that vehicles can pass easily and ensure that generation of dust is minimized. The excavated earth /construction materials shall be stored properly so that it does not generate fugitive emissions. Storage area should be located downwind of the habitation area. Contractor shall install wet scrubber or any other suitable pollution control mechanism for hot mix plant and ensure that flue gas passes through the wet scrubber before releasing into ambient air. Contractor shall also ensure that wet scrubber or other filter is always operational when hot mix plant is in operation.	Transportation of construction material/ All project roads	MoRTH 111.9; PMGSY ECOP 10: Air Quality / Noise	KRRDA/PIU	KRRDA

Mitigation Measure Code	Environmental Safeguard Purpose	Environmental Mitigation Measures	Sub-project/ Location	Reference	Responsibilities	
					Planning & Execution	Supervision/ Monitoring
		Although implemented during construction, these are embedded in the project documentation and therefore form part of the planned mitigation package. The setback conditions for sensitive receptor as prevailing CPCB guidelines is 500 m from human habitation, 200 m from highways, and 500 m from sensitive ecological/institutional zones. Where the setback distances specified above cannot be achieved and no alternative location is available, and subject to prior approval of the PIU/PISC, barricading with 6-meter-high GI sheets will be provided as a supplementary control. Barricading shall not be treated as a substitute for the prescribed separation distances, and avoidance of siting within the setback shall remain the first order of preference.				
EDM 19	Controls air pollution	LPG should be used as a fuel source in construction camps instead of wood. Ambient air quality shall be monitored by the Contractor as per the environmental monitoring plan of the EIA to ensure parameters are within permissible limits. Contractor shall follow Generic Guidelines for Environment Friendly Construction Methodology appended in EMP. DG set shall be provided with chimney of adequate height as per CPCB guidelines (Height of stack in meter = Height of the building + $0.2 \sqrt{\text{KVA}}$).	Construction zones/ all project roads	PMGSY ECoP; IRC:SP:108-2015; CPCB guidelines on DG stack height	PIU/ Contractors	KRRDA
EDM 21	Controls noise pollution	The plants and equipment used for construction will strictly conform to Central	Construction zones/	PMGSY ECoP;	PIU/ Contractors	KRRDA

Mitigation Measure Code	Environmental Safeguard Purpose	Environmental Mitigation Measures	Sub-project/ Location	Reference	Responsibilities	
					Planning & Execution	Supervision/ Monitoring
		Pollution Control Board (CPCB) noise standards. Vehicles, equipment and construction machinery shall be monitored regularly with particular attention to silencers and mufflers to maintain noise levels to minimum. Use of noise shields to construction machinery and provision of earplugs to the heavy machine operators are some of the mitigation measures.	all project roads	IRC:SP:108-2015		
EDM 22	Protects water quality	Contractor shall ensure that no spillage of spoil material in surface water bodies directly or indirectly. (Refer to Appendix 3-Waste Management Plan) Contractor shall ensure that no untreated discharge should enter into surface water bodies. Any discharges into environment should follow environmental standard. Install temporary silt traps or sedimentation basins along the drainage leading to the water bodies. Soak pit and septic tank will be provided to be constructed by the Contractor. Contractor shall prepare impervious surface at fuel refilling station, work shop area and material storage area. The fuel refilling station and workshop area should be provided with shed for sun and rain. Precaution should be taken to ensure that the impervious surface is not located on natural and critical habitats.	Construction and Labour Camp, all working locations near water bodies/ All Project roads	Water (Prevention and Control of Pollution) Act, 1974 Contract Water standards	PIU/ Contractor	PISC/ KRRDA
EDM 23	Protects water resource and ecology	Contractor shall obtain permission for withdrawal of surface or ground water and consult with the community and ensure that villager's user right is protected.	Construction and Labour Camp, all	Water (Prevention and Control of	PIU/ Contractor	PISC/ KRRDA

Mitigation Measure Code	Environmental Safeguard Purpose	Environmental Mitigation Measures	Sub-project/ Location	Reference	Responsibilities	
					Planning & Execution	Supervision/ Monitoring
		Contractors shall provide dedicated sources or supplementary supply where reliance on local systems is not feasible. Surface flow shall be diverted or construction activities shall be isolated from the surface flow in a manner acceptable to PIU. Any diversion / bund/isolation constructed for bridge/culvert work shall be removed by Contractor as soon as utility of those are over. Installation of slit fencing with planting vegetated swales at the mouth of the nearest water body to prevent any residual sediments from entering the water body. A total of 2,07,120 trees will be planted along the project roads to enhance biodiversity values	working locations near water bodies/ All Project roads	Pollution) Act, 1974 Central GroundWater Authority Notification, 2020 Contract Water standards		
EDM 24	Protects Drainage system	To prevent runoff and surface waters from entering agricultural fields or infiltrating the ground, the drainage system shall be kept in good condition as part of pre-monsoon maintenance. Rejuvenation of the drainage system by removing encroachments/ congestions will be regularly conducted.	Within RoW/ All project oads	EMP	PIU/ Contractors	PISC/ KRRDA
EDM 26	Community socioeconomy	Contractors to keep community members apprised of construction schedules in readily accessible public locations. Construction schedule to be aligned with agricultural cycle to avoid harvest period, and consulted with community and farmers. A traffic management plan (Appendix 11) to be prepared for construction phase as part of the EMP.	All project roads	EMP Contract	PIU/ Contractors	PISC/ KRRDA

Mitigation Measure Code	Environmental Safeguard Purpose	Environmental Mitigation Measures	Sub-project/ Location	Reference	Responsibilities	
					Planning & Execution	Supervision/ Monitoring
		The contractors shall ensure that no inconvenience is caused to the commuters and local communities.				
Additional Mitigation Measures (ADM)						
General	Environment Management- Overall	Development of site level EMP by contractors	All Project roads	GIIP	Contractor	PIU/PISC
SQ1	Soil erosion prevention	When soil is spread on slopes for permanent disposal, it shall be buttressed at the toe by retaining walls.	Outside RoW/ Roads in hilly terrain	MoRTH Clause 306	PIU/ Contractor	PISC/ KRRDA
SQ2	Borrow area management	Borrow areas if required, shall not be located near forest areas. The edges of borrow sites shall be no closer than 3 metres from any fence line or boundary. Adequate clearance shall be provided for the construction of catch drains. Borrow sites shall have adequate drainage outlets unless the relevant landowner has agreed that the borrow area is to create a permanent tank or dam. Cut batter slopes shall not be steeper than 3 to 1 and shall be left by the Contractor in a tidy and safe condition to the satisfaction of the Engineer. Written clearance from the land owner/village head shall be obtained before leaving a site. The depths in borrow pits to be regulated so that the sides shall not be steeper than 25%, to the extent possible, borrow areas shall be sited away from habituated areas. Borrow areas shall be levelled with salvaged material or other filling materials which do not pose contamination of soil.	Borrow areas/ All Project roads	MoRTH Clause 306	PIU/ Contractor	PISC/ KRRDA

Mitigation Measure Code	Environmental Safeguard Purpose	Environmental Mitigation Measures	Sub-project/ Location	Reference	Responsibilities	
					Planning & Execution	Supervision/ Monitoring
		The haulage distance from borrow areas will be selected based on the DPR consultant's assessment, with borrow areas to be sourced within 200 m of the alignment wherever suitable material is available, so as to minimise haulage and transport-related impacts (refer to the Borrow Area Management Plan at Appendix 13). Identification and verification of compliant borrow areas across all project roads shall be undertaken by the contractor and cleared by the PIU/PMC prior to opening any borrow area. (Refer Appendix 13 Borrow Area management plan)				
SQ3	Borrow area management	Obtain statutory approval from competent authority as detailed in chapter 2 (recent policy initiatives on mining of minor mineral) shall be obtained for borrow area.	Borrow areas/ All Project roads	MoRTH Clause 306	PIU/ Contractor	PISC/ KRRDA
SQ4	Soil pollution prevention	Fuel and lubricants shall be stored at the predefined storage location. The storage area shall be paved with gentle slope to a corner and connected with a chamber to collect any spills of the oils.	Construction Camp/ All Project Roads	Environment (Protection) Act, 1986	PIU/ Contractor	PISC/ KRRDA
SQ5	Soil pollution prevention	Unavoidable waste shall be stored at the designated place prior to disposal. To avoid soil contamination at the wash-down and refueling areas, "oil interceptors" shall be provided. Oil and grease spill and oil-soaked materials are to be collected and stored in labelled containers (Labelled: WASTE OIL; and hazardous sign be displayed) and sold off to SPCB/ MoEF&CC authorized refiners.) (Refer Waste Management Plan- Appendix 3)	Construction Camp/ All Project Roads	Environment (Protection) Act, 1986	PIU/ Contractor	PISC/ KRRDA

Mitigation Measure Code	Environmental Safeguard Purpose	Environmental Mitigation Measures	Sub-project/ Location	Reference	Responsibilities	
					Planning & Execution	Supervision/ Monitoring
SQ6	Soil pollution prevention	Septic tank or mobile toilets fitted with anaerobic treatment facility shall be provided.	Labour and Construction Camp/ All Project Roads	Environment (Protection) Act, 1986 Water (Prevention and Control of Pollution) Act, 1974	PIU/ Contractor	PISC/ KRRDA
SQ7	Soil pollution prevention	It will be Contractor's responsibility to ensure that spoil material does not spill in valley or any unwanted location. Contractor will have to dump spoil material at the approved dumping site. If loss to orchard, agricultural land causes due to Contractor's action, Contractor shall compensate such loss from his own cost. Dumping locations are given in EMP and guidelines has been provided for identification of dumping sites in EMP.	Outside RoW/ All Project Roads	Environment (Protection) Act, 1986	PIU/ Contractor	PISC/ KRRDA
SQ8	Topsoil management	The top soil (25cm depth) from the productive land shall be preserved and reused for plantation purposes. It shall also be used as top cover of embankment slope for growing vegetation to protect soil erosion. (Refer Appendix 9-Top Soil Management plan) It will be ensured that the land taken on lease for access road, borrow areas is restored back to its original land use.	Borrow areas/ All Project roads	Environment (Protection) Act, 1986	PIU/ Contractor	PISC/ KRRDA
AA1	Vehicular emissions	All vehicles and equipment to be procured for the proposed upgradation of project roads shall conform to the relevant Bureau of Indian Standard (BIS) norms. Vehicles and machinery shall be maintained regularly and Pollution Under Control (PUC)	Construction related transportation/ All Project roads	MoRTH: 111.1, 121.2 Contract Air standards	PIU/ Contractor	PISC/ KRRDA

Mitigation Measure Code	Environmental Safeguard Purpose	Environmental Mitigation Measures	Sub-project/ Location	Reference	Responsibilities	
					Planning & Execution	Supervision/ Monitoring
		certificates shall be obtained by the Contractor regularly.				
AN1	Ambient noise quality	All noisy construction in natural and critical habitats will be stopped between 10 PM and 6 AM except in case of laying of cement concrete pavement for which lower working temperature is a requirement Hot mix plant, batching or aggregate plants shall not be located within 500 m from human habitation, 200 m from highways, and 500 m from sensitive institutional zones, and natural/critical habitats, if applicable.	All working areas/ All Project roads	Noise Pollution (Regulation and Control) Rules, 2000 Contract Noise standards	PIU/ Contractor	PISC/ KRRDA
AN2	Ambient noise quality	Near to the sensitive receptors such as anganwadis and schools, construction time can be aligned with the institutions' operation timing to prevent noise impacts on the students.	All working areas/ All Project roads	Noise Pollution (Regulation and Control) Rules, 2000 Contract Noise standards	PIU/ Contractor	PISC/ KRRDA
AN3	Ambient noise quality	Phase demolition, earthmoving and ground-impacting operations, so as not to occur in the same time period. Unlike noise, the total vibration level produced could be significantly less when each vibration source operates separately.	All working areas/ All Project roads	Noise Pollution (Regulation and Control) Rules, 2000 Contract Noise standards	PIU/ Contractor	PISC/ KRRDA
WQ1	Surface water quality	Precast pipe culverts shall be installed wherever applicable.	Within RoW/ All Project roads	Water (Prevention and Control of Pollution) Act, 1974 Contract Water standards	PIU/ Contractor	PISC/ KRRDA

Mitigation Measure Code	Environmental Safeguard Purpose	Environmental Mitigation Measures	Sub-project/ Location	Reference	Responsibilities	
					Planning & Execution	Supervision/ Monitoring
BD1	Biodiversity	Vegetation on both sides of the road should not be cleared at the same time. Vegetation should be cleared in a phased manner, i.e., vegetation on one side of the road should be cleared first and then the vegetation on the other side. This will allow faunal components time to escape the construction area.	Within RoW/All Project Roads	EMP Contract	PIU/ Contractor	PISC/ KRRDA
BD2	Biodiversity	Invasive alien species disposal sites should be identified prior to the start of construction. The sites should not be in natural and/or critical habitats (Appendix 18). In case signs of accidental introduction of invasive alien species is noted, the same should be eradicated and disposed at dedicated at the pre-identified disposal sites.	Within RoW/Outside RoW/All Project Roads	EMP Contract	PIU/ Contractor	PISC/ KRRDA
BD3	Biodiversity	The contractor should ensure that creation of alternative routes for vehicular movement is prohibited in natural and/or critical habitats. This can be ensured either by keeping the road shut for traffic until the improvement is over or by allowing partial flow of traffic through sections where improvements have already taken place or are yet to begin.	Within RoW/Outside RoW/All Project Roads	Wildlife (Protection) Act, 1972 Forest (Conservation) Act, 1980	PIU/ Contractor	PISC/ KRRDA
BD4	Biodiversity	Existing quarry and borrow sites should be used for sourcing construction material. In case opening of quarry or borrow sites is required, such sites should be located outside protected areas, forest lands, and natural or critical habitats.	Within RoW/Outside RoW/All Project Roads	EMP Contract	PIU/ Contractor	PISC/ KRRDA
BD5	Biodiversity	Habitats adjacent to the RoW that may be impacted must be restored after the construction phase is over.	Within RoW/Outside RoW/All Project Roads	Wildlife (Protection) Act, 1972 Forest (Conservation) Act, 1980	PIU/ Contractor	PISC/ KRRDA

Mitigation Measure Code	Environmental Safeguard Purpose	Environmental Mitigation Measures	Sub-project/ Location	Reference	Responsibilities	
					Planning & Execution	Supervision/ Monitoring
BD6	Biodiversity	Improvement of bridges is proposed on season streams based on the data provided by KRRDA and DPR consultants. Improvement works of bridges should be done in dry season when the perennial rivers have minimal flows. Any riverbed substrate impacted should be restored.	Within RoW/Outside RoW/All Project Roads		PIU/ Contractor	PISC/ KRRDA
BD7	Biodiversity	Hunting, poaching, trapping of wild animals as well as collection of firewood or other natural resources from inside the forest lands or legally protected areas as well as natural habitats should be prohibited by the contractor.	Within RoW/Outside RoW/All Project Roads	Wildlife (Protection) Act, 1972	PIU/ Contractor	PISC/ KRRDA
BD8	Biodiversity	Construction should be restricted to the daytime, i.e., between 7:00 and 18:00. Nighttime construction should be discouraged.	Within RoW/Outside RoW/All Project Roads		PIU/ Contractor	PISC/ KRRDA
BD9	Biodiversity	Good housekeeping practices should be followed at construction sites and camps. Food and other wastes that may attract animals should be discarded appropriately. Food waste should not be disposed in a manner that will attract wild animals. (Refer to Appendix 3-Waste Management Plan)	Within RoW/Outside RoW/All Project Roads	Wildlife (Protection) Act, 1972	PIU/ Contractor	PISC/ KRRDA
BD10	Biodiversity	Construction workers should be trained about the forest and wildlife laws and acts in India. They should be sensitized about the dos and don'ts in ecologically sensitive areas.	Within RoW/Outside RoW/All Project Roads	Wildlife (Protection) Act, 1972 Forest (Conservation) Act, 1980	PIU/ Contractor	PISC/ KRRDA
BD11	Biodiversity	Construction waste should be disposed of at designated places which are not in forest lands, legally protected areas, natural and/or	Within RoW/Outside	Wildlife (Protection) Act, 1972	PIU/ Contractor	PISC/ KRRDA

Mitigation Measure Code	Environmental Safeguard Purpose	Environmental Mitigation Measures	Sub-project/ Location	Reference	Responsibilities	
					Planning & Execution	Supervision/ Monitoring
		critical habitats. Construction waste should not be disposed in culverts or drainages.	RoW/All Project Roads	Forest (Conservation) Act, 1980		
BD12	Biodiversity	For roads in critical and/or natural habitats, roadkill hotspots should be identified prior to the construction. Speed breakers and signages indicating road users to slow down as covered in EDM-14 should be additionally installed in such areas.	Within RoW/Outside RoW/All Project Roads		PIU/ Contractor	PISC/ KRRDA
BD13	Biodiversity	Residual impacts to natural and critical habitats will be mitigated through the BAP. The BAP includes actions for restoration of habitats at offset sites identified by the Karnataka Forest Department over an area equivalent to the amount of area of vegetation clearance/habitat loss and degradation, as is determined during the construction phase. (Refer to the BAP – Annexure 13).	Outside ROW/Roads in Natural and Critical Habitats	ADB SPS (2009) requirement in natural and critical habitats	PIU/Contractor	PISC/KRRDA
HA1	History and archaeology preservation	Predict vibration levels from construction activities for cultural and heritage structures, along the RoW, against peak particle velocity limits set for each structure category in accordance with DIN 4150-3 or equivalent, with defined work-suspension triggers and use low vibration equipment where applicable. Install real time vibration sensors and define threshold limit. Stop work if threshold is exceeded. Use trenches to dissipate vibration.	Outside RoW/ All Project roads	Ancient Monuments and Archaeological Sites and Remains (AMASR) Act of 1958 Karnataka Ancient and Historical Monuments and Archaeological Sites and	PIU/ Contractor	PISC/ KRRDA

Mitigation Measure Code	Environmental Safeguard Purpose	Environmental Mitigation Measures	Sub-project/ Location	Reference	Responsibilities	
					Planning & Execution	Supervision/ Monitoring
				Remains Act, 1961		
HA2	History and archaeology preservation	Mark 'no-entry' zone for heavy equipment near the heritage structures.	Outside RoW/ All Project roads	Ancient Monuments and Archaeological Sites and Remains (AMASR) Act of 1958 Karnataka Ancient and Historical Monuments and Archaeological Sites and Remains Act, 1961	PIU/ Contractor	PISC/ KRRDA
HA3	History and archaeology preservation	Regularly sprinkle water near heritage structures and use dust screens where possible.	Outside RoW/ All Project roads	Ancient Monuments and Archaeological Sites and Remains (AMASR) Act of 1958 Karnataka Ancient and Historical Monuments and Archaeological Sites and	PIU/ Contractor	PISC/ KRRDA

Mitigation Measure Code	Environmental Safeguard Purpose	Environmental Mitigation Measures	Sub-project/ Location	Reference	Responsibilities	
					Planning & Execution	Supervision/ Monitoring
				Remains Act, 1961		
CHS1	Community health and safety	Contractor to establish tie-up with nearest PHC/hospital and maintain emergency response plan.	All working locations/ all project roads	Occupational Safety, Health and Working Conditions Code, 2020; IRC:SP:20:2002	PIU/ Contractor	PISC/ KRRDA
CHS2	Community health and safety	Implement Workers' Code of Conduct and conduct cultural sensitivity training, including gender sensitivity training.	All working locations/ all project roads	Occupational Safety, Health and Working Conditions Code, 2020; IRC:SP:20:2002	PIU/ Contractor	PISC/ KRRDA
CR1	Competing Resources	The community interest and dependence on water resource will be protected through obtaining regulatory and local permissions. The contractor will obtain permission from Karnataka Ground Water Authority for abstraction of groundwater and, for other sources contractors will obtain permission from local panchayat or local governing body. In an event of drought during construction phase and/or in water scarce regions, a dedicated or supplementary water supply (e.g. tanker water) and water use restrictions shall be implemented so that community access to water resource is not compromised.	Project roads within over-exploited/ critical groundwater units	Central Groundwater Authority Notification, 2020 Contract	PIU/ Contractor	PISC/ KRRDA
C	Operation Phase					

Mitigati on Measur e Code	Environmental Safeguard Purpose	Environmental Mitigation Measures	Sub- project/ Location	Reference	Responsibilities	
					Planning & Execution	Supervis ion/ Monitori ng
	Embedded Mitigation Measures					
EDM 20	Controls air pollution	Road (main carriage way) damage to be promptly rectified with proper road repair and maintenance work to avoid dust emission.	Operation phase/ all project roads	PMGSY ECoP; IRC:SP:108- 2015	PIU/ Contractors	KRRDA
	Operation Phase (ADM)					
NH1	Flood prevention	Regular cleaning of side drains, culverts and causeways.	Througho ut the road alignment / All Project roads	IRC:34-2011 Contract	PIU/ Contractor	PISC/ KRRDA
NH2	Landslide/ flood prevention	Install simple signboards in landslide/flood-prone areas.	Outside RoW/ Roads in flood prone districts	IRC:SP:106- 2015 IRC:SP:48- 2023	PIU/ Contractor	PISC/ KRRDA
NH3	Flood prevention	Use local rainfall observation to restrict traffic during heavy rain.	Roads in flood prone districts	EMP	PIU/ Contractor	PISC/ KRRDA
AA2	Ambient air quality	Road (main carriage way) damage to be promptly rectified with proper road repair and maintenance work to avoid dust emission.	Within RoW/ All Project roads	Contract	PIU/ Contractor	PISC/ KRRDA
AN4	Ambient noise quality	Mitigating the impact of increased noise levels at the sensitive receptor locations includes posting of signs prohibiting the use of horns, speed restrictions, traffic calming, and dense roadside plantations.	Outside RoW/ All Project roads	EMP Contract	Roadside plantation- PIU/ Contractor	PISC/ KRRDA
BD14	Biodiversity	The roads should be inspected for potholes regularly during the monitoring phase, especially prior to the monsoons. Any	Within RoW /All Project Roads		PIU/ Contractor	PISC/ KRRDA

Mitigation Measure Code	Environmental Safeguard Purpose	Environmental Mitigation Measures	Sub-project/ Location	Reference	Responsibilities	
					Planning & Execution	Supervision/ Monitoring
		potholes on the roads must be repaired prior to the start of the monsoons. This is to ensure that amphibians which may use the potholes during the monsoons are safeguarded.				

H. Critical Habitat Analysis and Biodiversity Action Plan

815. A preliminary Critical Habitat Assessment (CHA) and Biodiversity Action Plan (BAP) have been prepared using baseline biodiversity data collected during the first survey season (March–June 2026). The preliminary assessment identified six Ecologically Appropriate Areas of Analysis (EAAAs), recognized 34 critical habitat-triggering biodiversity species at this stage, and determined that 591 project roads are located within these ecologically sensitive areas. The current assessment is based on a precautionary approach because it relies on a single season of field data and therefore may not fully capture seasonal variations in biodiversity, including migratory and congregatory bird species, amphibians, reptiles, ephemeral flora and fauna, and other species that are detectable only during specific seasons. Of the 591 roads located within the EAAAs, the preliminary BAP has been developed to guide the achievement of no net loss of biodiversity and, where feasible, net gains for critical habitat biodiversity values through the implementation of avoidance, minimization, restoration, monitoring, and adaptive management measures.

816. Additional biodiversity surveys covering the post-monsoon and winter seasons are currently pending and are scheduled for completion by February 2027. These surveys will generate a comprehensive multi-season biodiversity baseline and improve the understanding of species distribution, habitat use, ecological connectivity, and the presence of any additional critical habitat-triggering species. The information collected during the remaining survey seasons will be used to validate and refine the preliminary critical habitat boundaries, reassess impact significance where necessary, identify any additional biodiversity risks, and refine/update the mitigation and conservation measures proposed under the BAP. Consequently, both the CHA and BAP will be revised and finalized upon completion of the full seasonal survey, and the findings will be integrated into the final EIA, EMP, and associated safeguard documents. The preliminary CHA is provided in Appendix 18 and the preliminary BAP is provided in Appendix 19.

I. Environmental Management and BAP Budget

817. The budget of implementation of EMP and EMoP in 1335 roads is ₹326,606,685 and budget for implementation of BAP (Appendix 19) is ₹370,800,000. The road wise budget of implementation of EMP and EMoP is provided in Appendix 17. The breakdown of the budget is provided in Table IX-15 below.

Table IX-15 : Environmental and BAP Budget

Item	Amount in ₹
Environmental Budget	326,606,685
BAP Items	
Restoration of ~2051 hectares of habitats at offset sites determined with the help of Karnataka Forest Department	315,100,000
Deployment of qualified ecologist to survey for invasive alien species, bird nests in the vegetation and to quantify vegetation clearance and habitat loss prior to clearance	36,000,000
Training of the ecologists for the quantification of habitat losses, invasive alien species, and nesting surveys	500,000
Monitor semi-annually for five years to determine the status of the project towards no-net loss	2,200,000
Instal signages showing speed limit, wildlife crossings, in forest areas for enhancing public awareness	12,000,000
Community awareness –sessions, celebrations, competitions	5,000,000
Total BAP Costs	370,800,000
Grand Total of EMP and BAP Cost	697406685

X. CONCLUSION AND RECOMMENDATION

818. The Karnataka Rural Road Improvement Project (KRRIP) covers improvement of 1,335 existing rural roads, of aggregate length approximately 5,178 km, across 31 districts of Karnataka. The proposed works are confined to the existing road right of way (RoW) and include carriageway improvement, strengthening, paved shoulders, drainage, cross-drainage, road safety provisions and associated roadside works. The project is intended to improve all-weather rural connectivity, road safety, access to critical infrastructure such as schools, hospitals, administrative offices, Anganwadi, markets and services, and overall mobility for local communities. Associated facilities, comprising quarries, borrow areas, hot-mix and batching plants, crushers, haul roads and labour camps, are assessed in this EIA in accordance with paragraph 6 of ADB SPS, 2009.

819. The project has been classified as Category A for environment under ADB Safeguard Policy Statement (SPS), 2009, on account of the presence of critical habitats. Rural road improvement does not attract the requirement of prior environmental clearance under the EIA Notification, 2006 (as amended); the project nonetheless requires compliance with applicable national and state regulatory requirements, including permissions related to tree felling, forest land diversion, CRZ areas, ASI-regulated zones, construction plants, quarry and borrow material sourcing, labour, occupational health and safety, waste management, traffic management and other statutory requirements. Project Road ID 4817 in Belagavi district traverses forest land, and requires prior approval for diversion of 0.748 ha of forest land under the Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 (formerly the Forest (Conservation) Act, 1980), as amended. In addition, the required working permissions/No Objection Certificates (NOCs) for 307 project roads located within or adjoining forest stretches, shall be obtained prior to the commencement of any civil works under the Project. A GIS-based exercise is being undertaken by the KRRDA in collaboration with the Karnataka Forest Department to determine if additional clearances, permissions, or NOCs are required from the Karnataka Forest Department. Road ID 1392 in Uttara Kannada district requires CRZ clearance from the Karnataka Coastal Zone Management Authority under the CRZ Notification, 2019, read with the CRZ Notification, 2011, as applicable to the district in the absence of an approved Coastal Zone Management Plan. Road ID 4446 in Vijayanagara district fall within the regulated area of the centrally protected Group of Monuments at Hampi and require prior permission from the National Monuments Authority and the Archaeological Survey of India under the Ancient Monuments and Archaeological Sites and Remains Act, 1958 and the AMASR (Amendment and Validation) Act, 2010. No road shall be included in a works package until the statutory clearance applicable to that road has been obtained, and the status of each clearance and of compliance with its conditions shall be reported in every semi-annual environmental monitoring report (SEMR).

820. The baseline assessment indicates that the project roads are distributed across all physiographic regions of Karnataka, including the Western Ghats/Malnad belt, coastal Karnataka, and the northern, central and southern plateau regions. Roads located across 23 districts are exposed to natural hazards, comprising 251 roads in high soil erosion zones, 176 in flood-prone taluks, 16 in landslide-prone taluks, 172 in drought-prone areas, coastal roads exposed to cyclone and high wind in the coastal districts and 601 with high lightning exposure. These risks have been assessed in the Chapter 6, and the resulting adaptation measures - including cross-drainage sized for the 30-year return period rainfall intensity under the projected climate scenario, slope protection and bioengineering in the Western Ghats reaches, raised formation levels in flood-prone reaches and wind-firm roadside plantation in the coastal districts - have been incorporated into the design standards, drawings and cost estimates. Residual road-specific measures and construction-stage controls are specified in the EMP.

821. Baseline ambient air quality monitoring at 774 locations, undertaken over two season(s) in accordance with the CPCB National Ambient Air Quality Monitoring protocol, indicates that air quality along the project road corridors is generally influenced by rural background conditions, localized vehicular movement, re-suspension of road dust, agricultural activities and settlement-level emissions. Monitored 24-hour concentrations of PM₁₀, PM_{2.5}, SO₂, NO₂ and CO are within the National Ambient Air Quality Standards (NAAQS), 2009 at 768 of 774 locations. The NAAQS 24-hour limit for PM₁₀ and PM_{2.5} are does not exceeds at any of the monitored 774 locations, all in settlement and market stretches. Measured PM_{2.5} and PM₁₀ concentrations exceed the World Health Organization interim target values referenced in the World Bank Group Environmental, Health and Safety (EHS) Guidelines at 437 and 523 locations respectively. However, short-term increases in dust and emissions may occur during construction due to earthworks, material transport, operation of construction equipment, and movement of vehicles on unpaved or disturbed surfaces. Given the elevated baseline at settlement stretches, these impacts are assessed as localised, temporary and reversible, and are to be managed through water sprinkling at a frequency of not less than two times per day at habitation and school frontages, covered transportation of materials, enclosure or covering of stockpiles, wheel-washing at plant and quarry exits, maintenance of equipment and vehicles with valid PUC certification, prohibition of idling, and monitoring at the locations, parameters and frequency specified in the EMP monitoring plan. Ambient monitoring shall be reported against the more stringent of the NAAQS and the WBG EHS Guideline values.

822. Baseline noise monitoring indicates that the existing noise environment along the project roads is typical of rural road settings and is mainly influenced by local traffic, community activities, markets, construction activities in settlements, agricultural machinery and other localized sources. Measured day-time and night-time Leq values are within the limits prescribed under the Noise Pollution (Regulation and Control) Rules, 2000 for the corresponding land-use categories at 303 of 774 locations. Exceedances, principally of the night-time limit, are recorded at 269 locations comprising congested settlement stretches, market areas, junctions and locations with higher traffic movement. Construction activities may temporarily increase noise levels due to operation of machinery, movement of vehicles, compaction, excavation and material handling. Such impacts shall be controlled through equipment maintenance, restriction of high-noise activities within 200 m of sensitive receptors, prohibition of night-time construction within 200 m of habitations, schools, health facilities, places of worship and identified wildlife movement areas, use of acoustic enclosures for DG sets and crushers, provision of temporary noise barriers at identified sensitive receptors, and provision and enforced use of hearing protection for workers. Operation-stage noise has been predicted for the design year at 10 sensitive receptors using the SoundPLANEssential5.1; predicted levels remain within the prescribed limits except at 8 locations, where noise barriers or low-noise surfacing are provided and have been included in the cost estimate.

823. Surface water quality in the project influence area reflects the characteristics of local ponds, streams, canals, tanks and other water bodies that may be influenced by seasonal flows, agricultural runoff, domestic use and local drainage conditions. Monitoring at 551 surface water locations indicate conformity with CPCB Designated Best Use Class C, with exceedances of pH, Dissolved Oxygen, BOD and total/faecal coliform at 154 locations. Groundwater was monitored at 769 locations; 665 samples exceeded one or more acceptable limits of IS 10500:2012 for colour, pH, turbidity, total dissolved solids, total hardness, calcium, magnesium, alkalinity, chloride, sulphate, nitrate, fluoride, iron, manganese, copper, zinc, aluminium, arsenic, cadmium, mercury, nickel, faecal coliform and/or E. coli. . Construction water demand is estimated at 2124 kL/km and shall be met from locally available approved sources, such as nearby streams, village

ponds, or public water supply systems, against a valid permission from the competent authority, with no abstraction from sources used for drinking water and no in-stream extraction without prior approval. During construction, potential impacts may arise from silt runoff, disposal of excavated material, accidental fuel or oil spills, wastewater discharge from camps, and obstruction or alteration of natural drainage. These risks shall be addressed through silt fencing and sedimentation traps at all cross-drainage works, siting of camps, plants, fuel stores and material storage areas not less than 100 m from any water body, watercourse or drinking water source, prohibition of disposal of any waste or excavated material into water bodies, bunded fuel and oil storage with spill kits and a documented spill response procedure, treatment of camp wastewater to the prescribed discharge standards before release, maintenance of the hydraulic capacity of cross-drainage structures during and after construction, and monitoring of surface and groundwater quality at the locations, parameters and frequency specified in the EMP.

824. The biological assessment confirms that the project roads are existing roads and the direct footprint lies predominantly within modified habitat as defined in paragraph 25 of Safeguard Requirements 1 (SR1) of ADB SPS, 2009. Of the 1,335 project roads occur within ecologically sensitive landscapes, comprising 307 roads within reserved, protected and non –notified forest, 14 within a protected area, and 86 within eco-sensitive zones 148 roads fall within Western Ghats, which is a globally important biodiversity landscape and is considered as amongst the ‘hottest’ of the hotspots. A Critical Habitat Assessment (CHA) has been determined six Ecologically Appropriate Areas of Analysis (EAAAs) delineated for the project to be critical habitats, in accordance with paragraphs 27 and 28 of SR1 and the ADB Environment Safeguards Sourcebook (2012). The CHA confirms the presence of critical habitat triggered for threatened and range-restricted species under criteria 1 and 2 of IFC PS 6. Moreover, Western Ghats, as part of the Broadleaf Forests EAAA have been identified to be critical habitats for their supporting of Key Evolutionary Processes, Ecosystem Services, and in their being a highly threatened or unique ecosystem, and of cultural, social, and economic importance. A total of 591 roads has been determined to be in the EAAAs determined to be critical habitats. A Biodiversity Action Plan (BAP) has been prepared on the basis of the completed CHA. The BAP demonstrates that each of the conditions in paragraph 28 of SR1 is met, namely that there are no measurable adverse impacts on the ability of the critical habitat to support the identified biodiversity values, no reduction in the population of any recognised endangered or critically endangered species, and no significant net reduction in the value of the critical habitat. It delivers no net loss of natural habitat values and net gain of the affected critical habitat values and is supported by a long-term biodiversity monitoring and evaluation programme, a costed budget of ₹315.1 million, defined institutional responsibilities and a schedule aligned with the civil works programme. Recognised external biodiversity experts have been consulted in the design of the CHA and the BAP as required by paragraph 28 of SR1.

825. The main anticipated impacts arise during pre-construction and construction and include vegetation clearance, disturbance to habitats in sensitive locations, soil erosion and slope instability, localized drainage and flooding risks, dust and vehicular emissions, construction noise, impacts on surface water and groundwater resources, waste generation, occupational and community health and safety risks, traffic disruption, labour camp impacts, and potential impacts on cultural and archaeological features. Operation-stage impacts include wildlife injury/mortality and barrier effects arising from higher vehicle speeds on upgraded carriageways, traffic noise at roadside receptors, and altered surface drainage. Induced impacts associated with improved access to forest fringes and eco-sensitive zones - including encroachment, unauthorised extraction of forest produce, hunting and conversion of land use - have been assessed in accordance with paragraph 6 of SR1 and are material for the 407 roads adjoining forest and protected area boundaries. Cumulative impacts have been assessed at project level in

combination with other road, irrigation, transmission and quarrying activities. Tree felling is estimated at 80 trees and construction-stage greenhouse gas emissions at approximately 43.7 tCO₂e, which is below the annual reporting threshold of 100,000 tCO₂e in ADB SPS, 2009. With effective implementation of the EMP, BAP, site-specific plans and statutory clearance conditions, these impacts can be avoided, minimised, mitigated or, as a last resort, compensated, such that no significant adverse residual impact remains. Residual significance ratings before and after mitigation are presented in Chapter 6.

A. Mitigation Measures

826. The project design shall continue to follow the mitigation hierarchy of avoidance, minimisation, mitigation and restoration, and, only where residual impacts remain after these steps have been exhausted, offset or compensation. Alignment improvement, road widening, drainage, cross-drainage and safety provisions shall remain within the available right of way. Sensitive receptors, forest land, cultural properties, water bodies, steep slopes and ecologically sensitive locations shall be avoided. Where avoidance is not technically feasible for a particular road, the design engineer shall record the alternatives examined and the reasons for rejection, the residual impact shall be assessed, and the additional mitigation shall be approved by KRRDA and cleared by ADB before the design for that road is finalised.

827. Road sections located in erosion-prone, flood-prone, landslide-prone and high-rainfall areas shall be provided with longitudinal and cross-drainage designed for the return period and rainfall intensity established in the CRVA, erosion protection, slope stabilization, bio-engineering, retaining and breast walls where required, sediment control measures and safe discharge arrangements. These measures shall be reflected in the drawings and the bill of quantities for each affected road, and their implementation shall be verified by the PISC before certification of the corresponding work item, with particular attention to the Western Ghats, coastal and other high-risk locations.

828. Construction contractors shall implement site-specific control measures for dust suppression, noise control, traffic and pedestrian safety, material storage, quarry and borrow material sourcing, waste management, fuel and hazardous material handling, camp sanitation, wastewater management, stormwater control, emergency response, community health and safety, and occupational health and safety. Contractors shall comply with applicable national labour legislation and with ADB's requirements on core labour standards, including the prohibition of child labour and forced labour, equal pay for equal work, and provision of a workers' grievance mechanism separate from the community GRM. All construction plants, crushers, hot-mix plants, batching plants, DG sets, quarries and borrow areas shall operate only after obtaining applicable consents, permits and approvals from the competent authorities, copies of which shall be submitted to the PISC before mobilisation and listed in the SEMR. Material shall be sourced only from quarries holding a valid licence, consent to operate and environmental clearance. Where the project establishes a quarry or borrow area, or is its principal user, that facility shall be treated as an associated facility and managed to the requirements of ADB SPS, 2009, including site restoration on closure.

829. Tree felling shall be limited to the 80 trees identified as unavoidable in the road-specific tree inventory and shall be undertaken only after obtaining permission from the competent authority. Trees to be retained and trees to be felled shall be individually numbered and marked on site, and the inventory shall be reconciled by the PISC before and after felling. Compensatory plantation at a ratio of not less than 1:10, using native species appropriate to the local ecology and to the requirements of the BAP, shall be implemented, and survival shall be monitored and

reported for not less than one year with replacement of failures within the following planting season. Responsibility, funding and land availability for compensatory plantation shall be confirmed before felling commences. In forest stretches, no civil works shall commence until the applicable forest approval, working permission, NOC and other relevant approvals have been obtained and their conditions incorporated into the site-specific EMP and the works programme.

830. For roads passing through or near protected areas, eco-sensitive zones, critical habitats, wildlife movement areas, CRZ areas, ASI-regulated zones, water bodies and other sensitive receptors, the road-specific mitigation measures set out in the EMP and the BAP shall be integrated into the contractor's site-specific EMP and implemented in consultation with, and with the prior written concurrence of, the relevant authorities. These measures shall include prohibition of vegetation clearance beyond the notified working width, prohibition of night work in wildlife movement areas, enforced speed limits supported by physical speed-calming measures, wildlife warning signage and delineators, retention of existing canopy connectivity in wildlife movement areas in the EMP and BAP, induction and refresher awareness training for all workers, prohibition of hunting, trapping, fishing and collection of forest produce, prohibition of fuelwood use and of unauthorised lighting in camps near forest boundaries, sediment control, spill prevention, chance-find procedures, and compliance with every condition of the applicable clearance or NOC.

831. Meaningful consultations have been carried out in accordance with paragraphs 54 and 55 of ADB SPS, 2009, comprising 391 consultations with 9435 participants during the assessment stage and a second round of consultation on the draft EIA and draft BAP held between 6 to 11 July 2026; records are at Appendix 23 A and B. Consultations and information disclosures shall continue during the pre-construction, construction and operation stages. Concerns raised by affected persons, roadside communities, Gram Panchayats, line departments, forest officials, vulnerable groups and other stakeholders shall be documented and addressed through the EMP, site-specific mitigation measures and the project grievance redress mechanism. Particular attention shall be given to community safety, access management, temporary traffic arrangements, drainage, impacts on water bodies, cultural properties and livelihood-related concerns. The EIA, EMP, BAP, corrective action plans and subsequent monitoring reports shall be disclosed on the ADB website and made available in Kannada at the concerned Gram Panchayat, PIU and PMU offices.

B. Grievance Redressal Mechanism

832. KRRDA shall establish and maintain a project-level Grievance Redress Mechanism (GRM) to receive, register, assess and resolve complaints related to environmental performance, community health and safety, access disruption, drainage, construction impacts, labour issues and other project-related concerns. The GRM shall function at site, PIU and PMU levels with clearly defined responsibilities, timelines, escalation procedures, record-keeping and reporting requirements. The mechanism shall be disclosed to communities before construction at each road and shall remain accessible, gender-responsive, culturally appropriate and free of cost to complainants, and shall accept anonymous complaints. Availing of the GRM shall not impede an aggrieved person's access to the country's judicial or administrative remedies and affected people shall be informed of ADB's Accountability Mechanism. Grievances received, resolved, escalated and outstanding, with timelines, shall be reported in every SEMR.

C. Environment Management Plan (EMP)

833. An Environmental Management Plan (EMP) has been prepared as an integral part of the EIA to define mitigation measures, monitoring requirements, institutional responsibilities,

reporting arrangements, a budget of ₹326 million for measures not internalised in the civil works cost, and implementation procedures for the pre-construction, construction and operation stages of the project. The EMP shall be read together with the BAP, statutory clearance conditions, road-specific mitigation requirements and monitoring plans. A budget of ₹370 million is earmarked for implementation of BAP.

834. KRRDA, through the PMU and PIUs, shall be responsible for overall environmental safeguard implementation. A full-time Environmental Safeguards Specialist and a full-time Social Safeguards Specialist in the PMU, a designated Environmental Officer in each PIU, an Environmental Specialist and a qualified Biodiversity Specialist in the Project Implementation Support Consultant (PISC) team, and an Environment, Health and Safety Officer deployed by each contractor, shall be responsible for implementation, supervision, monitoring, reporting and corrective action tracking. The Ecologist shall be engaged for the full implementation period, with the qualifications, experience and person-months specified in the PISC terms of reference, and shall supervise BAP implementation, wildlife movement area measures, tree and habitat clearance and biodiversity monitoring. Any pooling of the Ecologist input across roads shall be provided for expressly in the PISC terms of reference and the PMU staffing plan. A training programme with a dedicated budget shall be delivered to PMU, PIU, PISC and contractor personnel before the start of works at each road and annually thereafter. The institutional arrangement shall be in place before award of the first civil works contract and shall provide adequate capacity for biodiversity management, statutory compliance, labour and OHS compliance, community engagement, grievance redress and environmental monitoring.

835. The EMP, BAP, clearance conditions requirements and other safeguard obligations shall be incorporated into the bidding documents, the PISC terms of reference and the civil works contracts and shall be reflected as measurable and payable items in the bill of quantities wherever practicable. Contractors shall allocate adequate resources for implementation of all environmental, health, safety, biodiversity and social safeguard requirements. The cost of mitigation, monitoring, statutory compliance, training, reporting and corrective actions shall be deemed included in the contract price, and compliance shall be an enforceable contractual obligation with defined remedies for default.

836. Before taking possession of any work site, each contractor shall prepare and submit a site-specific EMP to the PISC for review and to KRRDA/PIU for approval, and thereafter to ADB for information. The site-specific EMP shall include site-specific mitigation and monitoring measures, statutory permits, material sourcing plans, borrow and quarry management, traffic management, waste management, OHS plan, labour camp management, emergency response, biodiversity protection measures, chance-find procedure, reporting formats and responsibilities. No construction activity shall commence at any location until the relevant site-specific EMP has been approved and all statutory approvals applicable to that location are in place.

837. The PMU, PIUs and PISC shall monitor contractor compliance through regular site inspections, environmental monitoring, review meetings, monthly progress reports and semi-annual environmental monitoring reports submitted to ADB within 30 days of the close of each reporting period for review and disclosure on the ADB website. Non-compliances shall be recorded in a non-compliance register with corrective actions, responsibilities and timelines, and tracked to closure in each SEMR. KRRDA shall have the right to withhold payment, stop work or apply other contractual remedies if contractors fail to comply with the EMP, site-specific EMP, clearance conditions, labour requirements or health and safety obligations.

838. Given the Category A classification and the presence of critical habitat, KRRDA shall engage a qualified and experienced external monitor, unaffiliated with the project, to verify the project's monitoring information in accordance with paragraph 61 of ADB SPS, 2009, and to review implementation of the EMP and the BAP. The external expert shall supervise the Project Implementation Support Consultant (PISC) and the contractor for implementation of EMP and BAP, whose performance is managed by KRRDA under its own contract. The external monitor shall submit a half-yearly monitoring report, including any required corrective actions, to the PMU, which shall act on the findings and forward the report to ADB together with the corresponding SEMR. The terms of reference, qualifications, reporting lines and budget for the external expert are set out in the EMP.

839. In accordance with ADB SPS, 2009, and good international industry practice, pollution prevention and control measures shall be consistent with applicable Indian standards and World Bank Group Environmental, Health and Safety Guidelines. Where national standards and the World Bank Group EHS Guideline values differ, the more stringent requirement shall apply. Where a less stringent level is proposed for any parameter, full and detailed justification shall be provided in the EMP, demonstrating that the proposed level is protective of human health and the environment, and shall be acceptable to ADB and disclosed with the EIA.

840. The EIA, EMP, BAP and associated safeguard documents shall be updated as necessary based on changes in project components or design, the results of the additional seasonal biodiversity surveys programmed under the BAP, finalisation of forest, CRZ, ASI and other permissions, changes in road scope, or identification of unanticipated impacts during implementation. Any material change in project design, impact significance or mitigation requirement shall be reviewed by ADB, documented, subjected to re-categorisation and a further round of consultation where warranted, and re-disclosed on the ADB website and locally in accordance with ADB and Government requirements. Any road added to the programme after Board approval shall be screened and assessed against the criteria applied in this EIA, and shall not be taken up if it would trigger impacts of a type or scale not assessed here.

841. Subject to effective implementation of the EMP, BAP, statutory clearance conditions, GRM, monitoring programme and institutional arrangements set out above, the project is expected to deliver significant rural connectivity and road safety benefits while managing environmental and biodiversity risks in accordance with ADB SPS, 2009, applicable Indian law and good international industry practice. On the basis of the completed CHA and the BAP, no significant adverse residual environmental impact is anticipated, the conditions in paragraph 28 of SR1 for projects affecting critical habitat are met, and the project is assessed as compliant with the environmental safeguard requirements of ADB SPS, 2009.

D. Recommendation

842. On the basis of the assessment presented in this EIA, it is recommended that the project proceed subject to the following conditions being met and reflected in the loan documentation: (i) the CHA and the BAP are finalised, costed, disclosed and reflected in the design and the cost estimate before Board consideration; (ii) the outstanding seasonal and taxon-specific biodiversity surveys are completed to the sampling design agreed with ADB and the BAP updated accordingly; (iii) the EMP, BAP and applicable clearance conditions are incorporated into the bidding documents and civil works contracts before issue of the first invitation for bids; (iv) no civil works commence on any road until the site-specific EMP is approved and every statutory clearance applicable to that road has been obtained; (v) the PMU and PISC safeguard positions, including the Ecologist, NGO and the external monitor are established, funded and filled before

award of the first civil works contract; and (vi) implementation is monitored and reported to ADB through semi-annual environmental monitoring reports, with the half-yearly monitoring report of the external monitor.