THE REPUBLIC OF INDIA
KARNATAKA PUBLIC WORKS,
PROTS & INLAND WATER TRANSPORT DEPARTMENT

DATA COLLECTION SURVEY ON NATURAL ENVIRONMENT OF THE WESTERN GHATS IN THE REPUBLIC OF INDIA

FINAL REPORT

DECEMBER 2016

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

CTI Engineering International Co., Ltd.

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Location Map of the Project Area

Atmosphere in the Project Area

The project traverses inside the Western Ghats Conservation.
Considerations on the ecosystem and environmental preservation are essential.

Dysoxylum malabaricum (Endangered)

Indirana gundia (Critically Endangered)

Barilius Canarensis (Endangered)

Existing road. Both sides are covered with trees.

Outline of the Survey

The Shiradi Ghats area, in which the two proposed development projects are in the planning stage, is adjacent to the Western Ghats Mountains designated as a UNESCO World Heritage Site. In this area, inhabitation of rare or endangered species has been reported. Therefore, it will be necessary to examine the feasibility of these projects from the aspect of environmental and social considerations.

The JICA survey team conducted several surveys aiming to collect necessary information on the ecosystem in Western Ghats along National Road No. 48 in the Shiradi Ghats.

The survey team conducted literature and interview surveys on the Western Ghats ecosystem in the Shiradi Ghats as well as on environmental regulations regarding the required procedures, which the project proponent has to conduct, and environmental stakeholders as well as conducted a field survey in the area.

The collected literature indicates the inhabitation of many rare and endangered species, such as Elephant, Tiger, Wild dog, Doles and Macaque as mammals, various frogs as amphibians and some tropical trees as plants. The literature also indicates the area along National Road No. 48 in the Shiradi Ghats may work as a corridor between the northern part of Western Ghats and the southern part of Western Ghats for various mammals.

Information related to environmental stakeholders in Western Ghats region has also been surveyed. No negative orientation was observed for the Shiradi Ghats bypass Project. Several organizations consider the Project positive because the bypass could improve the discontinuity of Western Ghats Ecosystems disturbed by existing National Road No. 48. On the other hand, not a small number of organizations showed a negative orientation toward the Yettinahole Project mistrusting the submitted data for calculating possible intake from the region.

Considering those circumstances, JICA headquarters decided to conduct a field survey for verifying the existence of the rare and endangered species in this area.

In advance of conducting the field survey, the JICA survey team designed a possible construction road alignment, which is considered to be the major source of negative impact on the local ecosystem. Twenty-one sampling sites had been selected considering the possible habitats for amphibians, fishes and birds where the proposed alignment of the construction road and the streams cross. The subcontract team consists of professors of IISC and NGOs researchers who conducted a field survey from May to October 2016. The team found many endemic, rare and endangered species at most of the sampling sites. For amphibians, of the 37 species, 33 species are endemic to the Western Ghats, which clearly indicates the exclusive species composition of the region. Among the plant species documented, approximately 77 percent of the species were found to be Western Ghats endemics and approximately 17% species are listed under the rare endangered and threatened (RET) category.

Although the proposed structures of Shiradi Ghats bypass are designed to minimize the negative effects of the project on the environment, the effects of the construction road and the construction itself shall be seriously considered further. In the same manner, the effects of the construction phase shall be seriously considered. In addition, the installation of a proper number of rainfall gauges to re-evaluate the amount of the precipitation in the region is expected.

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Note: Annex 3 to 6 are attached as electric files of the Final Report.

Abbreviations

Abbreviation	Original Meaning
ADB	Asian Development Bank
CR	Critically Endangered Species
DEM	Digital Elevation Model
DPR	Draft Detailed Project Report
EAC	Environmental Appraisal Committee
EC	Environmental Clearance
EIA	Environmental Impact Assessment
EN	Endangered Species
GOK	Government of Karnataka
NH	National Highway
IISC	Indian Institute of Science
IUCN	International Union for Conservation of Nature
JICA	Japan International Cooperation Agency
KNNL	Karnataka Neeravari Nigam Limited
KSNDMC	Karnataka State Natural Disaster Monitoring Center
METI	Ministry of Economy, Trade and Industry of Japan
NGO	Non-Governmental Organization
PWD	Public Works, Ports & Inland Water Transport Department
RAP	Resettlement Action Plan
RET	Rare Endangered and Threatened
RoB	Railway Overpass Bridge
TMC	Thousand Million Cubic Feet (unit for water amount)
TOR	Term of Reference
UNESCO	United Nations Educational, Scientific and Cultural Organization
VU	Vulnerable Species
WRD	Water Resource Department of GOK

Chapter 1 Survey Description

1.1 Background of the Survey

The Public Works Department of the State Government of Karnataka (hereinafter referred to as "the PWD") is planning infrastructure projects including 1) the Road Improvement/Construction Project for Shiradi Ghats Stretch to mitigate serious traffic congestion and 2) the Yettinahole Water Supply Project to mitigate the chronic water shortage. The PWD also has a concern about utilizing Japan's ODA loan scheme for the project implementation.

In existing national highway 48, serious traffic congestion are expected as the economy of Karnataka state grows. It is very hard for widening or finding new alignment of the road in this area due to its geological feature and therefore bypass road is requested.

Drought prone districts in the eastern part of Karnataka such as Kolar and Chikkaballapur are frequently affected due to erratic rainfall and absence of any perennial source of water for drinking purposes for the populace as well as livestock in the region. Government of Karnataka has considered that west flowing rivers are the only source available and Yettinahole project is the only viable and sustainable solution with minimum environmental impact.

On the other hand, the Shiradi Ghats area in which the project is in the planning stage, is adjacent to the Western Ghats Mountains designated as a UNESCO World Heritage Site[1] and inhabitation of rare or endangered species has been reported. Therefore, it will be necessary to examine the feasibility of these projects from the perspective of environmental and social considerations. The survey aims to collect necessary information on the ecosystem in Western Ghats along National Road No. 48 in the Shiradi Ghats.

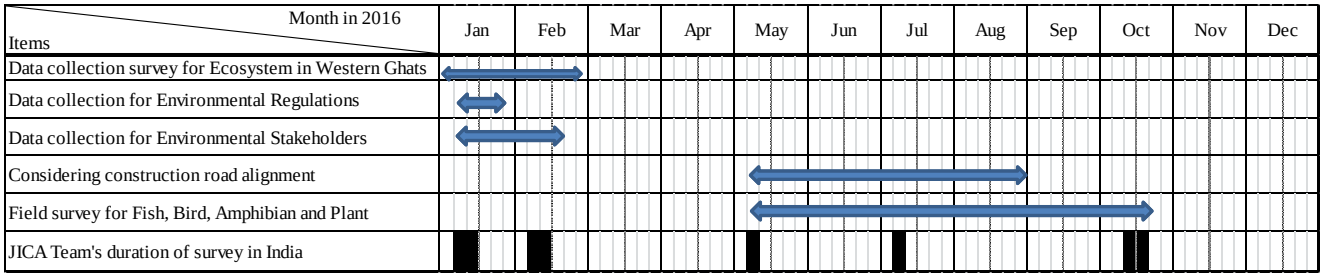
1.2 Survey Items

To consider the environmental and social influence of the proposed projects descried in bellows, the survey team conducted literature and interview surveys on Western Ghats ecosystem in Shiradi Ghats area, related environmental regulations regarding the necessary procedures which project proponent has to conduct, environmental stakeholders as well as conducted field survey in the area.

1.3 Survey Schedule

This survey with above items was conducted as following schedule.

Table 1.3.1 Survey Schedule



[1] The Karnataka State government has not approved the proposed sites of UNESCO World Heritage in Karnataka.

1.4 Target Projects for this Survey

1.4.1 Target Projects

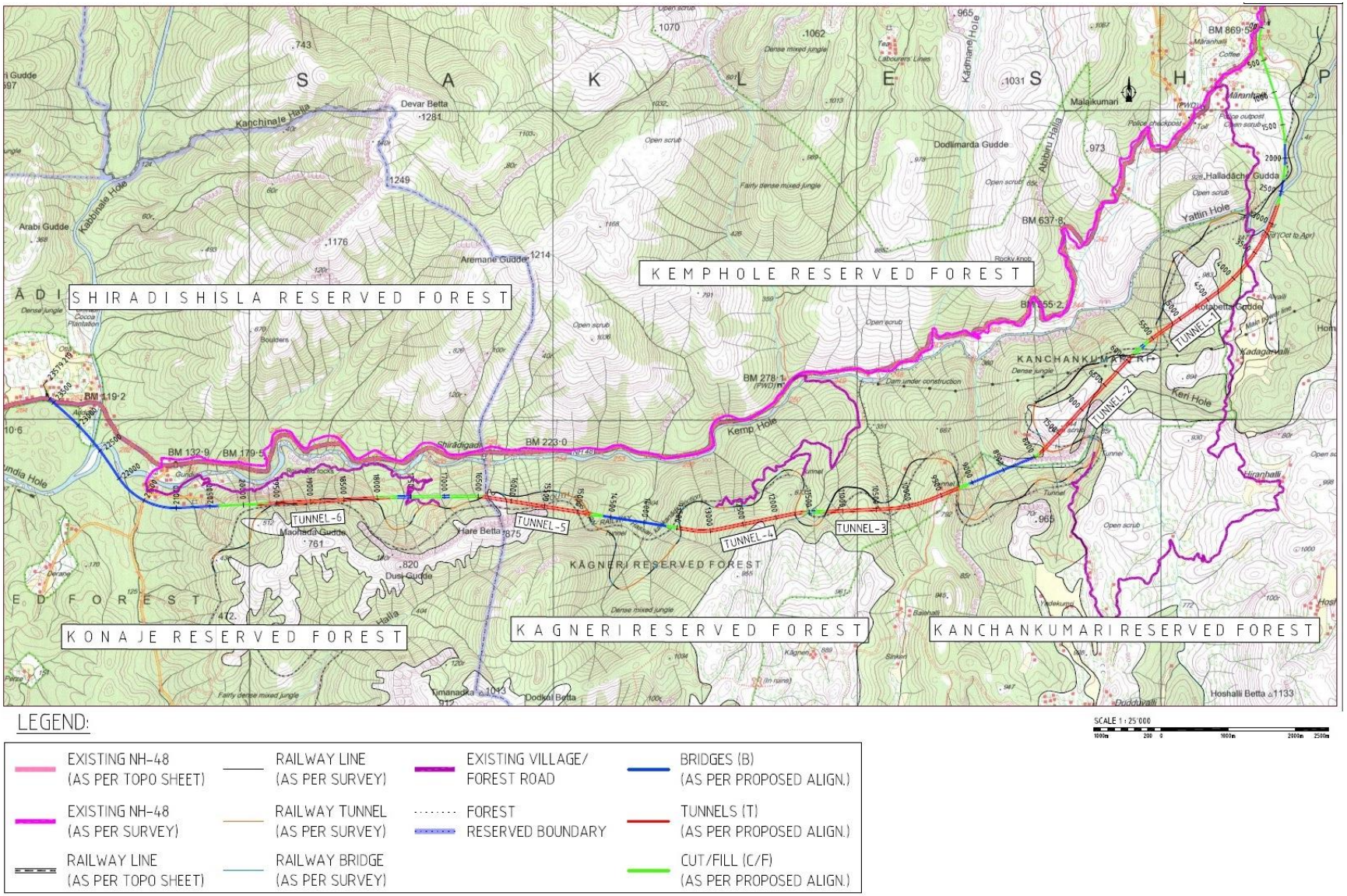
1) Shiradi Ghats bypass Project

Planned alignment is on the Southern side of existing NH-48 as describe as following figure. The alignment starts near Heggade Village (km 236.400) traverses through Greenfields, bypassing Heggade, Maranhally Kadagaravalli, Yedakumari and Gundya, villages and ends at Adda Hole (km 263.400) of NH-48. The total length of alignment under this option is 23.579 km, and the route consists of 6 (six) tunnels (length 12.631km varying from 1660 to 2960 m), 6 (six) bridges, 1 (one) railway overpass bridge and 1 (one) viaduct (length 6.327km, varying from 50 to 3217m), and 4.621km long cut & fill sections.

The route has low gradient (roads & bridges: 0 to 3.5%, tunnels: 3.0 to 3.5%) and gentle curves (R=500m to 2000m). The height of bridge piers in the deep valleys is restricted to 120m that makes the early implementation of the project possible. Also, tunnel lengths are limited to 3.0km that makes the scale of ventilation/emergency facilities ordinary in size. Only 4.621km out of total length of 23.579km is planned as "cut and fill" that requires deforestation of the construction area.

The detailed information is given as Annex attached as DPR[2]: Draft Detailed Project Report electric file in this report. This is given by PWD in January, 2016.

[2] The final version is planned to be released in December 2016 according to PWD.



LEGEND:

EXISTING NH-48 (AS PER TOPO SHEET)	RAILWAY LINE (AS PER SURVEY)	EXISTING VILLAGE/ FOREST ROAD	BRIDGES (B) (AS PER PROPOSED ALIGN.)
EXISTING NH-48 (AS PER SURVEY)	RAILWAY TUNNEL (AS PER SURVEY)	FOREST RESERVED BOUNDARY	TUNNELS (T) (AS PER PROPOSED ALIGN.)
RAILWAY LINE (AS PER TOPO SHEET)	RAILWAY BRIDGE (AS PER SURVEY)		CUT/FILL (C/F) (AS PER PROPOSED ALIGN.)

Source: PWD

Figure 1.4.1 Planned Bypass Road Alignment

2) Yettinahole Project

The Yettinahole Project is construct the following structures to divert about 24.01 TMC of water from west side of the Western Ghats mountain to the east side only during the monsoon period.

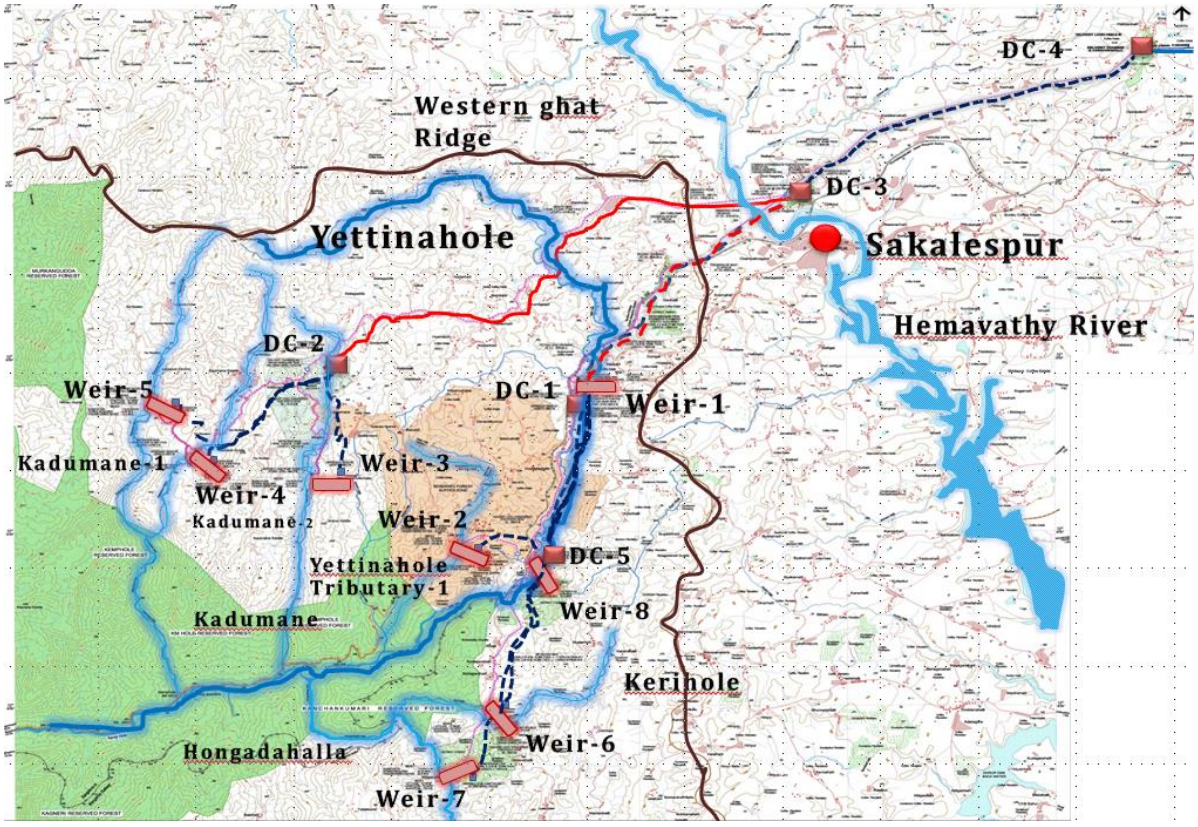
The Project consists of following components;

(A) Lift Components

a) Eight (8) diversion weirs across Yettinahole, Kadumanehole, Kerihole and Hongadahalla streams at identified locations, b) Jack well cum pump houses, c) Pumping machinery, d) Raising mains, e) Gravity main and f) Delivery chambers.

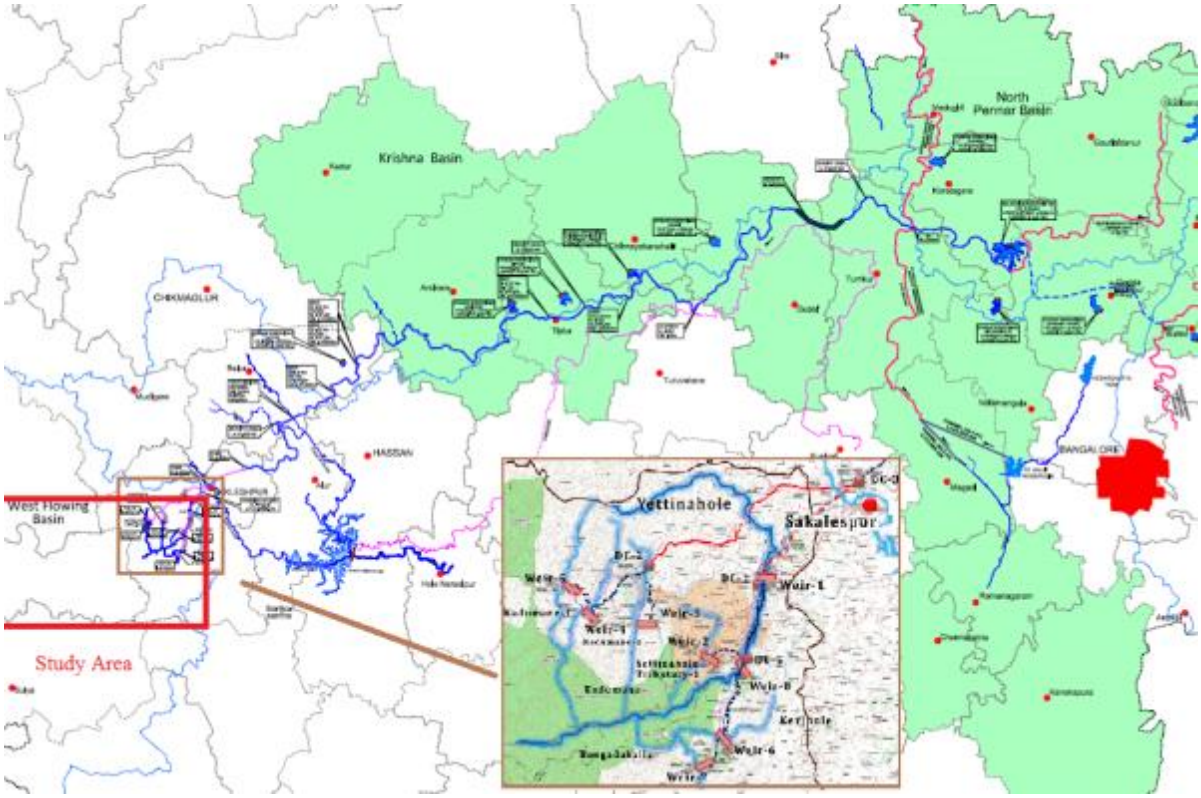
(B) Conveyance Systems

a) Construction of Gravity canal for a length of 273+865 km including an aqueduct of 12.5 km to reach the proposed balancing reservoir at Bhairagondlu, b) Construction of storage reservoirs, c) Balancing reservoir at Bhairagondlu in Koratagere Taluk, d) Raising main from balancing reservoir at Bhairagondlu of length 45 km to convey the water for Kolar, Chickaballapura and Bangalore rural districts, e) Feeder canals to supply required quantum of water to the beneficiary areas through dedicated feeder canals / conveyance system.



Source: KNNL Presentation in 2016

Figure 1.4.2 Yettinahole Project Lift Components



Source: KNNL Presentation in 2016

Figure 1.4.3 Yettinahole Project Lift and Conveyance Components

The yield statement provided KNNL is given in Table 1.4.1. The yield is calculated based upon the simulated precipitation amount "6,000 mm in a year[3]" in the basin while the figure is not directly measured.

Table 1.4.1 Yield Statement

Weir No.	Name of the stream	Yield (June to ¥November)				Divertible Yield (June to November)			
		Avg	90%	75%	50%	Avg	90%	75%	50%
1	Yettinahole	9.46	6.08	6.75	7.99	12.31	10.15	10.89	11.91
2	Yettinahole Tributary - 1	1.4	0.9	1	1.18				
3	Yettinahole Tributary– 2	1.9	1.22	1.36	1.6				
4	Kadumane hole-1	1.45	0.93	1.04	1.23				
5	Kadumane hole – 2	2.67	1.72	1.91	2.26				
6	Kerihole	4.7	3.02	3.35	3.97	4.63	3.9	4.16	4.42
7	Yettinahole down stream	2.25	1.45	1.61	1.9				
8	Hongada halla	10.43	6.7	7.44	8.81	7.81	6.37	6.88	7.68
Total		34.26	22.02	24.46	28.94	24.75	20.42	21.93	24.01

Source: KNNL Presentation in 2016

The detailed information is given as Annex attached as DPR: Draft Detailed Project Report electric file in this report. This is given by KNNL: Karnataka Neeravari Nigam Limited in January, 2016.

[3] The simulation was conducted based on the precipitation data acquired by farming site near the basin with circumstantial information such as flow and top soil thickness. The rainfall gauge is more than 30 year old without calibration.

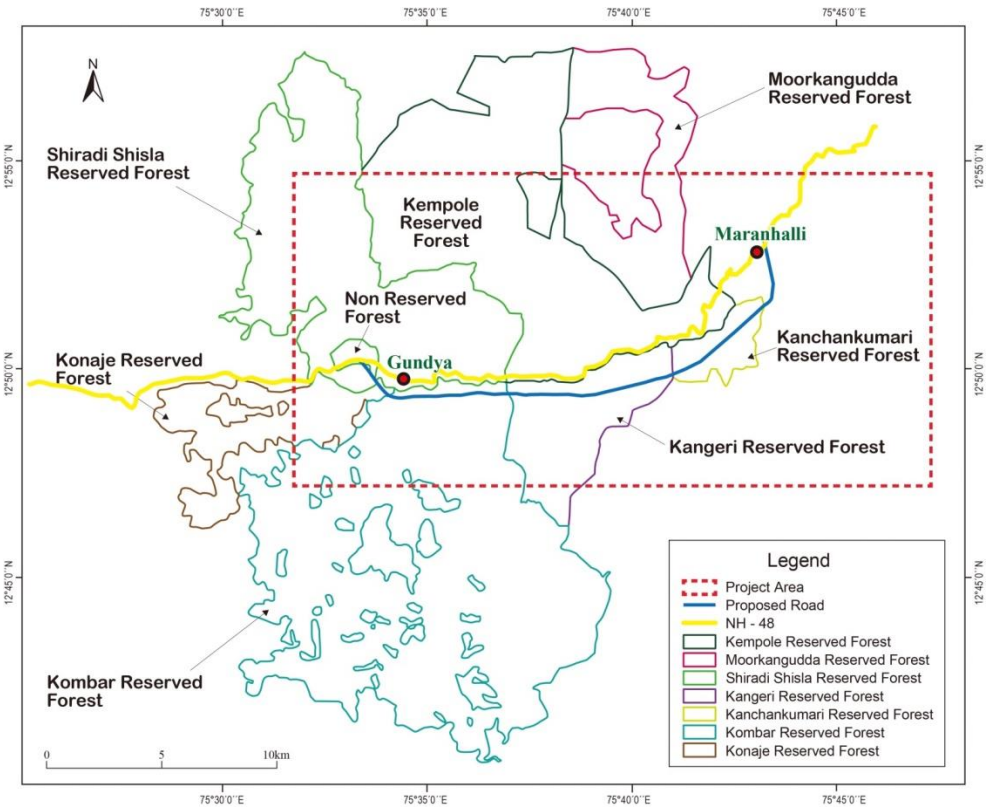
1.4.2 Target Area of this Survey

This survey is targeting the project sites of Shiradi Ghats Bypass project as well as lift component of Yettinahole Project where bypass road alignment and intake structures of Yettinahole Project are planned to be implemented. Literature & interview survey were conducted covering above mentioned area and ecological field survey was conducted along with the proposed construction road aliment of Shiradi Ghats Bypass Project.

The project area is located in the Western Ghats. It is mostly covered by forest and has rich biodiversity. The most area of those two projects is designated as Reserved Forest by Karnataka State. There is a National Park designated by the Indian Government in the northern area of the project and a Wildlife Sanctuary in the south. These areas are also designated as the UNESCO world heritage sites. (Note: The Karnataka state government has not approved the proposed sites of UNESCO World Heritage Centre in Karnataka.)

1) Reserved Forest

The Figure 1.4.4 shows the three alignments proposed by this project and the map of the Reserved Forests (See appendix 601 for vegetation of the Reserved Forests). All routes need to pass through the Reserved Forests in most areas.



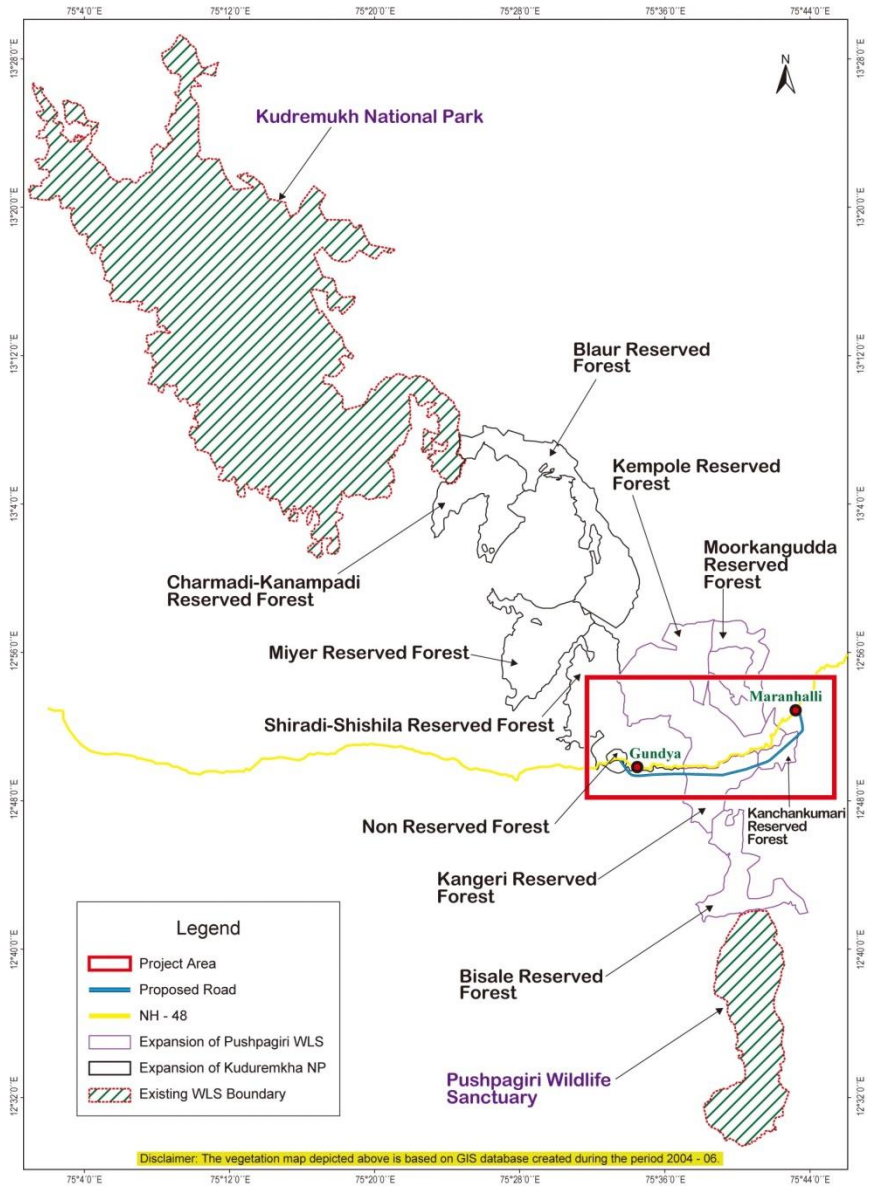
Source: Forest Department of Karnataka State

Figure 1.4.4 Target Area and Reserved Forests

2) Protected Areas

Based on the Wildlife (Protection) Act 1972, the Indian Government designates National Parks and Wildlife Sanctuary as areas to promote environmental protection at national level. This project does not include these protected areas. However, as it is shown in Figure 1.4.5, there is Kudremukh National Park approximately 30km

away in the northwest and Pushpagiri Wildlife Sanctuary approximately 14km away in the south.



Source: Produced by the METI Study[4] Team based on the official information from UNESCO World Heritage Center

Figure 1.4.5 Target Area and Protected Areas

3) UNESCO World Heritage Sites

UNESCO has registered the "Western Ghats" as the world heritage in 2012. The Western Ghats itself is a quite huge area of 160,000 km^2 along the western coast of India. Out of the area, 39 sites are registered as the world heritage, which are important from the perspective of biodiversity. The 39 sites are comprised of 6 sub-clusters shown in Figure 1.4.6 and the Kudremukh National Park and the Pushpagiri Wildlife Sanctuary are included in the world heritage sites. However, the Karnataka state government has not approved the proposed sites of UNESCO World Heritage Centre in Karnataka. Thus, UNESCO World Heritage Centre expresses the sites as "Proposed Sites" in its website.

[4] METI Study: Study on Road Improvement Project for Shiradi Ghats Stretch in India, METI 2015

Source: Produced by the METI Study Team based on the official information from UNESCO World Heritage Center
Note: the Karnataka state government has not approved the proposed sites

Figure 1.4.6 Target Area and "Proposed" UNESCO World Heritage Sites

Chapter 2 Literatures of Western Ghats Ecosystem

Literature, documentation and thesis of ecosystem related to the above target area have been conducted for considering the existence of rare and endangered species. As results of the survey, the literature indicates the existence of rare and endangered species and thus, JICA decided to conduct a field survey at the Project site.

2.1 Protected Species

2.1.1 Government of Karnataka

Wildlife Protection Act (1972) amended in 1991 stipulates the selection of the species that will be protected as "Scheduled Species." The following table shows the scheduled species of the Government of Karnataka.
The Categories of International Union for Conservation of Nature Red List (IUCN Red List) are follows;
Critically Endangered (CR) :"Extremely high risk of extinction in the wild.", Endangered (EN) :"High risk of extinction in the wild.", Vulnerable (VU) :" High risk of endangerment in the wild." and DD: "Data deficient.

Table 2.1.1 Scheduled Species of the Government of Karnataka

Animals				
	Scientific name	Common name	IUCN Status	Distribution
1	Latidens salimalli	Salim Ali's fruit bat		Endemic
2	Otomops wroughtoni	Wroughton's Free-tailed Bat, Wroughton's Giant Mastiff Bat	DD	
3	Viverra civettina	Malabar large-spotted civet	CR	Endemic
4	Balaenoptera musculus	Blue Whale	EN	
5	Dugong dugong	Dugong		
6	Panthera tigris tigris	Bengal Tigar		
7	Gyps bengalensis	white-rumped vulture	CR	
8	Gyps indicus	Indian vulture	CR	
9	Dermochelys coriacea	Leatherback sea turtle	VU	
10	Eretmochelys imbricata	Hawksbill turtle	CR	
11	Fejervarya murthii	Ghats wart frog, Murthy's frog	CR	Endemic
12	Indirana gundia	Gundia Indian Frog	CR	Endemic
13	Indirana phrynoderma	Toad Skinned Frog	CR	
14	Micrixalus kottigeharensis	Kottigehar Bush Frog	CR	Endemic
15	Viverra civettina	Malabar large spotted civet	CR	Endemic
16	Macaca silenus	Lion tailed macaque	EN	Endemic
Plants				
	Scientific name	Common name	IUCN Status	Distribution
1	Barleria grandiflora	Grand Barleria		
2	Beaumontia jerdoniana	Nepal Trumpet Flower		
3	Ceropegia decaisneana			Endemic
4	Cinnamomum geaense			
5	Holigarna beddomei			Endemic
6	Impatiens mysorensis			
7	Impatiens raziana			Endemic
8	Justitia nilgerrensis			
9	Madhuca insignis		EX	Endemic
10	Phyllanthus talbotii			
11	Salacia malabarica			Endemic
12	Toxocarpus concanesis			
13	Toxocarpus palghatensis			Endemic
14	Vanda thwaitesii			Endemic
15	Vanda wightii			Endemic
16	Hopea canarensis		DD	Endemic

Source: Karnataka State Government

2.1.2 IUCN list in Karnataka

Species defined by IUCN Red List in the location of "Karnatak" are described in the following Table 2.1.2 to 2.1.5. However, it has to be noted that the IB (EN) species such as Tiger (Panthera tigris), Elephant, Gaur, Lion-tailed macaque, Common otter, Nilgiri Marten,Travancore Flying Squirrel, Ceylon Frog Mouth and IA (CR) species such as Gundia Indian Frog (Indirana gundia), Kottigehara Bush Frog are not listed the species tagged as "Location Karnataka".

Table 2.1.2 IA: Critically Endangered Animal Species

1	Barbodes wynaadensis (Wayanad Mahseer)
2	Glyptothorax kudremukhensis (Kudremukh Glyptothorax)
3	Hemibagrus punctatus (Nilgiri Mystus)
4	Hypselobarbus pulchellus
5	Hypselobarbus thomassi (Red Canarese Barb)
6	Nyctibatrachus dattatreyaensis (Dattatreya Night Frog)
7	Psilorhynchus tenura (none)

Source: INCN http://www.iucnredlist.org/

Table 2.1.3 IB: Endangered Animal Species

1	Barilius canarensis (Jerdon's Baril)
2	Batasio sharavatiensis (Sharavati Batasio)
3	Botia striata (Zebra Loach)
4	Cnemaspis goaensis (Goan Day Gecko)
5	Cremnoconchus syhadrensis
6	Dawkinsia arulius (Aruli Barb)
7	Etroplus canarensis (Canara Pearlspot)
8	Glyptothorax madraspatanus
9	Hypselobarbus curmuca
10	Hypselobarbus dubius (Nilgiri Barb)
11	Hypselobarbus mussullah (Hump Backed Mahseer)
12	Idionyx galeata
13	Labeo potail (Deccan Labeo)
14	Lamiopsis temminckii (Broadfin Shark)
15	Longischistura striatus
16	Macaca silenus (Lion-tailed Macaque)
17	Nemacheilus petrubanarescui
18	Nemachilichthys shimogensis (Shimoga Loach)
19	Philautus neelanethrus
20	Pseudomulleria dalyi
21	Pterocryptis wynaadensis (Malabar Silurus)
22	Puntius cauveriensis (Cauvery Barb)
23	Puntius crescentus
24	Sahyadria denisonii (Red Line Torpedo Barb)
25	Schismatorhynchos nukta (Nukta)
26	Schistura nagodiensis (Nagodi Loach)
27	Sphyrna mokarran (Great Hammerhead)
28	Thynnichthys sandkhol (Sandkhol Carp)
29	Tor khudree (Black Mahseer)
30	Tor malabaricus (Malabar Mahseer)

Source: INCN http://www.iucnredlist.org/

Table 2.1.4 IA: Critically Endangered Plant Species

1	Croton lawianus
2	Dipterocarpus bourdilloni
3	Hopea erosa
4	Hopea jacobi
5	Isachne meeboldii
6	Isachne veldkampii
7	Pinnatella limbata
8	Vateria indica
9	Vatica chinensis

Source: INCN http://www.iucnredlist.org/

Table 2.1.5 IB: Endangered Plant Species

1	Aporusa bourdillonii
2	Cinnamomum wightii
3	Cycas circinalis
4	Cynometra bourdillonii
5	Cynometra travancorica
6	Dalbergia congesta
7	Decalepis hamiltonii
8	Dimeria hohenackeri
9	Dipterocarpus indicus
10	Dysoxylum malabaricum (White Cedar)
11	Eriocaulon anshiense
12	Eriocaulon dalzellii
13	Eriocaulon richardianum
14	Glochidion pauciflorum
15	Glochidion tomentosum
16	Hopea glabra
17	Hopea parviflora
18	Hopea ponga
19	Hopea racophloea
20	Isoetes panchganiensis
21	Ixora lawsoni
22	Kingiodendron pinnatum
23	Lamprachaenium microcephalum
24	Limnopoa meeboldii
25	Maesa velutina
26	Myristica magnifica
27	Rapanea striata
28	Rotala ritchiei
29	Shorea roxburghii (White Meranti)
30	Syzygium stocksii
31	Tarenna agumbensis
32	Utricularia cecilii
33	Xylosma latifolium

Source: INCN http://www.iucnredlist.org/

2.2 Literatures sited Rare and Endangered Species

2.2.1 Species List in the Study "Biodiversity of the proposed Gundia Hydro Electric Project, Karnataka"

The Rare Species listed in the report of "Biodiversity of the proposed Gundia Hydro Electric Project, Karnataka" are described in the following Table 2.2.1 and Table 2.2.2.

Source: Biodiversity of the proposed Gundia Hydro Electric Project, Karnataka 2010, IISc

Figure 2.2.1 Study Area

Table 2.2.1 Mammal Species Found in Gundia Region

S.No	Species	Scientific name	IUCN Status
1	Barking Deer	*Muntiacus muntjak*	Least concerned
2	Black napped hare	*Lepus nigricollis*	Least concerned
3	Civet	*Paradoxurus jerdoni*	Least concerned
4	Jungle cat	*Felis chaus*	Least concerned
5	Porcupine	*Hystrix indica*	Least concerned
6	Mongoose	*Herpestes edwardsii*	Least concerned
7	Otter	*Lutra lutra*	Near threatened
8	Gaur	*Bos gaurus*	Vulnerable
9	Elephant	*Elephas maximus*	Endangered
10	Wild dog	*Cuon alpinus*	Endangered

Source: Biodiversity of the proposed Gundia Hydro Electric Project, Karnataka 2010, IISc

Table 2.2.2 Amphibian Species Found in Gundia Region

Species	Sites			IUCN status
	Kerihole & Yettinahole	Bettakumari	Hongadahalla	
Family: ICHTHYOPHIDAE				
Ichthyophis sp.*	-	-	+	
Family: BUFONIDAE				
*"Bufo" parietalis**	-	-	+	NT
Duttaphrynus melanostictus	+	+	+	LC
Family: NYCTIBATRACHIDAE				
*Nyctibatrachus sanctipalustris**	+	+	+	EN
Nyctibatrachus aff. *major**	-	+	+	
Nyctibatrachus sp. *	-	-	+	
Family: MICRIXALIDAE				
*Micrixalus saxicola**	+	+	+	VU
Family: RANIXALIDAE				
*Indirana beddomii**	+	+	-	LC
*Indirana gundia **	+	+	+	CR
Family: MICROHYLIDAE				
Microhyla ornata	-	-	+	LC
*Ramanella mormorata**	+	-	-	EN
Ramanella aff. *triangularis**	-	-	+	
Family: DICROGLOSSIDAE				
Euphlyctis cyanophlyctis	+	+	+	LC
*Fejervarya sp. (striped)**	+	+	+	
*Fejervarya sp. (non-striped)**	+	+	+	
Family: RANIDAE				
Hylarana aff. *montanus**	+	+	+	
*Clinotarsus curtipes**	-	-	+	NT
Family: RHACOPHORIDAE				
*Philautus amboli**	+	+	+	CR
*Philautus lueteolus**	+	+	+	DD
*Polypedates pseudocruciger**	+	-	-	LC
*Rhacophorus malabaricus**	-	+	-	LC
TOTAL SPECIES	14	13	17	

Source: Biodiversity of the proposed Gundia Hydro Electric Project, Karnataka 2010, IISc
Note: NT=Near threatened, LC=Least concern, EN= Endangered, Vu=Vulnerable, DD=Data deficient, CR=Critically endangered.

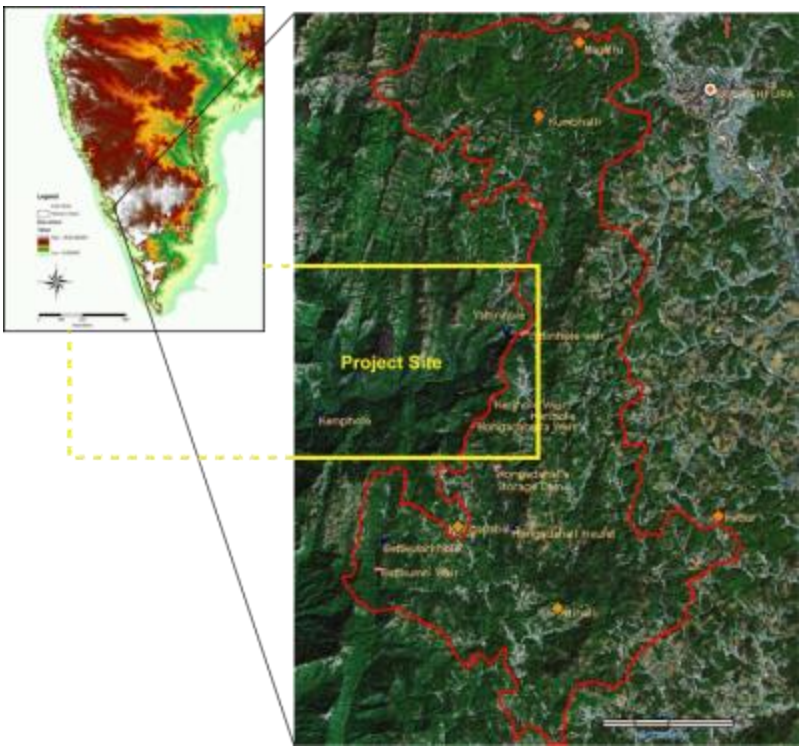
Table 2.2.3 Endemic Plant Species Found in Gundia Region

	Species	Family	Distribution
1	*Actinodaphnae malabarica*	Lauraceae	PI, Srilanka
2	*Alseodaphne semecarpifolia*	Lauraceae	PI, Srilanka
3	*Artocarpus hirsutus*	Moraceae	PI, Srilanka
4	*Calophyllum apetalum*	Clusiaceae	PI, Srilanka
5	*Cleistanthus malabaricus*	Euphorbiaceae	PI, srilanka
6	*Eunonymus angulatus*	Celastraceae	PI, Srilanka
7	*Gordonia obtusa*	Theaceae	WG alone
8	*Holigarna arnottiana*	Anacordiaceae	WG alone
9	*Kingiodendron pinnatum*	Fabaceae	WG alone
10	*Knema attenuata*	Myristicaceae	WG alone
11	*Mangifera indica*	Anacordiaceae	WG alone
12	*Myristica malabarica*	Myristicaceae	WG alone
13	*Palaquium ellipticum*	Sapotaceae	WG alone
14	*Phlebophyllum canaricum*	Acanthaceae	WG alone
15	*Scolopia crenata*	Flacourtiaceae	WG alone
16	*Vateria indica*	Dipterocarpaceae	WG alone
17	*Atlantia wightii*	Rutaceae	WG (Kerala and Karnataka)
18	*Pinanga dicksonii*	Palmae	WG, (Karnataka)

Source: Biodiversity of the proposed Gundia Hydro Electric Project, Karnataka 2010, IISc
Note: PI= Peninsular India, WG= Western Ghats (Ranging from state Maharastra, Goa, Karnataka, Tamilnadu and Kerala).

2.2.2 Species List in the Study "BIODIVERSITY AND ECOLOGICAL SIGNIFICANCE OF GUNDIA RIVER CATCHMENT"

The Rare Species listed in the report of "Biodiversity of the proposed Gundia Hydro Electric Project, Karnataka" are described in the following Table 2.2.3 and Table 2.2.4.



Source: BIODIVERSITY AND ECOLOGICAL SIGNIFICANCE OF GUNDIA RIVER CATCHMENT

Figure 2.2.2 Study Area

Table 2.2.4 Fish Species Found in the Study Area

Species name	Distribution	IUCN Status
Anguilla bengalensis (Gray)	India	VU
Aplocheilus blocki (Arnold)	India	DD
Aplocheilus lineatus (Val.)	India	LR
Barilius bakeri (Day)	Endemic	VU
Barilius canarensis (Jerdon)	Endemic	DD
Barilius gatensis (Val.)	Endemic	DD
Brachydanio rerio (Ham.)	India	LR
Channa orientalis (Bl. & Schn.)	India	VU
Channa striatus	India	LR
Cirrhinus reba (Ham.)	India	VU
Clarias dussumieri (Val.)	Endemic	VU
Cyprinus carpio communis (Linne.)	India	Intro
Danio aequipinnatus	India	LR
Danio malabaricus (Jerdon)	India	LR
Esomus thermoicos (Val.)	India	LR
Etroplus canarensis	Endemic	CR
Etroplus maculatus (Bloch)	India	LR
Garra gotyla stenorhynchus	Endemic	EN
Garra mullya (Sykes)	India	LR
Glossogobius giuris	India	LR

Fish Species Found in the Study Area (Continued)

Species name	Distribution	IUCN Status
Horabagrus brachysoma (Gunther)	Endemic	CR
Hyporhamphus limbatus (Val.)	India	DD
Hypselobarbus kurali Menon and Rema Devi	Endemic	EN
Labeo kontius (Jerdon)	Endemic	EN
Lepidocephalus thermalis (Val.)	India	LR
Mastacembelus armatus Lacepede	India	LR
Mesonemacheilus petrubanarescui	Endemic	DD
Mystus cavasius (Ham.)	India	LR
Mystus malabaricus (Jerdon)	Endemic	EN
Oreochromis mossambica (Peters)	India	Intro
Osteochilichthys nashii Day	Endemic	VU
Poecilia reticulata (Peters)	India	Intro
Pristolepis marginata (Jerdon)	Endemic	VU
Pseudosphromenus cupanius (Val.)	India	DD
Puntius amphibius (Val.)	India	LR
Puntius arulius arulius (Jerdon)	Endemic	EN
Puntius bimaculatus (Bleeker)	India	DD
Puntius conchonius (Ham.)	India	VU
Puntius filamentosus (Val.)	India	DD
Puntius melanampyx (Day)	Endemic	LR
Puntius melanostigma (Day)	Endemic	EN
Puntius sarana subnasutus (Val.)	Endemic	LR
Puntius setnai Chhapgar and Sane	Endemic	DD
Puntius sophore	India	LR
Puntius ticto (Ham.)	India	LR
Puntius vittatus Day	India	VU
Rasbora daniconius (Ham.)	India	LR
Salmostoma acinaces (Val.)	India	LR
Salmostoma boopis (Day)	Endemic	LR
Schistura denisonii denisonii	India	VU
Schistura kodaguensis Menon	Endemic	DD
Schistura nilgiriensis Menon	Endemic	EN
Schistura semiarmatus Day	Endemic	VU
Tetraodon (M.) *tavancoricus* Hora & Nair	Endemic	EN
Tor khudree (Sykes)	India	VU
Xenentodon cancila (Ham.)	India	LR

Source: BIODIVERSITY AND ECOLOGICAL SIGNIFICANCE OF GUNDIA RIVER CATCHMENT

Table 2.2.5 Plant Species Found in the Study Area

Species	Family	Habit	Distribution	Ecological status
Aglaia anamalayana	Meliaceae	Tree	S W India	Rare
Ancistrocladus heyneanus	Ancistrocladaceae	Climber	S W India	Common
Antidesma menasu	Euphorbiaceae	Tree	S W India	Common
Apama siliquosa	Aristolochiaceae	Shrub	S W India, Sri Lanka	Common
Ardisia solanacea	Myrsinaceae	Shrub	India	Common
Arenga wightii	Arecaceae	Palm	S W India	Rare
Artocarpus hirsutus	Moraceae	Tree	S W India	Common
Artocarpus integrifolia	Moraceae	Tree	S W India	Common
Bauhinia phoenicea	Fabaceae	Climber	S W India	Common
Bridelia crenulata	Euphorbiaceae	Tree	India	Common
Callicarpa tomentosa	Verbenaceae	Shrub	S India	Common
Callophyllum apetalum	Clusiaceae	Tree	S W India	Common
Canarium strictum	Burseraceae	Tree	S W India	Rare
Canscora deccurens	Gentianaceae	Herb	S W India	Rare
Canthium dicoccum	Rubiaceae	Tree	S W India	Common
Dalbergia sympethetica	Fabaceae	Climber	S W India	Rare
Dendrobium aqueum	Orchidaceae	Herb	S W India	Rare
Diospyros assymilis	Ebenaceae	Tree	S W India	Common

Plant Species Found in the Study Area (Continued)

Species	Family	Habit	Distribution	Ecological status
Diospyros nigrescens	Ebenaceae	Tree	S W India	Common
Dipterocarpus indicus	Dipterocarpaceae	Tree	S W India	Rare
Elaeocarpus serratus	Elaeocarpaceae	Tree	India	Common
Ervatamia heyneana	Apocynaceae	Tree	S W India	Common
Euonymus indicus	Celastraceae	Tree	S W India	Rare
Ficus arnottiana	Moraceae	Tree	S W India, Sri Lanka	Common
Flacourtia montana	Flacourtiaceae	Tree	S W India	Rare
Flickingeria nodosa	Orchidaceae	Herb	India	common
Garcinia cambogia	Clusiaceae	Tree	S W India, Sri Lanka	Common
Garcinia talbotii	Clusiaceae	Tree	S W India	Rare
Gnetum ula	Gnetaceae	Climber	S India	Rare
Gordonia obtuse	Theaceae	Tree	S W India	Rare
Holigarna arnottiana	Anacardiaceae	Tree	S W India	Common
Holigarna ferruginia	Anacardiaceae	Tree	S W India	Rare
Holigarna grahmii	Anacardiaceae	Tree	S W India	Rare
Hopea ponga	Dipterocarpaceae	Tree	S W India	Common
Hydnocarpus laurifolia	Flacourtiaceae	Tree	S W India	Rare
Ixora arborea	Rubiaceae	Tree	S W India	Rare
Knema attenuate	Myristicaceae	Tree	S W India	Common
Lagerstroemia microcarpa	Lythraceae	Tree	S W India	Common
Ligustrum gamblei	Oleaceae	Shrub	S W India	Rare
Linociera malabarica	Oleaceae	Tree	S W India	Rare
Macaranga peltata	Euphorbiaceae	Tree	S W India, Sri Lanka	Common
Madhuca nerifolia	Sapotaceae	Tree	S W India, Sri Lanka	Rare
Mangifera indica	Anacardiaceae	Tree	S W India	Common
Memycylon malabaricum	Melastomataceae	Tree	S W India	Common
Memycelon terminale	Melastomataceae	Shrub	S W India	Rare
Myristica dactyloides	Myristicaceae	Tree	S W India	Common
Neonauclea purpurea	Rubiaceae	Tree	S W India	Rare
Nothopegia colebrookeana	Anacardiaceae	Tree	S W India	Rare
Ochlandra scriptoria	Poaceae	Shrub	S W India	Common
Olea dioca	Oleaceae	Tree	S India	Common
Persea macrantha	Lauraceae	Tree	S W India, Sri Lanka	Rare
Phoenix humilis	Arecaceae	Shrub	S W India	Common
Piper nigrum	Piperaceae	Herb	S India	Common
Pithecolobium monadelphum	Fabaceae	Tree	India	Common
Polyalthia fragrans	Annonaceae	Tree	S W India	Rare
Rhaphidophora laciniata	Araceae	Climber	S W India, Sri Lanka	Common
Rubus fockei	Rosaceae	Climber	S W India	Common
Sterculia guttata	Sterculiaceae	Tree	S W India, Sri Lanka	Common
Symplocos racemosa	Symplocaceae	Tree	S W India	Common
Syzygium gardneri	Myrtaceae	Tree	S W India, Sri Lanka	Common
Syzygium laetum	Myrtaceae	Tree	S W India	Common
Terminalia paniculata	Combretaceae	Tree	India	Common
Trias stocksii	Orchidaceae	Herb	S W India	Rare
Vateria indica	Dipterocarpaceae	Tree	S W India	Common
Vepris bilocularis	Rutaceae	Tree	S W India	Rare
Vitex altissima	Verbenaceae	Tree	S India	Common
Zeuxine longilabris	Orchidaceae	Herb	S W India, Sri Lanka	Rare

Source: BIODIVERSITY AND ECOLOGICAL SIGNIFICANCE OF GUNDIA RIVER CATCHMENT

2.2.3 Lion-tailed Macaque sited in "Decline of the Endangered lion-tailed macaque Macaca silenus in the Western Ghats[5]. India (Oryx, 43(02), 292-298)"

The number of lion-tailed macaques inhabiting the Western Ghats area is 3,500 to 4,000 while the number is decreasing due to the decrease of its habitats as well as fragmentation of the habitats. In the study, 9 groups are recognized.

Lion Tailed Macaque and its Habitat in Gundia River Basin

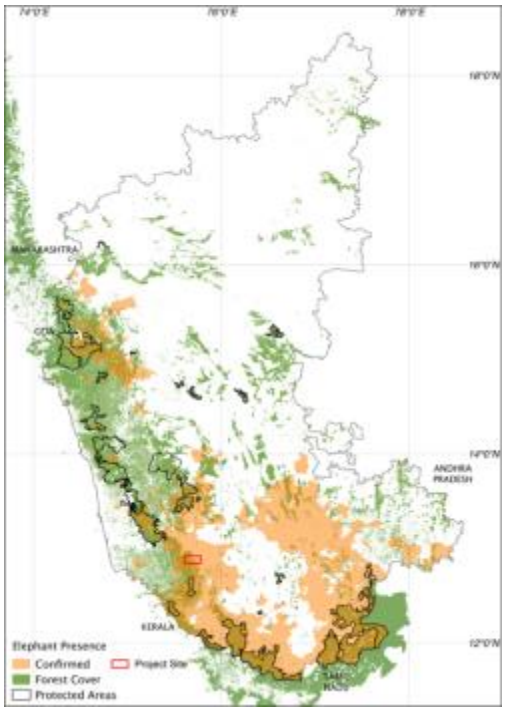
Source：Gundia River basin – Eco sensitive region and the Hottest Hotspot of Biodiversityhttp://www.ces.iisc.ernet.in/biodiversity/pubs/ces_tr/TR122/section2.htm

Figure 2.2.3 Lion-tailed Macaque Distribution in Gundia River Basin

2.2.4 Asian elephants cited in "Distribution, relative abundance, and conservation status of Asian elephants in Karnataka, southern India[6]. Biological Conservation, 187, 34-40."

Karnataka is regarded as one of the foremost and biggest habitats of the Asian elephant in India. Among the 2,855 forests in Karnataka, the elephant has been found in 972 forests. According to Dr. Raman Sukumar, professor of IISC, the elephant's habitat on the south side of the bypass project site is currently saturated, and it is a concern that the bypass may hinder the northward movement of the elephants.

[5] Kumara, H. N., & Sinha, A. (2009)
[6] Madhusudan, M. D., Sharma, N., Raghunath, R., Baskaran, N., Bipin, C. M., Gubbi, S., ... & Pillay, R. (2015)

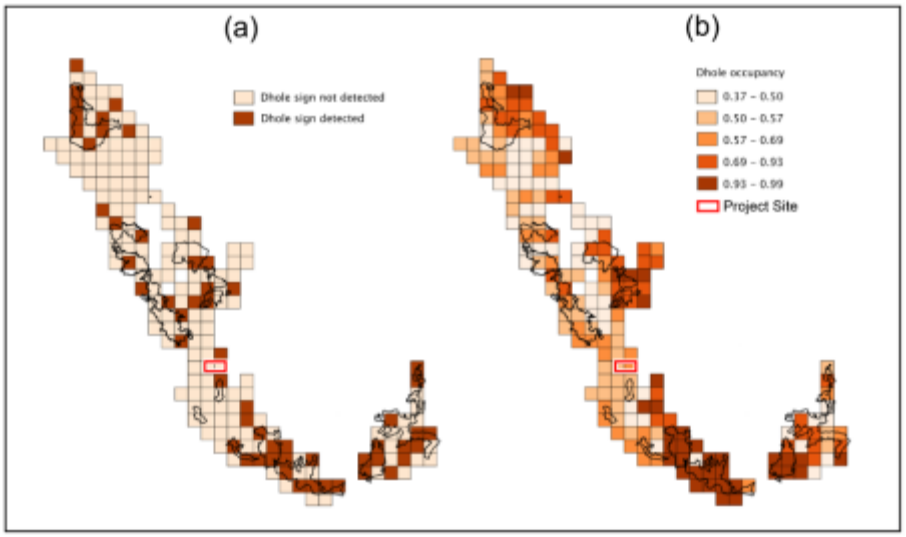


Source: Distribution, relative abundance, and conservation status of Asian elephants in Karnataka, southern India. Biological Conservation, 187, 34-40)

Figure 2.2.4 Elephant Distribution in Karnataka

2.2.5 Dhole cited in "On a Dhole Trail: Examining Ecological and Anthropogenic Correlates of Dhole Habitat Occupancy in the Western Ghats of India[7]. PLoS ONE 9(6): e98803"

The total number of Dhole (Cuon alpinus) is less than 2,500 in the world. The distribution pattern of the Dhole in Karnataka is analyzed as follows.



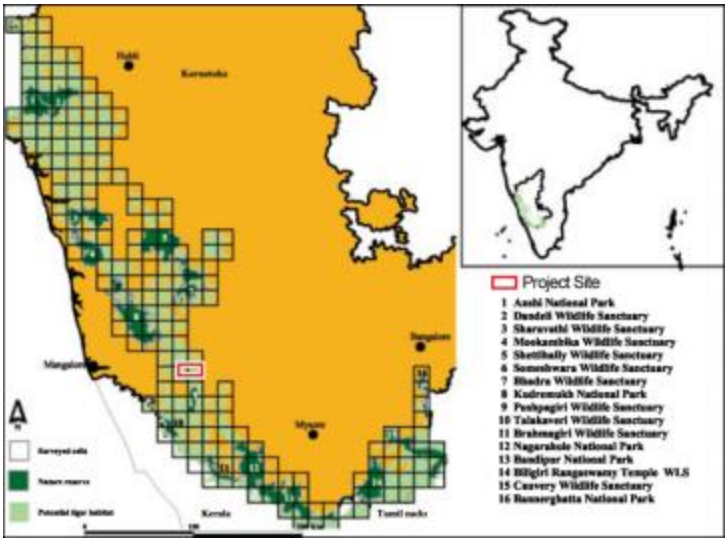
Source: Examining Ecological and Anthropogenic Correlates of Dhole Habitat Occupancy in the Western Ghats of India

Figure 2.2.5 Probability of Dhole Distribution

[7] Srivathsa A, Karanth KK, Jathanna D, Kumar NS, Karanth KU (2014)

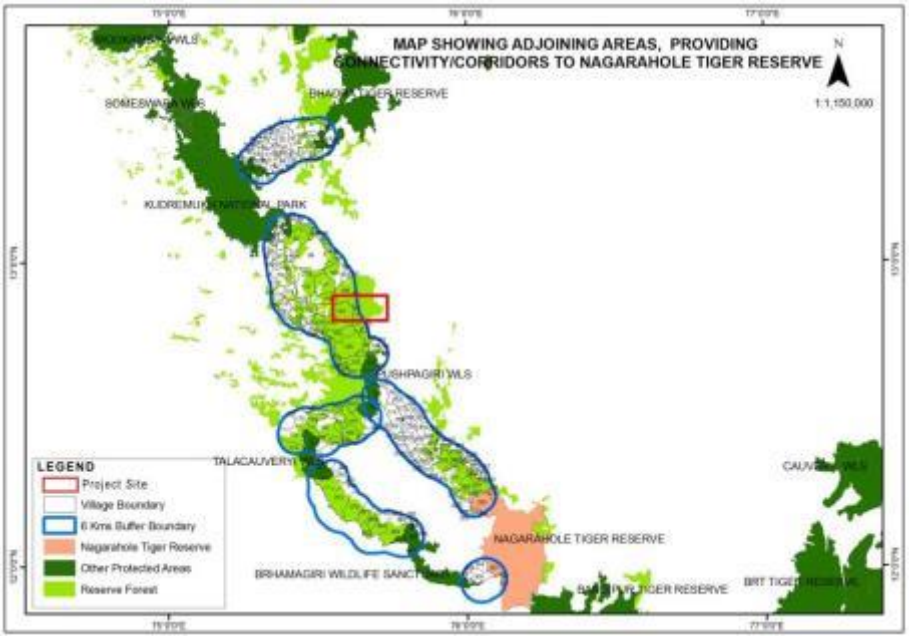
2.2.6 Tiger cited in "Monitoring carnivore populations at the landscape scale: occupancy modelling of tigers from sign surveys[8]. Journal of Applied Ecology, 48(4), 1048-1056"

The distribution pattern of the Tiger in Karnataka is analyzed as follows.



Source: Monitoring carnivore populations at the landscape scale: occupancy modelling of tigers from sign surveys, Journal of Applied Ecology

Figure 2.2.6 Location of Malenad-Mysore Tiger Landscape (MMTL)



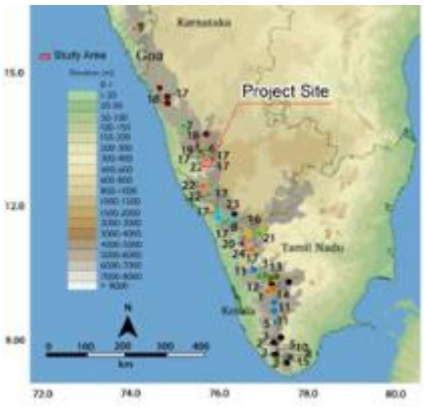
Source: Monitoring carnivore populations at the landscape scale: occupancy modelling of tigers from sign surveys, Journal of Applied Ecology

Figure 2.2.7 Tiger Corridors

[8] Karanth, K. U., Gopalaswamy, A. M., Kumar, N. S., Vaidyanathan, S., Nichols, J. D., & MacKenzie, D. I. (2011)

2.2.7 Frogs cited in "DNA barcoding reveals unprecedented diversity in Dancing Frogs of India (Micrixalidae, Micrixalus): a taxonomic revision with description of 14 new species[9]. Ceylon Journal of Science (Bio. Sci.) 43 (1)"

The study for Dancing Frog "Micrixalus" was conducted at 70 sampling sites and 14 new species were found. Both Micrixalus saxicola (VU) and Maranhalli were also found in this study. Some of the sampling sites are close to the project area.



Source: DNA barcoding reveals unprecedented diversity in Dancing Frogs of India (Micrixalidae, Micrixalus): a taxonomic revision with description of 14 new species

Figure 2.2.8 Sampling Points of the Frog Study

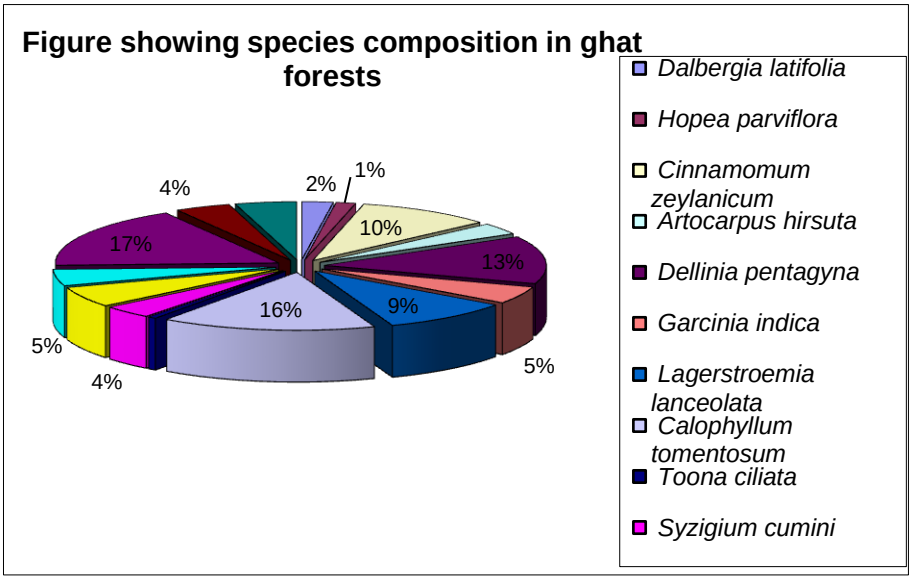
2.2.8 Vegetation cited in "Working Plan For The Hassan Forest Division for Period - 2001-02 to 2010-11[10]"

Hassan division has wide variation in its climate and vegetation and can be divided into two distinct types. Vegetation varies from Wet Evergreen Tropical Rain forest in Malnad to Dry Tropical Scrub forests in Maidan areas. The Hassan ghat forests had remained practically in their virgin state until 1942. This division had some of the best evergreen forests of Karnataka State. Evergreen and Semi-evergreen forests constitute approximately 4.5% and 26%, respectively, of the forest area of the division. The percentage compositions of other forest types are Moist deciduous (1.5%), Grasslands (6%), Dry Deciduous (10%), Dry Scrub (29%) and Dry Thorn forest (23%).

Important species of timber marketed in the Division include Teak, Beete, Honne, Mathi, Nandi, Tadasal, Yethega, Jambe, Bilwara, Tare, Dindiga, Hebbalasu, Burga, and Doddathoppe, among others. There is a great demand for firewood and construction materials from the local people. Minor Forest Produce (MFP) of various kinds is also available in this division. This includes Canes, Dhupa, Cinnamomum, Soapnut, Myrobolans, Tanning bark, Pepper, Honey, bee wax, Tamarind, Alalekai, Seegekai, seeds of Honge, and Beedi leaves and grasses. However, the extraction of green timber in all forests of the division has been stopped since 1986. Extraction was limited to fuel wood plantations.

The following graph shows the composition of tree species in the Ghat forest.

[9] S.D.Biju, Sonali Garg, K.V.Gururaja, Yogesh Shouche, Sandeep A. Walujkarand (2014)
[10] The Government of Karnataka, 2001



Source: Working Plan For The Hassan Forest Division for Period - 2001-02 to 2010-11

Figure 2.2.9 Species Composition in Ghat Forests

Chapter 3 Related Laws and Regulations: Necessary Environmental Procedures

Laws and regulations related to the development projects have been surveyed considering the actual situation of necessary procedures for acquiring permissions.

3.1 Environmental Impact Assessment

The Environmental Assessment Law (1986) stipulates the conditions requiring the conduction of Environmental Assessment, Details procedures are stipulated in the Notices of Environmental Assessment (2006, 2009 and 2012). These stipulate that Environmental Clearance (EC) has to be issued for the project sets in certain categories.

For a project categorized as A, EC of MOEF, the Ministry of Environment, Forest and Climate Change has to be issued through the validation of Expert Appraisal Committee. On the other hand for a project categorized as B project, EC of Environment Assessment Committee of the state government has to be issued through the validation of Expert Appraisal Committee of the state government.

The categorization is described in the following Table 3.1.1. According to PWD officials, for the Shriradi Ghats bypass Project the alignment is approximately 23km in length and sits in the B category.

For the Yettinahole Project, the water supply project, is categorized as the project that is not required EIA. KNNL has acquired the confirmation letter, which states the above category is right for the Yettinahole Project.

Table 3.1.1 Categorization of EIA (EIA circular 2006)

Project Type	Categorization	
	A Central Government	B State Government
High way	Requiring EIA for i) Newly constructed National Highway. ii) Extension of existing National Highway road for more than 30km, the width of the road is more than 20m and passing states.	i) Newly constructed State Highway. ii) Extension of existing State Highway road for more than 30km, the width of the road is more than 20m and passing states.
Water Supply	EIA is not required.	

Source: Compiled by the Survey Team

However, the project area is in an ecologically sensitive area and many endemic, rare and endangered species have been found as described later in this report.

Therefore, proposed projects could be categorized as “Category A” by this notification. If so, it is necessary to acquire EC from Ministry of Environment, Forest and Climate Change with the recommendation from Environmental Appraisal Committee (EAC) after conducting an environmental assessment. The process of acquiring EC is as follows.

3.1.1 Application for Prior Environmental Clearance

The application for the project categorized “Category A” needs to be submitted to the Ministry of Environment, Forest and Climate Change. The following information is required in the application form.

1) Information indicated in Appendix I of EIA notification
   - Basic information
   - Activity
   - Environmental Sensitivity
   - Proposed Terms of Reference for EIA studies
2) Pre-feasibility project report (in the case of construction projects, the conceptual plan is to be provided)
3) Information indicated in Appendix II of EIA notification
   (Land environment, water environment, vegetation, fauna, etc.)

3.1.2 Scoping

Scoping is a process to be done by EAC. In this process, EAC discusses application forms and detailed TOR for EIA is prepared. After that, the TOR will be conveyed to the applicant, and the TOR will be displayed on the website of the Ministry of Environment and Forests and the concerned State Level Environment Impact Assessment Authority.

3.1.3 Public Consultation

The State Pollution Control Board or Union Territory Pollution Control Committee conducts public consultation. After completion of the public consultation, the applicant will address all the material environmental concerns expressed during this process, and make appropriate changes in the draft EIA and Environmental Management Plan. The final EIA report, so prepared, will be submitted by the applicant to the concerned regulatory authority for appraisal.

3.1.4 Appraisal

The Expert Appraisal Committee or State Level Expert Appraisal Committee concerned makes categorical recommendations to the regulatory authority concerned either for grant of prior environmental clearance on stipulated terms and conditions, or rejection of the application for prior environmental clearance, together with reasons for the same.

At the hearing survey with Karnataka Forest Department, the following are shown as the average period of time in acquiring EC. Thus, it is assumed that it takes roughly one year to acquire EC.

- Application ~ Preparation of TOR: Maximum 60 days
- Collection of seasonal data: Minimum 105 days Summer (Feb. - May) or Winter (Oct. – Feb.)
- Preparation of EIA report: Average 15 to 20 days
- Public consultation: Minimum 45 days
- Evaluation by EAC: Maximum 60 days
- Issue of appraisal: Maximum 45 days

In addition, the EIA report should include the following information.

1. Introduction
   (Purpose of the report, Identification of project & project proponent, Brief description of nature, size, location of the project)

2. Project Description
3. Description of the Environment
4. Anticipated Environmental Impacts & Mitigation Measures
5. Analysis of Alternatives (Technology & Site)
6. Environmental Monitoring Program
7. Additional Studies
8. Project Benefits
9. Environmental Cost Benefit Analysis
10. Environmental Management Plan
11 Summary & Conclusion
12. Disclosure of Consultants engaged

3.2 Preparations Need to Be Done by Organizations to Proceed Proposed Project

In order to smoothly implement the proposed project, 1) Preparations to acquire Environmental Clearance, 2) Preparations to turn forest area into non-forest area, and 3) Preparation of budget for land acquisition, are necessary to consider in advance. Although these preparations are required under Indian law and regulations, the procedures need to fill the safeguard policy stipulated by JICA, World Bank, and ADB, if the proposed project is implemented as a load project from the Japanese Government. Thus, it is necessary to meet the requirement by these safeguard policies as well as to follow Indian laws and regulations.

3.2.1 Preparations to Acquire Environmental Clearance

In order to start the procedure of EC acquisition, project proponent submits project outline to Ministry of Environment, Forest and Climate Change. Project outline covers the information about project related activities which may cause environmental impact. It is recommendable that the project proponent should gather the information shown below in advance, if the existing information is not sufficient.

Table 3.2.1 Information Needed to Be Submitted in EC Application

No.	Information about:
1	Construction, operation or decommissioning of the Project involving actions, which will cause physical changes in the locality (topography, land use, changes in water bodies, etc.)
2	Use of Natural resources for construction or operation of the Project (such as land, water, materials or energy, especially any resources that are non-renewable or in short supply)
3	Use, storage, transport, handling or production of substances or materials, which could be harmful to human health or the environment or raise concerns about actual or perceived risks to human health.
4	Production of solid wastes during construction or operation or decommissioning
5	Release of pollutants or any hazardous, toxic or noxious substances to air
6	Generation of Noise and Vibration, and Emissions of Light and Heat
7	Risks of contamination of land or water from releases of pollutants into the ground or into sewers, surface waters, groundwater, coastal waters or the sea
8	Risk of accidents during construction or operation of the Project, which could affect human health or the environment
9	Factors that should be considered (such as consequential development), which could lead to environmental effects or the potential for cumulative impacts with other existing or planned activities in the locality

Source: Study on Road Improvement Project for Shiradi Ghats Stretch in India, METI 2015

3.2.2 Preparations to Turn Forest Area into Non-Forest Area

In addition, based on the Forest (Conservation) Act 1980 and Forest (Conservation) Rules 2003, permission is required when the user intends to turn forestland into non-forest land. The rule stipulates that permission from the Ministry of Environment, Forest and Climate Change is required if the land to be changed is more than 40(ha) while the permission from Chief Conservator of Forests or Conservator of Forests is required if the land to be changed is less than 40(ha). In the case of the proposed project, the total forest land to be cut on the construction road is approximately 25(ha), and the total forest land to be cut for temporary construction road on which forest can be planted after the construction is approximately 21(ha). Thus, there is the possibility that the total area may exceed 40(ha), and permission from the Ministry of Environment, Forest and Climate Change is required. After conducting the detailed survey about the forest cutting area, the project proponent should start the necessary preparation for construction in the forest area.

In addition, in advance of the construction phase, a preliminary survey will be conducted. To conduct this survey, permissions for entering and surveying are also required.

3.2.3 Preparation of Budget for Land Acquisition

Land acquisition relating to the project will be done based on the National Highway Act 1956. Although the expected resettlement scale is not large, the recommendation is that consideration of the budget relating to land acquisition should proceed by estimating the expected area and compensation amount, if necessary.

Chapter 4 Environmental Stakeholders

Information related to environmental stakeholders in the Western Ghats region has been surveyed through website searches as well as hearing surveys with administrative agencies, research institutes and others.

No negative orientation was observed for the Shiradi Ghats bypass Project. Several organizations consider the Project positively because the bypass could improve the discontinuity of Western Ghats Ecosystems disturbed by the existing National Road No. 48, the south part and the north part. However, the said expectation is based on the premises of the abandonment of the existing road in the region after the start of the usage of the bypass.

Seven (7) of the thirteen organizations showed negative orientation toward the Yettinahole Project because of mistrust with the submitted data for calculating possible intake from the region.

The detailed results of the survey are described in the following Table 4.1.

Table 4.1 Environmental Stakeholders

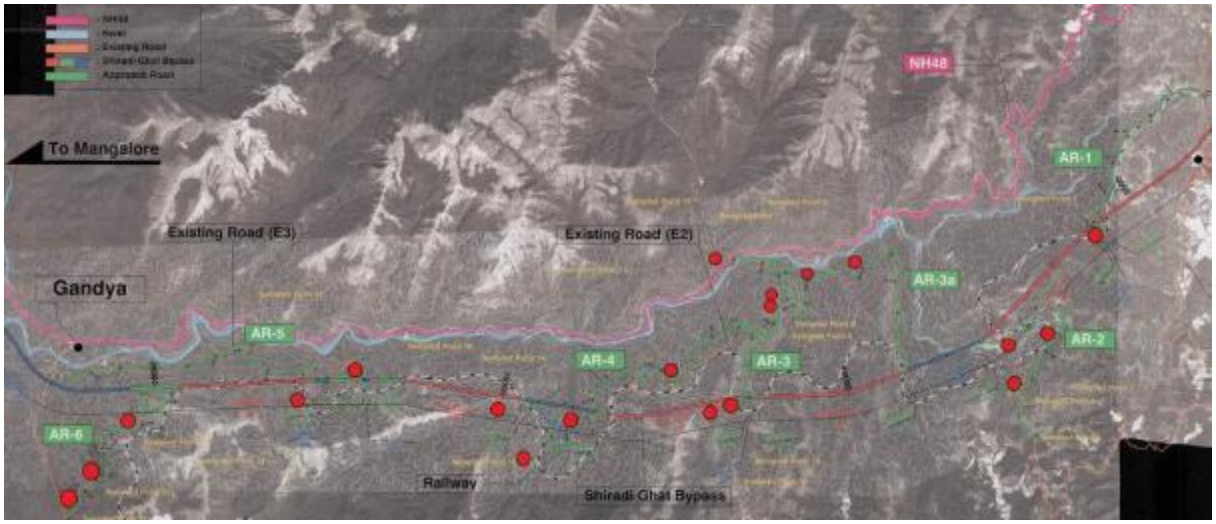
No.	Organization	Representative	URL	Major Activities	Orientation toward related Projects	Notes
1	Centre for Wildlife Studies (CWS)	Dr. K. Ullas Karanth	www.wcs.org	Scientific Research and cocervation activity for big mamals such as elephat, tiger and etc.	Neutral to weekly positive to Shiradhi Ghat Bypass	• Conducting investigative research on tiger's ecology (habitat, population, and migration route, etc.). The research targets also include elephant and feral dogs. The migration length of tiger could reach to 300 km. The current population is about 400. Tigers and elephants migrate along valleys. • The factors of convers are: 1) exploitation of natural resources, 2) substances (harmful) brought by freight cars. Dr. Karanth is positively interested in new bypass, especially the tunnel construction. Wall (sound isolation) could block animals' migration. The new infrastructure projects (especially road) with appropriate mitigation measures are acceptable. • Blasting for tunnel construction is NG. It disrupts animals.
2	Ashoka Trust for Research in Ecology and the Environment (ATREE)	Dr Jagdish Krishnamurthy	http://www.atree.org	Recommendated western ghats area as world heritage site in 2006. Field research in Kudremukh national park.	Neutral to Shiradhi Ghat Bypass	
3	Nature Conservation Foundation	Sanjay Gubbi	http://ncf-india.org/	Policy recommendation, educational research and field research. Ecological survey for big cats such as tiger. Mr. Gubbi is a member of biodiversity board of Karnataka state.	Not clear	• Because the meeting was not officially hold, no official comments can be presented for the report.
4	Care Earth	Dr R J Ranjit Daniels	http://careearthtrust.org/	Research for biodiversity and environmental education. Developped national biodiversity strategy and activity plans for 2000-2002. Not much activities in Karnataka.	Not clear	• Little activities condcuted in Karnataka
5	Nagarika Seva Trust	Prabhakar Inna,Deputy Director	No website	Played a major role in "Appiko movement" as natural concervation demonstration movement for protecting western ghats region.	Negative to Yettinahole Project	
6	Dakshina Kannada Parisarasaktara Okkuta	ASHOK KUNDAPUR	No website		Negative to Yettinahole Project	
7	Salim Ali Centre for Ornithology and Natural History	Director Telephone: 091(422)2657101-105	www.saconindia.org	Established for concervation of biodiversity in Inda mainly targeting western ghats region in 1990. Suppored by Ministry of Environment and Forests (MoEF).	Not clear	• Major activities have been conducted in Tamil Nadu.
8	ASIAN NATURE CONSERVATION FOUNDATION	Dr R. Sukumar	www.asiannature.org	Research for conflict between human and asian elephant. Posesses asian elephant database.	Neutral to Shiradhi Ghat Bypass	• He is in a position to accept implementation of infrastructure projects as long as appropriate mitigation measures are taken. He has cooperated with the assessment of small-scale gas pipeline project. • The concerns in the Western Ghats region include the habitat of wildlife, especially the elephants (also tigers). The elephant's habitat on the south side of the bypass project site is currently saturated, and it is a concern that the bypass may hinder the northward movement of the elephants.
9	Regional Empowered Committee (REC) of Ministry of environment and forest (MoEF)	A N Yellappa Reddy	http://timesofindia.indiatimes.com/city/mangaluru/Yettinahole-project-Activists-to-meet-Regional-EmpoweredCommittee-team/articleshow/50271459.cms	Former forest officer in Hassan districe and served for more than 20 years. He has precise knowledges regarding ecosystem in Project area.	Negative to Yettinahole Project http://timesofindia.indiatimes.com/city/mangaluru/Yettinahole-project-Activists-to-meet-Regional-EmpoweredCommittee-team/articleshow/50271459.cms	• Mr. Reddy is a member of local committee of environmental affairs and he has expressed opposition to the Yettinahole Project for the following reasons. 1. The hydrological information described in DPR is not trustworthy. 2. Even if intake is possible, it is unknown how to pump up the water. It is not realistic. 3. The water intake would impact on the groundwater level in the area, and it could have a serious effect on the cultivation of spices (pepper, cardamom, etc.) and farmers. 4. The project has been supported by the contractor's and other's lobbying activities as well as politicians, therefore, the environmental impact is not properly considered. 5. Forest Department does not have appropriate information and technologies to understand and assess the environmental impact.
10	Zilla Nethravathi Nadi Samrakshana Okkoota	Chief Convener Dr Niranjan Rai	http://www.deccanherald.com/content/517726/yettinahole-anti-people-project-nethravathi.html	Conservation of Netravati river.	Negative to Yettinahole Project http://m.dailyhunt.in/news/india/english/deccan-herald-epaper-deccan/okkoota-plans-protest-against-yettinahole-project-on-oct-15-newsid-44796620	
11	Sahyadri Sanchayana Vedike	Convener Dinesh Holla			Negative to Yettinahole Project http://www.mangalorean.com/uppinangady-protesters-vow-to-stop-yettinahole-river-diversion-project-warn-government/	
12	Paschima Ghatta Samrakshana Horata Vedike	K.N. Somashekhar			Negative to Yettinahole Project	
13	Suman Jhumani (The EIA Resource and Response Centre)	Research Associate	http://www.ercindia.org/	Monitoring the EIA precess for development projects.	Negative to Yettinahole Project	• The data (rainfall mount) which is described in DPR of Yettinahole is one of the data from Kaadumane Estate (Private Company), and the specified maximum rainfall amount is intentionally used which is stretched interpretation. • Although the area of the catchment (river basin) is considered to be an accurate value, however it is hard to say that the rainfall mount allocated to the each basin is accurately calculated. It is different from the condition of ground surface in the field, and it is not consistent with the value of DPR which is calculated to have the same Runoff Coefficient. • Currently, there are four (4) lawsuits against the Yettinahole Project. • Blasting could affect the behavior of elephants.

Chapter 5 Field Survey

The large part of planned bypass alignment is designed as tunnels and bridges to minimize the negative impact on environment by improving the continuity as well as the accessibility of the ecosystems between north and south which is disturbed by the NH48 currently. On the other hand, the construction road is considered to be the major source of having negative impact on the local ecosystem. Especially, area close to river and stream is considered to be the prominent habitats of amphibians and fishes. The area where the alignment of the road and the stream cross is considered to be the possible habitats of amphibians and fishes.

Therefore, prior to the conduction of ecological field survey, the JICA survey team conducted a survey considering possible construction road alignment. Twenty-one sampling sites had been selected considering the possible habitats for amphibians, fishes and birds where the proposed alignment of the construction road and the streams cross. The subcontract team consists of professors of IISC and NGOs researchers who conducted the field survey from May to October 2016.

The results of the survey are described as follows.



Source: The Survey Team

Figure 3.2.1 Sampling Sites for the Field Survey

5.1 Considering Possible Construction Road Alignment

5.1.1 Survey Flow

The study on construction roads is conducted based on the following study flow.

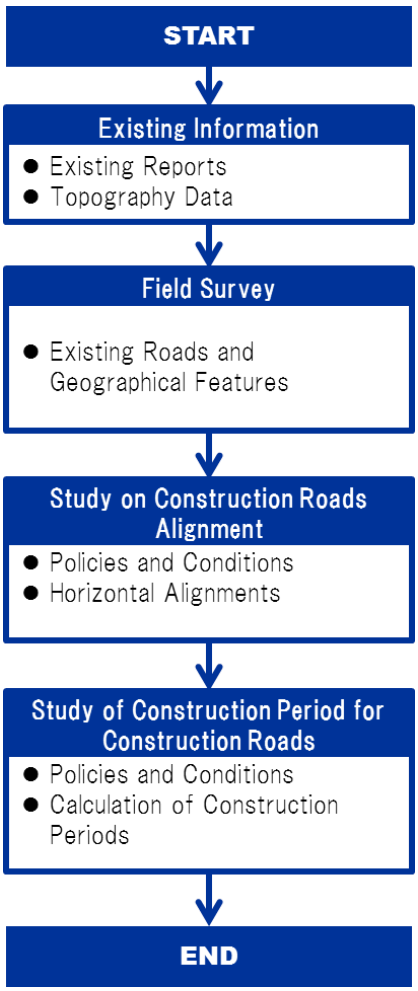


Figure 5.1.1 Flow of the Consideration

5.1.2 Existing Information

1) Shiradi Ghats bypass Plan

The Shiradi Ghats bypass Route was initially studied in the project, "Study on Road Improvement Project for Shiradi Ghats Stretch in India 2015 (METI Study)," carried out from August 2014 till February 2015, under the Ministry of Economy, Trade and Industry of Japan.

The State Government of Karnataka then commissioned consultancy services for "Feasibility-Cum-Geo Technical Study or the bypass to Shiradi Ghats from km 238.000 to 261.450 on NH-48 in the State of Karnataka (hereinafter referred as the KD-6 Project)" to GEOCONSULT INDIA Pvt. Ltd., which is presently implementing the review of the alignment and the geological investigations.

In this study, the construction roads shall be planned based on the alignment[11] established by the KD-6 Project.

2) Topography Data

The topography of the survey area was generated from the Digital Elevation Model (DEM). The DEM data[12] purchased for this survey. The topography features were utilized for planning the construction roads. The specification of the DEM data purchased is as follows.

[11] Approved Alignment as of July, 2016.
[12] Digital representation of topographic features of land surface, which is called Digital Elevation Model.

Table 5.1.1 Specification of DEM Data

Product Name	AW3D
Area	290km^2 (UTM Zone 43)
Mesh Width	5m
Spheroid	WGS84
Height	Altitude EGM96

5.1.3 Conditions of the Survey Area

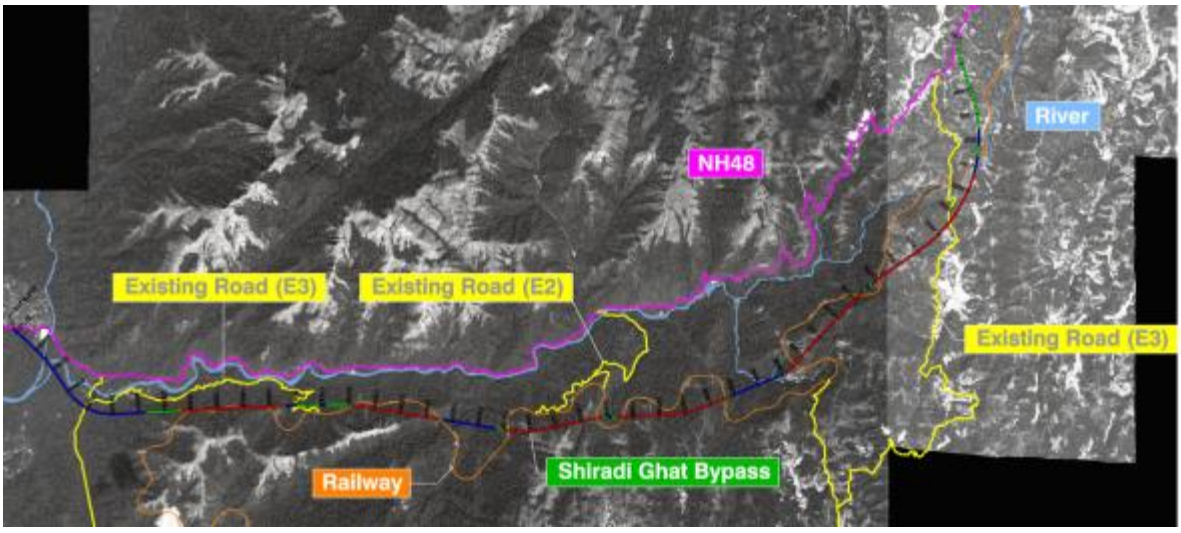
1) Confirmation of Existing Roads

The study area is a designated reserved forest. It is therefore required to minimize impacts on the environment to the possible extent. Identifying the existing roads around the Shiradi Ghats bypass and confirming the condition of these roads to utilize as construction roads is necessary in order to come up with a plan that takes the environmental impacts into consideration.

The situation of existing roads of the study area, confirmed by the field survey, is shown in the figures below.

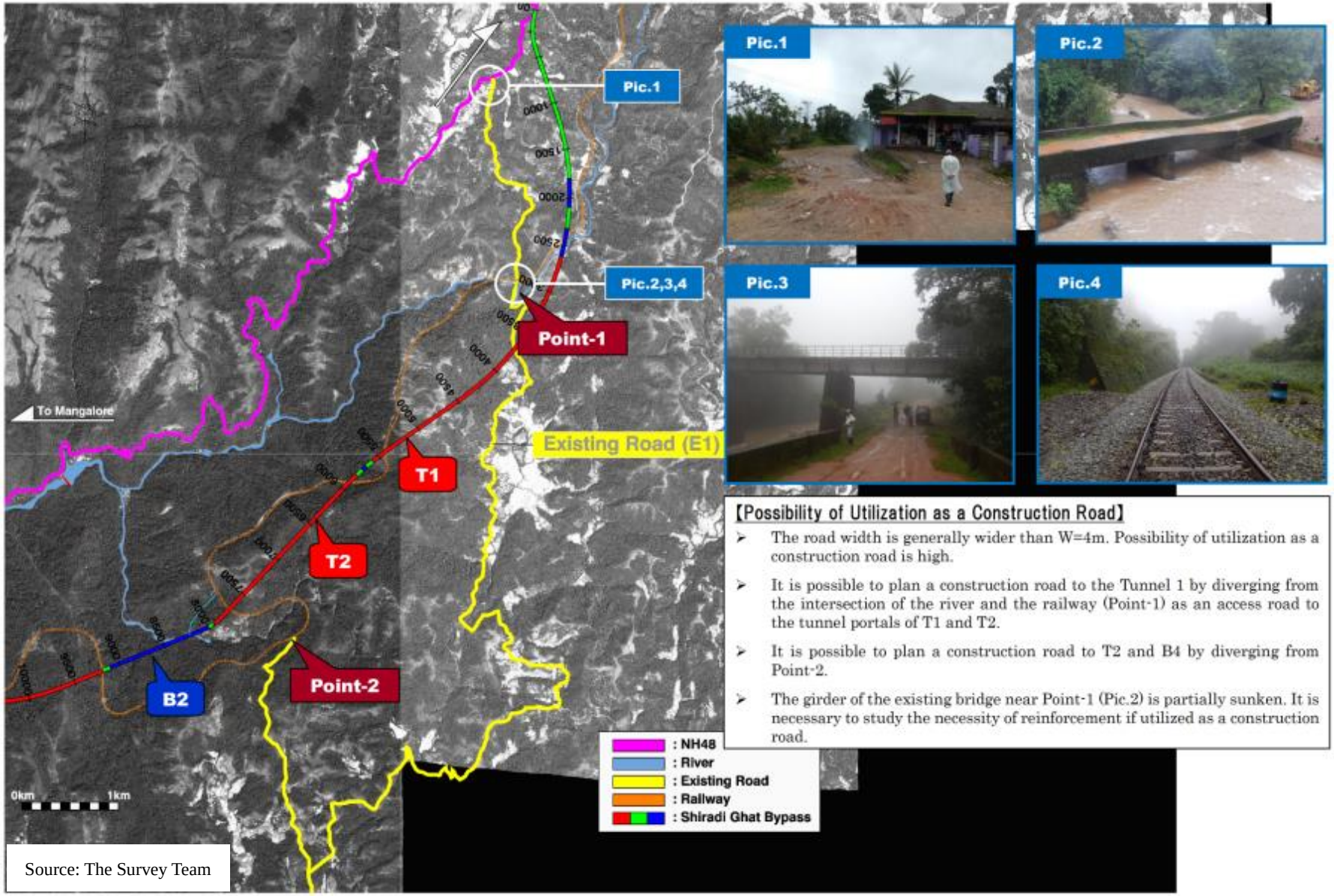
【Situation of Existing Roads】

- Existing roads identified within the Shiradi Ghats bypass are 1) existing road (E1*) diverging from NH48 at the start point of the Shiradi Ghats bypass, 2) existing road (E3*) diverging from R114 at the end point of the Shiradi Ghats bypass and 3) existing road (E2*) located in 10km west of Ganjya along NH48.
- The width of the river which runs along NH48 is relatively wide and the height difference between NH48 and the river is big in many places. Thus, it is only E2 where construction roads can be connected to NH48. Other than this, in case new construction roads are planned along NH48, large-scale temporary bridges are very likely to be required.
- E1 and E3 are unpaved roads. In rainy season (monsoon season), its traffic is partially restricted.



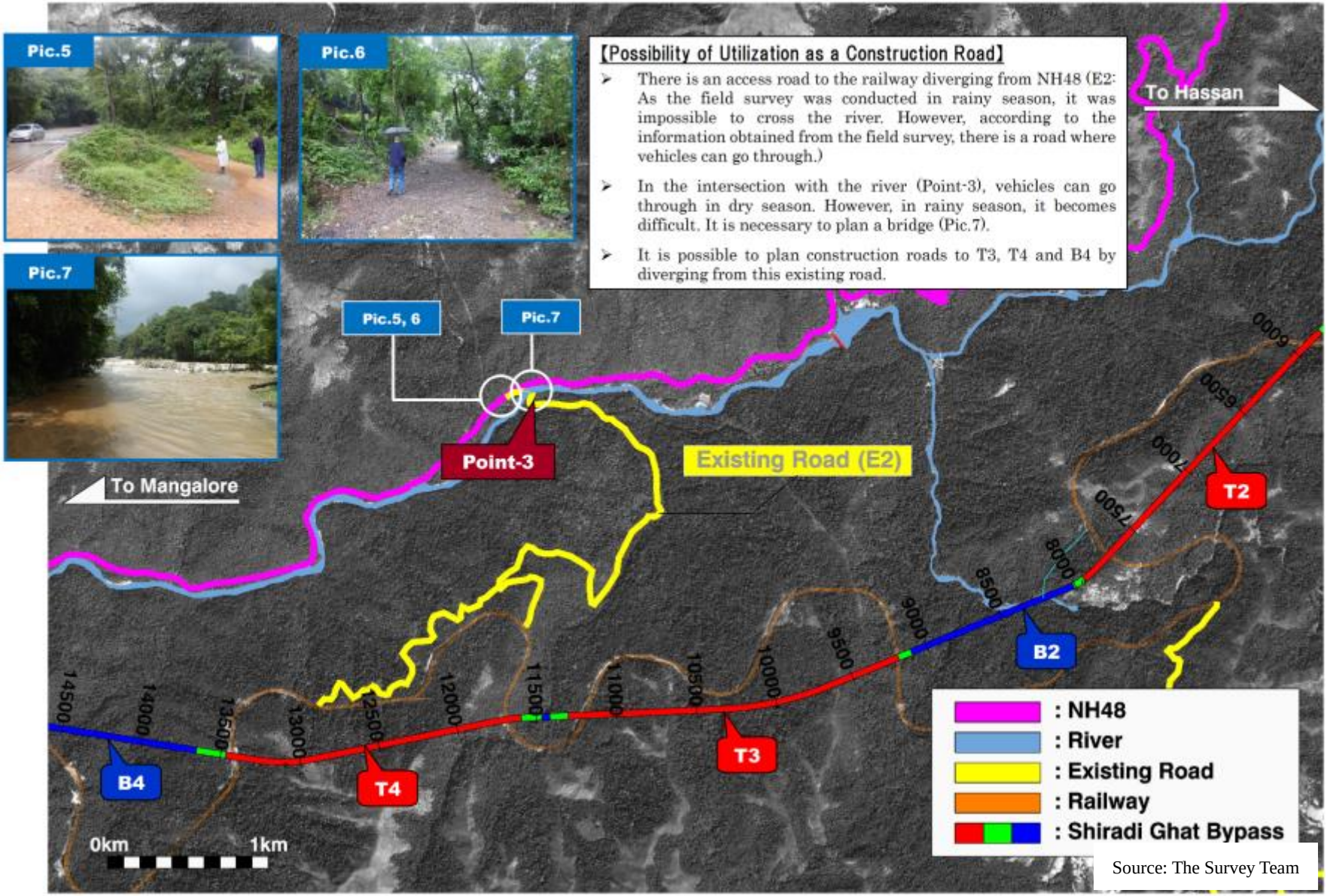
Source: The Survey Team

Figure 5.1.2 Location of the Existing Roads



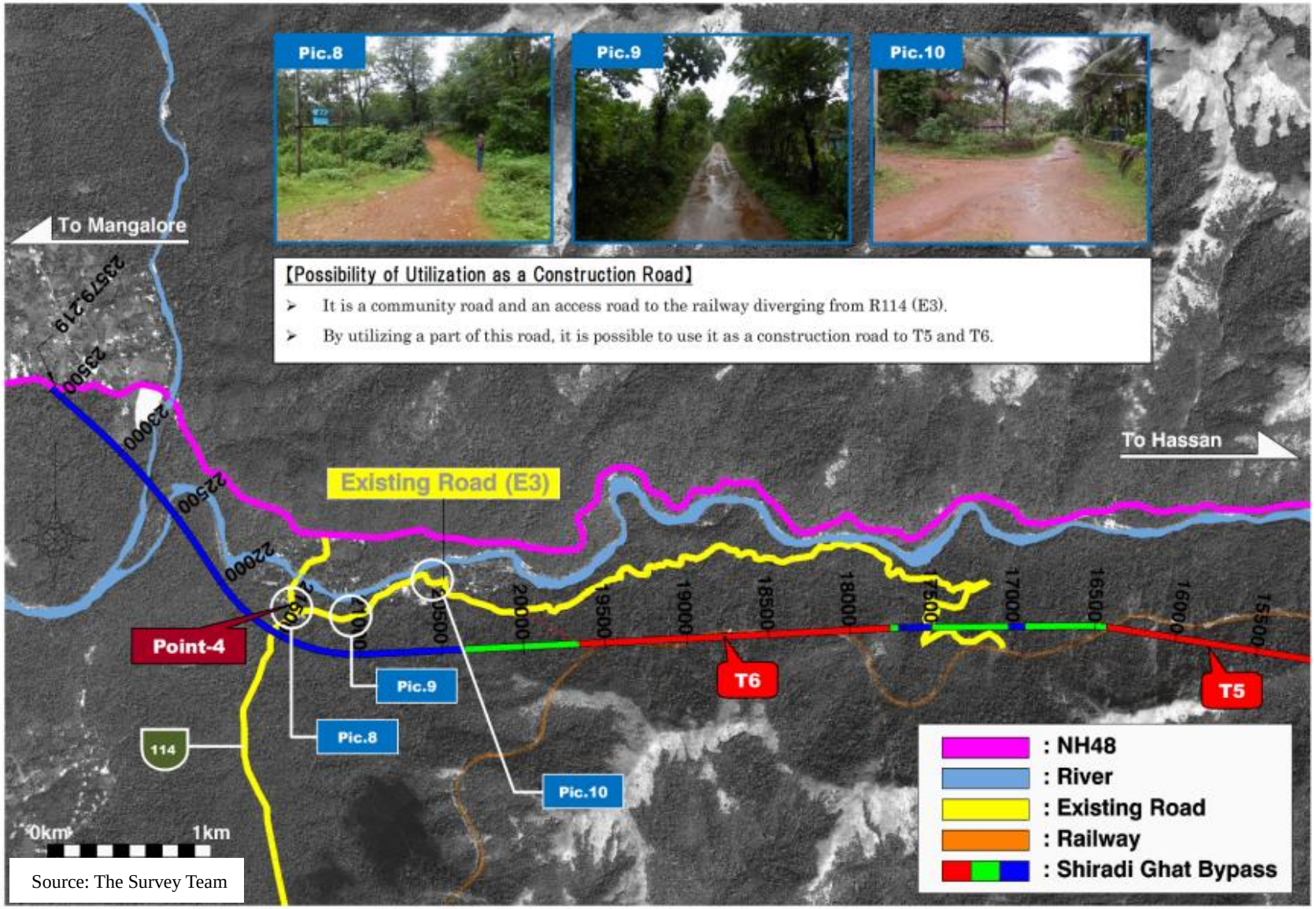
Source: The Survey Team

Figure 5.1.3 Location of Existing Road (E1)



Source: The Survey Team

Figure 5.1.4 Location of Existing Road (E2)



Source: The Survey Team

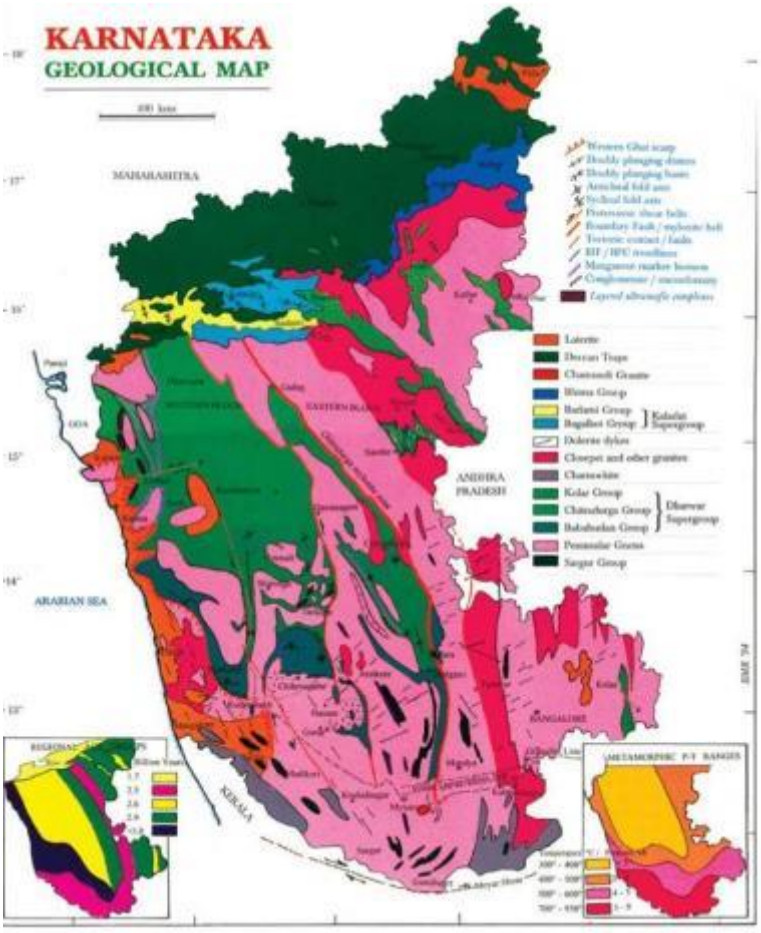
Figure 5.1.5 Location of Existing Road (E3)

2) Geology

Distribution of granite and gneiss are mainly found (See Figure 5.1.6) in the survey area. Along NH48, the exposure of granite-gneiss was confirmed in several places. The exposed granite-gneiss is considered to be relatively hard with few cracks.

In addition, the slope of cut along the existing road is 1:0.5 – 1:0.8. It is considered to be stable as there is no evidence of collapse (See Photo 2 and Photo 3).

Therefore, the slope of cut of construction roads is planned to be 1:0.5.



Source: Karnataka State

Figure 5.1.6 Geological Map of the Karnataka State

Photo 1: Exposure	Photo 2: Slope of the Existing Road (1)	Photo 3: Slope of the Existing Road (2)
		

Source: The Survey Team

Figure 5.1.7 Photos of Existing Roads

5.1.4 Considering Construction Roads

1) Policies and Conditions

The policies and conditions in planning construction roads are set as follows.

【Policies】

- Alignments of construction roads are made fit as much as possible to geographical features in order to minimize the area of cut and fill.
- Existing roads are utilized to the maximum extent in order to minimize the area of newly-constructed construction roads.
- Construction roads are constructed in order to access the both entrances of each tunnel and the abutments of long bridges (B2 and B4).

【Conditions】

- Design speed of construction roads: 20km/h
- Minimum curve radius: 15m
- Single-lane roadway width : single-lane road width 3.5m, shoulder 0.5m, total width 4.5m
- Maximum longitudinal slope 9% (special case 12%, 16% if the length is less than L=100m.)
- Slope of fill 1:1.0 Slope of Cut 1:0.5

2) Study of Horizontal Alignments

Based on the above policies and conditions, the construction roads are planned.

Table 5.1.2 List of Planned Construction Roads

No.	Construction Road	Length	Structure
1	AR-1	3.72km	Tunnel portal of T1 (End point side) Tunnel portal of T2 (Start point side)
2	AR-2	4.36km	Tunnel portal of T2 (End point side) Abutment of B2 (Start point side)
3	AR-3	4.46km	Tunnel portal of T3 (End point side) Tunnel portal of T4 (Start point side)
4	AR-3a	5.91km	Tunnel portal of T3 (Start point side)
5	AR-4	5.99km	Tunnel portal of T4 (End point side) Abutment of B4 (End & start point) Tunnel portal of T5 (Start point side)
6	AR-5	5.22km	Tunnel portal of T5 (End point side) Tunnel portal of T6 (Start point side)
7	AR-6	3.65km	Tunnel portal of T6 (End point side)

Source: The Survey Team

Plans of each construction road are shown in the following figures.

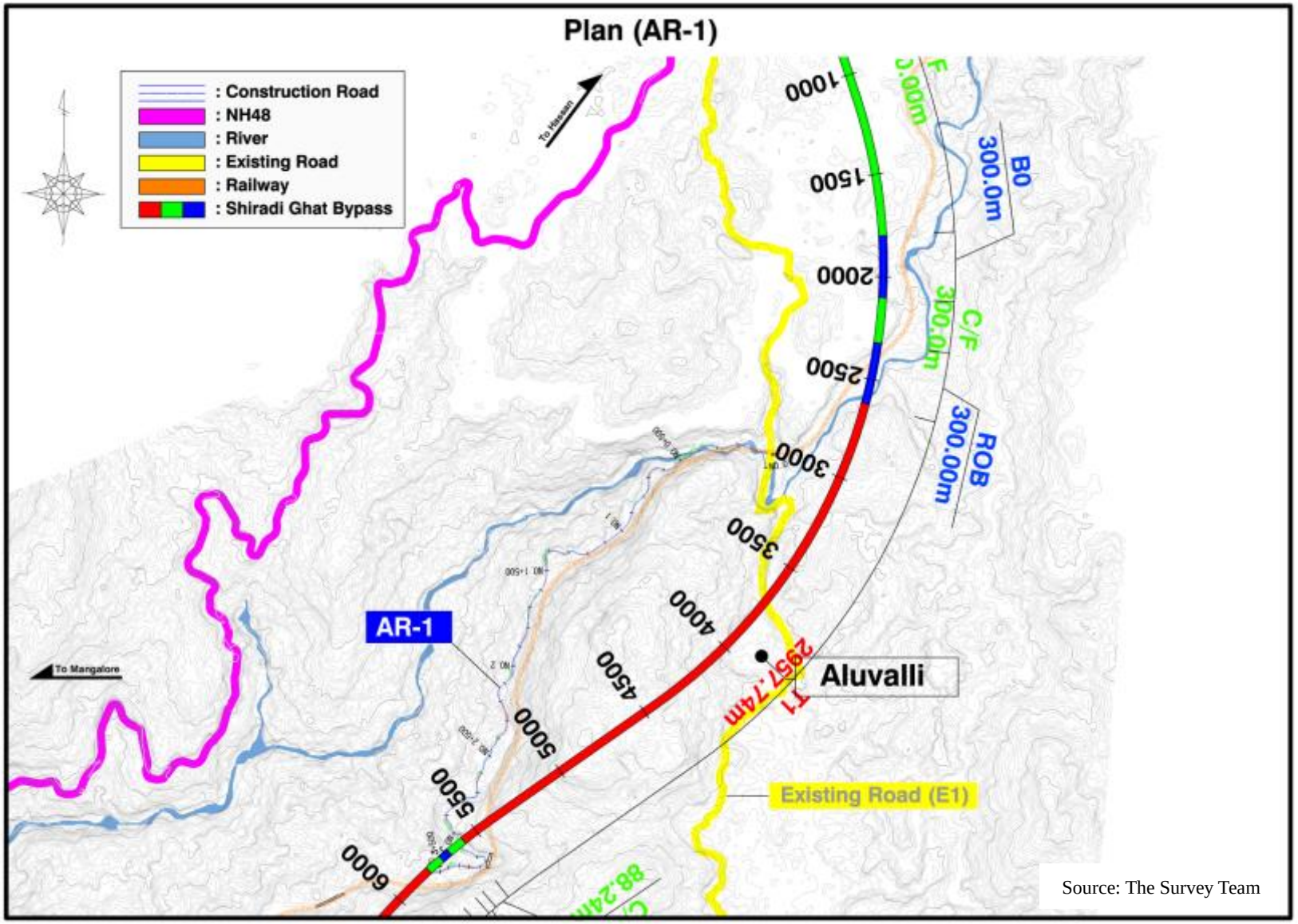


Figure 5.1.8 Plan of Construction Road (AR-1)

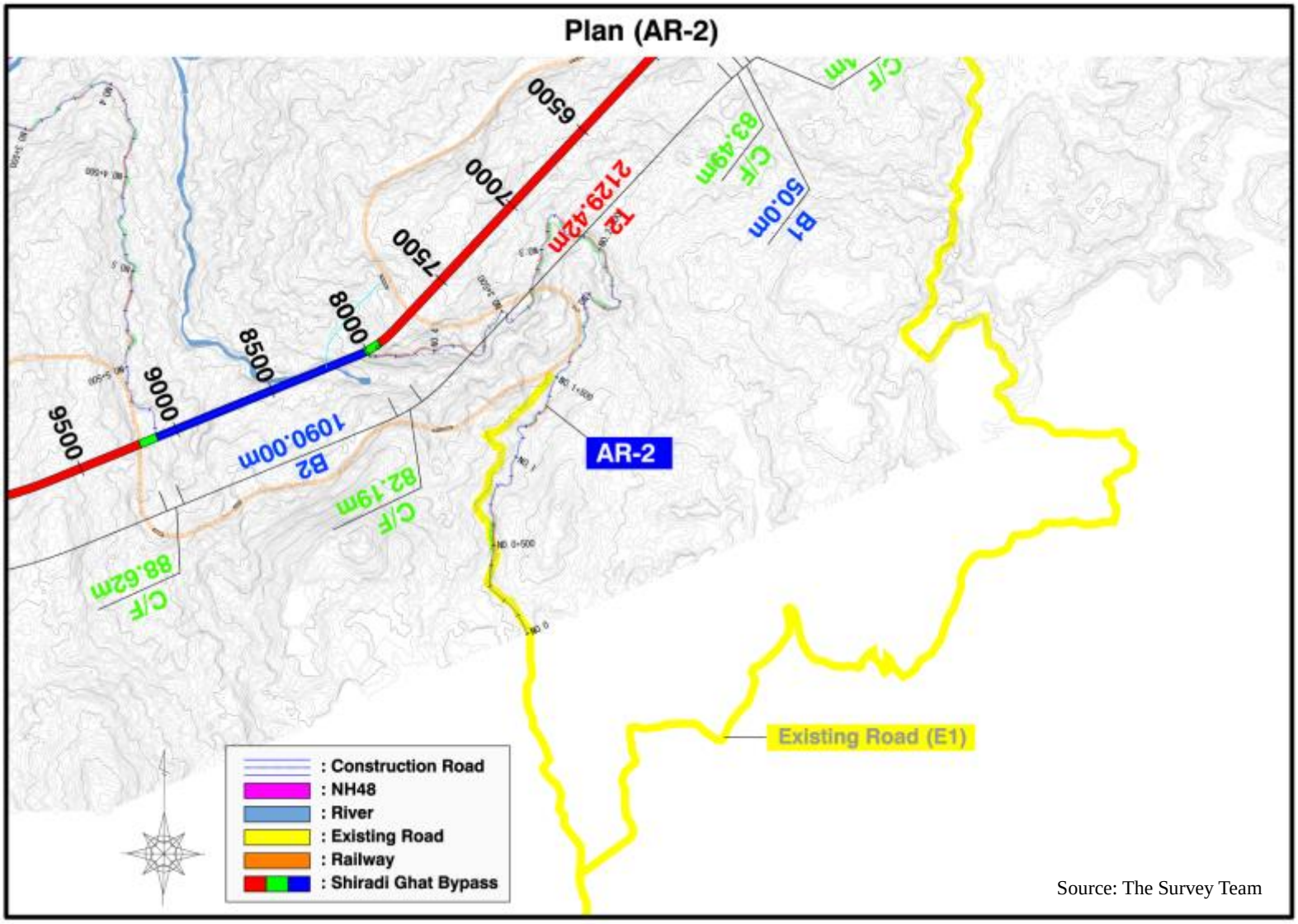


Figure 5.1.9 Plan of Construction Road (AR-2)

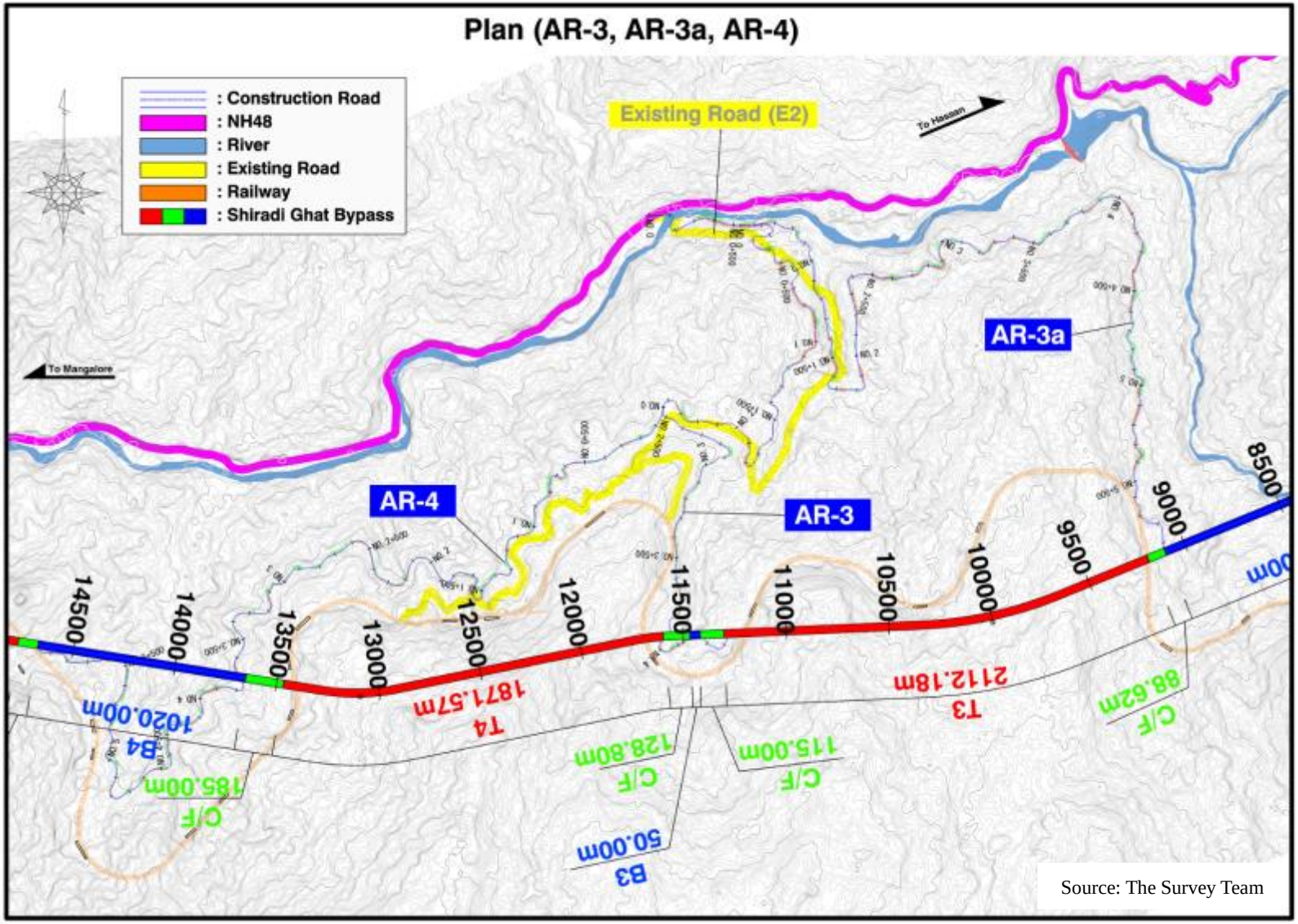


Figure 5.1.10 Plan of Construction Road (AR-3, AR-3a, AR-44)

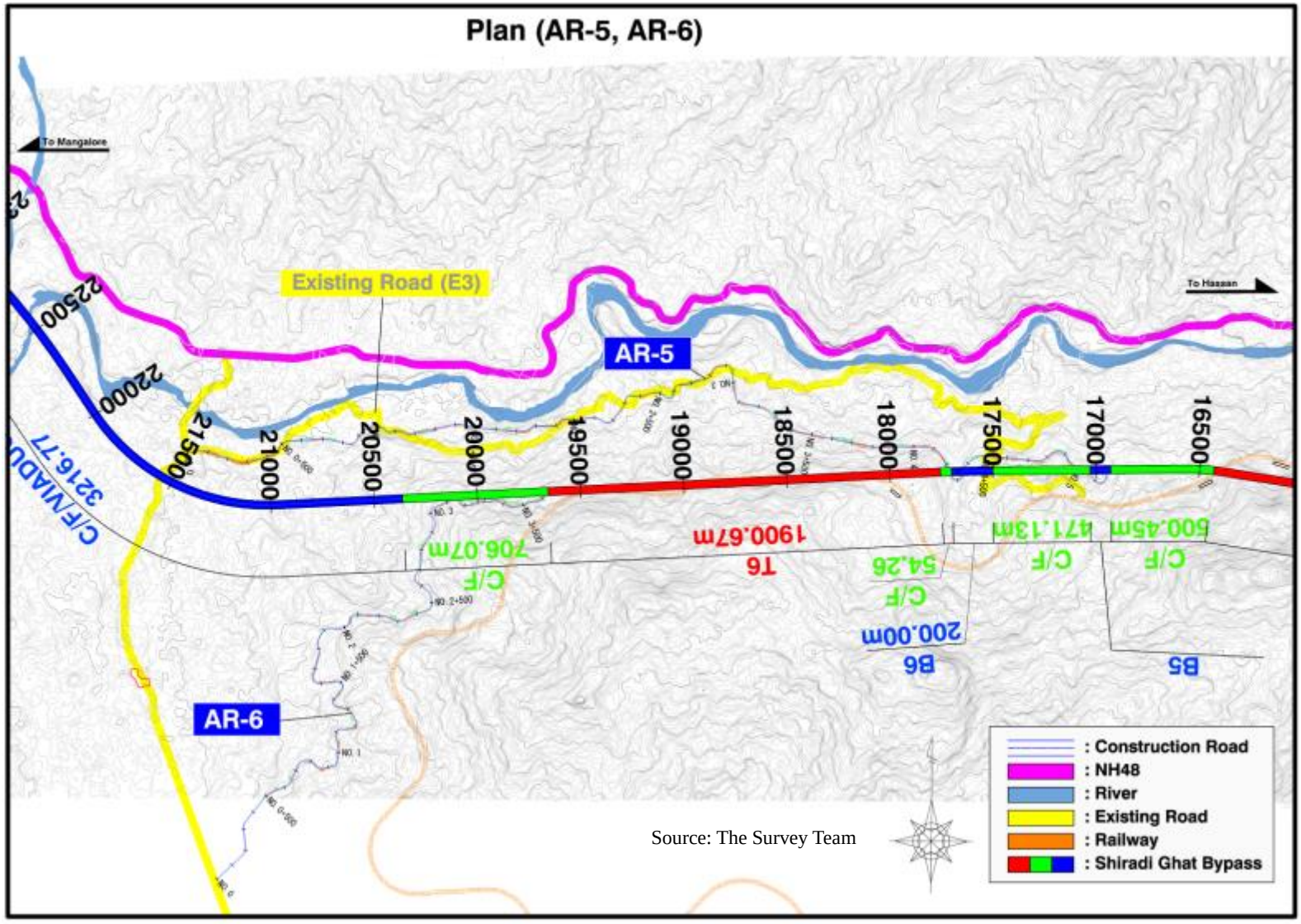


Figure 5.1.11 Plan of Construction Road (AR-1, AR-6)

5.1.5 Construction Period of Construction Roads

1) Basic policy and Conditions

The policy and conditions for calculation of construction period of construction roads of Shiradi Ghats bypass are set as follows.

【Policy】

- Based on the result of the study on alignments of construction roads, the construction period of each construction road (AR-1 – AR-6) is examined.

【Conditions】

- Based on the alignments of construction roads (AR-1 – AR-6) examined in this study, the construction periods are calculated.
- The construction periods are calculated referring to "Standard for Civil Works Cost Estimation (2016)" and "Standard for Civil Works Cost Estimation".

2) Calculation of Construction Periods

Based on the above mentioned conditions, the construction period of each construction road is calculated. The result is shown in the following table.

Table 5.1.3 Outline and Construction Periods of Construction Roads

No.	Construction Road	Length	Amount of Soil	Construction Period
1	AR-1	3.72km	Fill: 32,000m^3 Cut: 50,000m^3	Approx. 4.8 months
2	AR-2	4.36km	Fill: 55,000m^3 Cut: 45,000m^3	Approx. 6.4 months
3	AR-3	4.46km	Fill: 54,000m^3 Cut: 51,000m^3	Approx. 6.6 months
4	AR-3a	5.91km	Fill: 60,000m^3 Cut: 55,000m^3	Approx. 7.3 months
5	AR-4	5.99km	Fill: 50,000m^3 Cut: 68,000m^3	Approx. 7.0 months
6	AR-5	5.22km	Fill: 60,000m^3 Cut: 38,000m^3	Approx. 6.6 months
7	AR-6	3.65km	Fill: 37,000m^3 Cut: 31,000m^3	Approx. 4.4 months

Source: The Survey Team

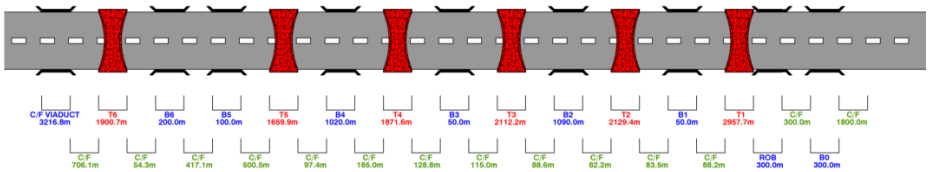
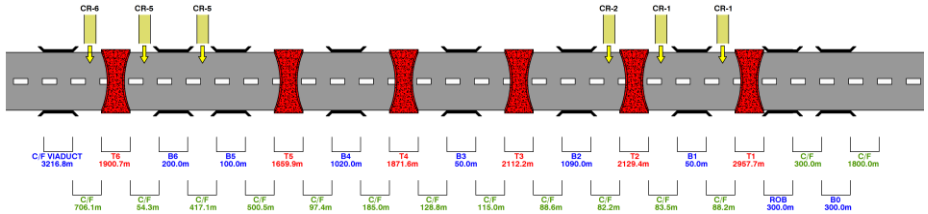
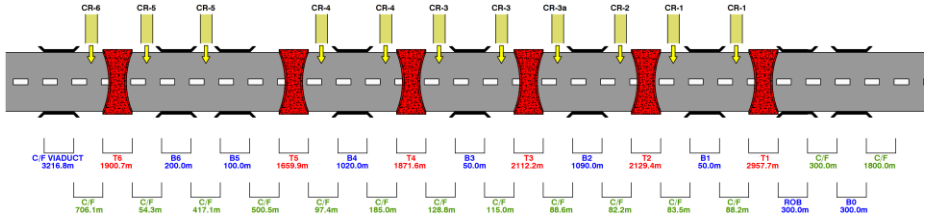
5.1.6 Effects on the Environment by the Construction Roads

The more length as well as the number of the construction road is required, the larger forest area is required to be cut as well as the higher chance of the roads come across river/stream where is the habitats of the rare and endangered amphibians and fishes. Thus, the risks to have negative impact on the local ecosystem increase.

In addition, longer construction terms could have more negative impacts on migration of mammals between the north and south ecosystem in the Western Ghats by longer terms of noise and vibration.

The followings describe the possible impacts on local ecosystem by the project. .

Table 5.1.4 Construction Schedule and Evaluation of Impacts on the Environment of Construction Roads

Case	Outline Drawing	Comparison Items		
Case-1	 Construction of construction roads is not necessary.	Summary	One-way tunneling from the start point and the end point of the bypass + No construction of construction roads.	
		Construction Period	Construction Road	Not necessary
			Bypass (Ratio)	1.00
		Impacts on the Environment	The major negative impacts are caused by construction as well as the land use alteration by cut & fill part only, not from construction road. On the other hand, this case requires the longest construction term which could give the longest disturbance toward mammal migrations by noise and vibration.	
Case-2	 161,000m^2 of forest area is required for the construction road.	Summary	One-way tunneling from the start point and the end point of the bypass + Construction of construction roads by utilizing the existing roads 1 & 3.	
		Construction Period	Construction Road	Approx. 6.6 months (Construction period of AR-5)
			Bypass (Ratio)	0.54
		Impacts on the Environment	The major negative impacts are caused by the alteration of land use in the cut and fill part of the planed alignment of the bypass as well as the construction roads. This case requires shorter construction road as well as smaller number of river/streams in the construction zone with about half construction term. Thus, the case 2 gives medium impacts on fish and amphibians while gives medium impacts on the migration of mammals by noise and vibration.	
Case-3	 318,000m^2 of forest area is required for the construction road.	Summary	One-way tunneling from the start point and the end point of the bypass + Construction of construction roads by utilizing the existing roads 1, 2 & 3.	
		Construction Period	Construction Road	Approx. 7.3 months (Construction period of AR-3a)
			Bypass (Ratio)	0.22
		Impacts on the Environment	This case requires the longest construction road as well as the biggest number of river/streams in the construction zone. Thus the impact on fish and amphibians by the construction road is the biggest in case 3. On the other hand, case 3 requires the shortest construction term and thus, the case have the smallest impacts on the migration of mammals.	

5.1.7 Challenges in the Future

1) Detailed Study on Construction Roads

Since no study has been conducted on construction roads for the Shiradi Ghats bypass in the previous studies, this study examined the outline of construction roads considering the utilization of the existing roads. As a result of the examination, it is found out that the existing roads are few which can be utilized as construction roads. Thus, the possibility is high that it necessitates large-scale new construction roads (the total length of construction roads examined in this study is approximately 34km). In addition, considering the fact that the project area is located in reserved forests where rare species are reported to exist, more detailed examination is necessary on alignments and structures of construction roads. In detailed examination of construction roads, it is important to examine structures and construction schedule considering the impacts on the environment based on the information obtained from topographic survey and boring survey.

Furthermore, the construction schedule of the whole Shiradi Ghats bypass largely depends on the construction of construction roads. Therefore, the construction roads shall be planned considering not only impacts on the environment but also the efficiency of construction of the whole Shiradi Ghats bypass.

2) Possibility of Utilization of Existing Railway

There exists a railway along mountains in the south of NH48. The existing railway is a single-track railway constructed approximately 50 years ago and runs twice a day (morning and evening). As is located near the Shiradi Ghats bypass, it may be possible to utilize it as a transportation method of construction materials and construction generated soil. In examination of the detailed construction schedule, it is necessary to consult with counterparts and to coordinate with the railway manager (Indian Railway) when needed on the utilization of the existing railway as a transportation method of materials and soil.

3) Disposal Sites of Construction Generated Soil

Twelve tunnels are planned in total of up and down lanes for the Shiradi Ghats bypass. The excavated soil of tunnel is estimated to be approximately 3,900,000m^3. Construction generated soil shall be used as fill of this construction as much as possible. At the same time, it is necessary to examine with counterparts the appropriate location of soil disposal sites including effective utilization of construction generated soil. Moreover, it is important to fully examine treatment methods of construction generated soil (procedures of treatment).

4) Environmental Measures for the Bypass

As mentioned above, the planned area of the Shiradi Ghats bypass is located in reserved forests where rare species are reported to exist. In design and construction of the Bypass and its construction roads, it is important to minimize impacts on the environment by taking environmentally friendly measures. For this purpose, it is necessary to conduct more detailed study on the presence of houses and facilities near the planned area, the existence of fauna and flora to be considered and the surrounding environment such as groundwater use. Based on the survey, in the following design and construction phases, it is also necessary to plan appropriate measures to impacts caused by the construction of the Bypass and construction roads such as changes of geographical features, noise and vibration and groundwater lowering by tunnel excavation.

5) Management of Construction Roads after Construction

The Shiradi Ghats bypass is a road of the length of 23.5 km comprised of a series of structures. It is necessary to secure escape roads for the safety of users in case of occurrence of serious accidents such as fire on the road. In the KD-6 project under implementation, lateral piles are planned to connect up and down lanes of tunnels and they can be used as escape roads. Construction roads can also be used as escape roads if they are maintained after operation. On the other hand, as the planned area is located in reserved forests, it may be desirable to remove construction roads after operation in order to restore the present conditions. Therefore, it is necessary to consult with counterparts in order to determine the policy of how to deal with construction roads after operation from various perspectives.

5.2 Results of the Field Survey

5.2.1 AMPHIBIANS

This survey has listed 37 species of amphibians from the region with 36 species frogs and toads and one species of caecilian. Of the 37 species, 33 species are endemic to the Western Ghats, which clearly indicates the exclusive species composition of the region. The presence of critically endangered species like Indirana gundia (Semi-aquatic), Micrixalus kottigeharensis (Aquatic) and Raorchestes ponmudi (Arboreal) indicates the diverse habitats and presence of micro-habitat for these species. Presence of 27 species within 0-5m from stream is a clear indication of stream dependency in these amphibians.

Amphibian richness in the study area clearly indicates

- Perennial streams
- Diverse micro-habitats
- Closed canopy
- Least human impacts in the area.

By the results of the field survey, all the sampling points possess not only high species richness but also hold critically endangered, stream dependent and endemic species of amphibians of the Western Ghats.

Hence, without appropriate avoidance and mitigation measures, any modification in any of the streams and/or micro-habitats and/or canopies can be detrimental to maintaining the current amphibian richness.

Table 5.2.1 List of Amphibians Found in Designated Sampling Points

Species	1	2	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Duttaphrynus melanostictus		+		+	+				+			+								+
Ghatophryne ornata	+										+	+	+			+	+		+	
Microhyla ornata									+											
Microhyla sholigari	+								+											
Uperodon triangularis																				+
Uperodon mormoratus									+											
Micrixalus elegans	+		+	+	+	+	+	+	+		+	+		+		+	+	+	+	+
Micrixalus saxicolas	+														+			+		
Micrixalus kottigeharensis		+	+	+	+	+	+	+	+	+	+	+		+	+	+	+	+	+	+
Nyctibatrachus Kumbara	+				+	+			+			+		+	+	+	+			+
Nyctibatrachus grandis		+		+						+	+							+		
Nyctibatrachus kempholeyensis	+	+	+	+	+	+	+	+	+		+	+	+	+	+	+	+			+
Nyctibatrachus sanctipalustris				+			+	+					+		+			+		
Fejervarya granosa				+	+	+						+								+
Fejervarya mudduraja			+	+					+							+				
Fejervarya caperata		+			+				+			+								+
Fejervarya sahyadris	+								+										+	+
Fejervarya rufescens	+																		+	
Euphlyctis cyanophlyctis		+			+	+	+	+	+											+
Euphlyctis mudigeri			+	+						+										
Spaherotheca breviceps										+										
Indosylvirana intermedius	+	+	+	+			+	+	+		+					+				+
Indosylvirana montanus							+	+		+	+									+
Clinotarsus curtipes					+				+		+				+					
Indirana semipalmata		+	+				+	+	+				+			+				
Indirana gundia	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Raorchestes ochlandrae	+						+	+	+											

5.2.2 FLORA

Among the species documented, 77.17% of the species were found to be Western Ghats endemics and 16.93% species are RET category. Among all the species, the highly endemic and threatened species include Dimorphocalyx beddomei, Dipterocarpus indicus, Dysoxylum malabaricum, Hopea erosa, H. parviflora, H. ponga, Kingiodendron pinnatum, Madhuca neriifolia, Nothopegia beddomei, Psychotria macrocarpa, Syzgygium travancoticum, Syzygium zeylanicum and Vateria indica that were found in this relic forest.

The evergreen forest is a multi-storied forest in which the top stratum is represented by tall evergreen trees in association with giant woody climbers (liana). The tall trees like Vateria indica, Dipterocarpus indicus, Dysoxylum malabaricum, Kingiodendron pinnatum, Lophopetalum wightianum, and Bischopia javanica, among others, are common in the forests. The woody climbers like Ventilago madarapatana, Gnetum ula, Combretum latifolium, Embelia ribes, and Bauhinia phoenecia formed a canopy in association with the major trees. The canopy cover in these forest areas is 85-90%.

The regenerating species represented by 164 species including trees, shrubs, climbers and liana of 115 genera belonging to 44 diverse families with an overall density of 30970 stems/ha. Species such as Vateria indica, Hopea ponga, Dimocarpus longan, Kingiodendron pinnatum and Palquium ellipticum were found in the highest density throughout the forest. However, these species along with endemic species like Dipterocarpus indicus and Gymnacranthera canarica were also found to be the most dominant and frequently occurring species in the forest. The regenerating plots suggested that all the species are not equally abundant because regenerating plots are dominated by shrubby species.

Table 5.2.2 List of Plants Found in Designated Sampling Points

No.	Species	Habit	Family	IUCN Red List	Distribution	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	*Achornychia pedunculata*	T	Rutaceae	*Not Listed*			+				+				+		+	+				+		+		
2	*Actinodaphne hookeri*	T	Lauraceae	*Not Listed*	Endemic					+	+				+			+						+		
3	*Actinodaphne malabarica*	T	Lauraceae	*Not Listed*	Endemic						+		+			+	+					+			+	
4	*Aglaia barberi*	T	Meliaceae	*Not Listed*	Endemic				+											+	+		+	+		
5	*Aglaia elaegnoidea*	T	Meliaceae	Lower Risk/ least concern	Endemic		+			+	+				+	+						+	+			
6	*Aglaia lawii*	T	Meliaceae	Lower Risk/ least concern	Endemic	+			+	+	+					+	+	+		+	+					
7	*Agrostistachys indica*	T	Euphorbiaceae	*Not Listed*																						
8	*Albizia chinensis*	T	Fabaceae	*Not Listed*																			+			
9	*Allophyllus cobbe*	S	Sapindaceae	*Not Listed*			+								+									+		
10	*Alstonia scholaris*	T	Apocynaceae	Lower Risk/ least concern		+			+						+		+		+		+	+		+	+	
11	*Anamirta cocculus*	L	Menispermaceae	*Not Listed*	Endemic	+																				
12	*Ancistrocladus heyneanus*	L	Dipterocarpaceae	*Not Listed*													+									
13	*Angiopteris sps*	F	Pterideae	*Not Listed*	Endemic																					+
14	*Antidesma menasu*	S	Euphorbiaceae	*Not Listed*	Endemic														+	+						
17	*Apama siliquosa*	S	Aristolochiaceae	*Not Listed*							+				+	+		+	+				+		+	
15	*Aphanamyxis polystachya*	T	Meliaceae	Lower Risk/ least concern	Endemic						+							+	+							
16	*Aphananthe cuspidata*	T	Ulmaceae	*Not Listed*	Endemic						+					+										
18	*Apodytes beddomei*	T	Icacinaceae	*Not Listed*	Endemic											+	+									
19	*Aporosa lindleayana*	T	Euphorbiaceae	*Not Listed*											+			+					+		+	
20	*Archidendron monadelphum*	T	Fabaceae	*Not Listed*		+									+											+
21	*Arenga wightii*	P	Arecaceae	Vulnerable	Endemic						+	+			+	+		+	+	+			+			
22	*Aristolochia tagala*	C	Aristolochiaceae	*Not Listed*	Endemic					+																
25	*Artocapus gomezianus*	T	Moraceae	*Not Listed*						+																
23	*Artocarpus heterophyllus*	T	Moraceae	*Not Listed*			+				+				+			+						+	+	
24	*Artocarpus hirsutus*	T	Moraceae	*Not Listed*	Endemic		+		+		+		+		+	+	+	+		+				+	+	
26	*Atalantia racemosa*	S	Rutaceae	*Not Listed*					+	+					+		+									
27	*Atalantia wightii*	S	Rutaceae	*Not Listed*	Endemic						+					+										
28	*Bauhinia phoenicea*	L	Fabaceae	*Not Listed*	Endemic	+						+	+	+												
29	*Beilschmiedia wightii*	T	Lauraceae	*Not Listed*	Endemic	+			+		+					+				+	+					
30	*Bischopia javanica*	T	Euphorbiaceae	*Not Listed*					+		+					+	+	+	+	+	+	+				
31	*Blachia denuadata*	S	Euphorbiaceae	*Not Listed*	Endemic	+																	+			
32	*Blachia reflexa*	S	Euphorbiaceae	*Not Listed*	Endemic									+								+				
33	*Blepharistemma membranifoliu*	S	Rhizophoraceae	*Not Listed*	Endemic																	+	+	+	+	
34	*Cajanus lineatus*	S	Fabaceae	*Not Listed*																				+		
35	*Calamus sps*	S	Arecaceae	*Not Listed*	Endemic				+		+	+	+		+	+	+	+	+						+	+
36	*Calicarpa tomentosa*	S	Verbenaceae	*Not Listed*							+				+											
37	*Calophyllum apetalum*	T	Clusiaceae	Vulnerable	Endemic										+											
38	*Calophyllum austroindicum*	T	Clusiaceae	*Not Listed*	Endemic						+												+			
39	*Calophyllum polyanthum*	T	Clusiaceae	*Not Listed*	Endemic	+			+		+	+				+		+	+				+			
40	*Calycopteris floribunda*	L	Combretaceae	*Not Listed*											+										+	+
41	*Canarium strictum*	T	Burseraceae	*Not Listed*	Endemic				+	+											+				+	
42	*Canthium angustifolium*	S	Rubiaceae	*Not Listed*							+				+		+								+	
43	*Canthium dicocum*	T	Rubiaceae	*Not Listed*	Endemic	+	+								+											
44	*Carallia brachiata*	T	Rhizophoraceae	*Not Listed*		+									+			+								
45	*Caryota urens*	P	Arecaceae	LC		+	+		+	+	+		+	+	+		+	+		+	+			+	+	
46	*Casearia escelanta*	T	Flacourtiaceae	*Not Listed*	Endemic		+					+		+		+					+		+	+	+	+
47	*Casearia ovata*	T	Flacourtiaceae	*Not Listed*	Endemic						+					+										
48	*Cassine glauca*	T	Celastraceae	*Not Listed*																				+		
49	*Celtis philippensis*	T	Ulmaceae	*Not Listed*						+					+											
50	*Chasalia ophioxiloides*	S	Rubiaceae	*Not Listed*	Endemic						+					+				+						
51	*Chionanthus malabarica*	S	Oleaceae	*Not Listed*	Endemic				+	+			+		+											
52	*Chonemorpha fragrans*	C	Apocynaceae	*Not Listed*	Endemic										+											
53	*Chrysophyllum lanceolatum*	T	Sapotaceae	*Not Listed*	Endemic		+											+								
54	*Cinamomum macrocarpum*	T	Lauraceae	*Not Listed*	Endemic	+	+			+	+	+				+	+	+	+	+		+	+			
55	*Cinnamomum heyneana*	T	Lauraceae	*Not Listed*	Endemic	+																				
56	*Cinnamomum malabatrum*	T	Lauraceae	*Not Listed*	Endemic	+					+				+								+			
57	*Clausena dentata*	T	Rutaceae	*Not Listed*			+																			
58	*Cleidon spicifloum*	T	Euphorbiaceae	*Not Listed*	Endemic				+							+										
59	*Clerodendron viscosum*	S	Verbenaceae	*Not Listed*							+				+									+		
60	*Combretum latifolium*	L	Combretaceae	*Not Listed*					+						+					+				+	+	
61	*Combretum ovalifolium*	L	Combretaceae	*Not Listed*							+						+									
62	*Connarus wightii*	L	Connaraceae	*Not Listed*	Endemic	+																			+	

List of Plants Found in Designated Sampling Points (Continued)

No.	Species	Habit	Family	IUCN Red List	Distribution	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
63	*Croton malabaricus*	T	Euphorbiaceae	*Not Listed*	Endemic						+	+		+												
64	*Cynometra iripa*	T	Fabaceae	*Least Concern*	Endemic							+	+			+										
65	*Debregeasia longifolia*	S	Urticaceae	*Not Listed*					+																	
66	*Derris brevipes*	L	Fabaceae	*Not Listed*													+									
67	*Derris heyneana*	L	Fabaceae	*Not Listed*					+							+									+	+
68	*Desmos lawii*	L	Anonaceae	*Not Listed*											+							+				+
69	*Dichapetalum gelanoides*	S	Dichapetalaceae	*Not Listed*	Endemic		+			+	+				+	+	+									
70	*Dillenia pentagyna*	T	Dilleniaceae	*Not Listed*		+									+									+		
71	*Dimocarpus longan*	T	Sapindaceae	Lower Risk/ near threatened	Endemic	+	+		+		+		+	+	+	+	+	+	+	+	+	+	+	+	+	+
72	*Dimorphocalyx beddomei*	T	Euphorbiaceae	Endangered	Endemic																					
73	*Diospyros angustifolia*	T	Ebenaceae	*Not Listed*	Endemic						+			+												
74	*Diospyros assimilis*	T	Ebenaceae	*Not Listed*	Endemic															+	+		+		+	
75	*Diospyros buxifolia*	T	Ebenaceae	*Not Listed*	Endemic							+	+					+								
76	*Diospyros candolleana*	T	Ebenaceae	Vulnerable	Endemic						+				+											
77	*Diospyros crumenata*	T	Ebenaceae	Endangered	Endemic						+															
78	*Diospyros montana*	T	Ebenaceae	*Not Listed*						+					+											
79	*Diospyros ocarpa*	T	Ebenaceae	*Not Listed*								+														
80	*Diospyros paniculata*	T	Ebenaceae	Vulnerable												+										
81	*Diospyros pruriens*	T	Ebenaceae	*Not Listed*	Endemic				+		+	+				+		+	+							
82	*Diospyros sylavtica*	T	Ebenaceae	*Not Listed*	Endemic		+		+		+	+		+	+	+		+	+	+	+	+		+		+
83	*Diploclisia glaucascens*	L	Menispermaceae	*Not Listed*	Endemic										+		+									
84	*Dipterocarpus indicus*	T	Dipterocarpaceae	Endangered	Endemic	+			+		+	+	+			+	+	+	+	+	+				+	
85	*Drypetes confertiflorus*	T	Euphorbiaceae	*Not Listed*	Endemic																					
86	*Drypetes oblongifolia*	T	Euphorbiaceae	*Not Listed*	Endemic						+					+										
87	*Drypetes wightii*	T	Euphorbiaceae	Vulnerable	Endemic									+		+	+	+					+			
88	*Dysoxylum malabaricum*	T	Meliaceae	Endangered	Endemic				+							+	+				+		+			
89	*Elaeagnus conferta*	L	Elaeagnaceae	Endangered											+										+	+
90	*Elaeocarpus serratus*	T	Elaeocarpaceae	*Not Listed*														+						+		
91	*Elaeocarpus tuberculatus*	T	Elaeocarpaceae	*Not Listed*	Endemic	+			+	+	+			+											+	
92	*Embelia ribes*	L	Myrsinaceae	*Not Listed*	Endemic															+						
93	*Ensette superbum*	S	Mussaceae	*Not Listed*																+		+				
94	*Entada pursaetha*	L	Fabaceae	*Not Listed*			+								+										+	
95	*Eugenia codyensis*	S	Myrtaceae	*Not Listed*												+									+	
96	*Eugenia macrocephala*	S	Myrtaceae	*Not Listed*	Endemic													+					+			
97	*Eugenia thwiatesii*	S	Myrtaceae	*Not Listed*	Endemic	+	+		+		+						+									
98	*Euodia lunu-ankenda*	T	Rutaceae	Endangered	Endemic	+			+							+				+						
99	*Euonymus angulatus*	T	Celastraceae	Endangered	Endemic		+													+						
100	*Exacum tetragonum*	H	Gentianaceae	*Not Listed*					+												+					
101	*Fagraea ceilanica*	L	Loganiaceae	*Not Listed*					+												+					
102	*Fahrentia zeylanica*	T	Euphorbiaceae	*Not Listed*	Endemic											+	+	+	+							
103	*Ficus callosa*	T	Moraceae	*Not Listed*													+			+				+		
104	*Ficus hispida*	T	Moraceae	*Not Listed*							+															
105	*Ficus nervosa*	T	Moraceae	*Not Listed*	Endemic	+				+								+	+	+	+		+	+	+	
106	*Flamengia sps.*	S	Fabaceae	*Not Listed*										+												
107	*Garcinia gummi-gutta*	T	Clusiaceae	*Not Listed*	Endemic	+	+		+	+	+	+	+	+		+	+	+			+			+	+	+
108	*Garcinia indica*	T	Clusiaceae	Vulnerable	Endemic		+			+																
109	*Garcinia morella*	T	Clusiaceae	*Not Listed*	Endemic	+	+				+					+	+	+			+		+		+	
110	*Garcinia talbotii*	T	Clusiaceae	*Not Listed*	Endemic		+				+	+		+			+	+		+			+			
111	*Glochidioan malabaricum*	T	Euphorbiaceae	*Not Listed*								+			+						+					
112	*Glochidion ellipticum*	T	Euphorbiaceae	*Not Listed*	Endemic												+			+						
113	*Glochidion jhonstonei*	T	Euphorbiaceae	*Not Listed*	Endemic	+																				
114	*Gnetum ula*	L	Gnetaceae	LC	Endemic		+									+								+		
115	*Gomphandra tetrandra*	S	Icacinaceae	*Not Listed*	Endemic		+											+	+							
116	*Goniothalamus thwaitesii*	S	Anonaceae	*Not Listed*	Endemic		+																			+
117	*Grewia serrulata*	S	Tiliaceae	*Not Listed*													+									
118	*Grewia tilifolia*	T	Tiliaceae	*Not Listed*		+									+											
119	*Guania microcarpa*	L	Rhamanceae	*Not Listed*												+										
120	*Gymnacranthera canarica*	T	Myristicaceae	Vulnerable	Endemic	+							+	+												+
121	*Habenaria crinifolia*	H	Orchidaceae	*Not Listed*	Endemic																					
122	*Helictres isora*	S	Tiliaceae	*Not Listed*		+																				
123	*Heritiera papilio*	T	Sterculiaceae	*Not Listed*	Endemic																	+				
124	*Holigarna arnottiana*	T	Anacardiaceae	*Not Listed*	Endemic							+			+				+						+	+

List of Plants Found in Designated Sampling Points (Continued)

No.	Species	Habit	Family	IUCN Red List	Distribution	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
125	*Holigarna beddomei*	T	Anacardiaceae	*Not Listed*	Endemic				+		+		+			+	+		+	+	+					
126	*Holigarna feruginea*	T	Anacardiaceae	*Not Listed*	Endemic					+						+									+	
127	*Holigarna grahamii*	T	Anacardiaceae	*Not Listed*	Endemic	+			+		+	+				+	+			+	+		+	+	+	
128	*Hopea erosa*	T	Dipterocarpaceae	Critically Endangered	Endemic																+	+	+			
129	*Hopea parviflora*	T	Dipterocarpaceae	Endangered																					+	
130	*Hopea ponga*	T	Dipterocarpaceae	Endangered	Endemic	+					+	+	+	+	+	+	+	+	+		+	+	+	+	+	+
131	*Humboltia brunonis*	T	Fabaceae	*Not Listed*	Endemic	+					+	+	+	+					+	+					+	
132	*Hydnocarpus alpina*	T	Flacourtiaceae	*Not Listed*	Endemic				+			+														
133	*Hydnocarpus pentandra*	T	Flacourtiaceae	Vulnerable	Endemic		+		+	+	+	+	+		+				+	+						
134	*Impatiens acaulis*	H	Balsaminaceae	*Not Listed*	Endemic														+		+			+		
135	*Impatiens gardneriana*	H	Balsaminaceae	*Not Listed*	Endemic												+	+								
136	*Ixora nigricans*	S	Rubiaceae	*Not Listed*	Endemic					+							+					+			+	+
137	*Ixora sps*	S	Rubiaceae	*Not Listed*						+																
138	*Kingiodendron pinnatum*	T	Fabaceae	Endangered	Endemic	+					+	+	+	+		+	+	+	+	+	+	+	+	+		
139	*Knema attenuata*	T	Myristicaceae	Lower Risk/ least concern	Endemic	+			+		+	+				+	+	+	+	+	+	+			+	+
140	*Kydia calycina*	T	Malvaceae	*Not Listed*						+								+				+				
141	*Lagerstroemia microcarpa*	T	Lythraceae	*Not Listed*	Endemic																			+		
142	*Lagerstroemia speciosa*	T	Lythraceae	*Not Listed*																					+	
143	*Lannea coromandelica*	T	Anacardiaceae	*Not Listed*																		+				
145	*Leea crispa*	S	Leeaceae	*Not Listed*												+	+									
144	*Leea indica*	S	Leeaceae	*Not Listed*																				+		
146	*Lepisanthes subpelatatum*	S	Piperaceae	*Not Listed*																		+				
147	*Litsea floribunda*	T	Lauraceae	*Not Listed*	Endemic		+				+					+										
148	*Litsea ghatica*	T	Lauraceae	*Not Listed*	Endemic																+					
149	*Litsea insignis*	T	Lauraceae	*Not Listed*	Endemic																					
150	*Litsea laevigata*	T	Lauraceae	*Not Listed*	Endemic					+													+		+	
151	*Litsea mysorensis*	T	Lauraceae	*Not Listed*	Endemic	+				+	+		+						+	+	+	+			+	
152	*Lophopetalum wightianum*	T	Celastraceae	Lower Risk/ least concern	Endemic	+	+						+	+											+	+
153	*Luvunga sarmentosa*	L	Rutaceae	*Not Listed*	Endemic																					
154	*Macaranga peltata*	T	Euphorbiaceae	*Not Listed*						+							+				+	+	+		+	
155	*Maduca neriifolia*	T	Sapotaceae	*Not Listed*	Endemic								+	+												
156	*Mallotus philippensis*	T	Euphorbiaceae	*Not Listed*																			+			
157	*Mallotus tetracoccus*	T	Euphorbiaceae	*Not Listed*			+			+											+					
158	*Mangifera indica*	T	Anacardiaceae	Data Deficient			+							+					+		+			+		
159	*Margaretiera indica*	T	Euphorbiaceae	*Not Listed*														+								
160	*Meiogyne ramarowii*	S	Anonaceae	*Not Listed*	Endemic						+															
161	*Memecylon angustifolium*	S	Melastomaceae	*Not Listed*	Endemic																					
162	*Memecylon gracile*	S	Melastomaceae	*Not Listed*	Endemic											+										
164	*Memecylon malabaricum*	S	Melastomaceae	*Not Listed*	Endemic		+				+					+		+		+						
163	*Memecylon terminale*		Melastomaceae	*Not Listed*													+									
165	*Mesua ferrea*	T	Clusiaceae	*Not Listed*	Endemic		+									+	+		+	+						
166	*Mimusops elengii*	T	Sapotaceae	*Not Listed*								+														
167	*Mitragyna tubulosa*	T	Rubiaceae	*Not Listed*	Endemic																					
168	*Moullava spicata*	L	Fabaceae	*Not Listed*	Endemic										+											
169	*Myristica dactyloides*	T	Myristicaceae	Vulnerable	Endemic	+			+		+					+			+	+	+					
170	*Myristica malabarica*	T	Myristicaceae	Vulnerable	Endemic							+				+										
171	*Neolamarckia cadamba*	T	Rubiaceae	*Not Listed*							+		+			+										
172	*Neolitsea foliosa*	T	Lauraceae	*Not Listed*	Endemic													+				+				
173	*Neonauclea purpurea*	T	Rubiaceae	*Not Listed*	Endemic	+																				+
174	*Nothapodytes nimmoniana*	S	Icacinaceae	*Not Listed*	Endemic	+				+					+						+	+				
175	*Nothopegia beddomei*	T	Anacardiaceae	*Not Listed*	Endemic				+							+									+	
176	*Nothopegia heyneana*	T	Anacardiaceae	Lower Risk/near threatened	Endemic					+	+	+				+							+			
177	*Nothopegia racemosa*	T	Anacardiaceae	*Not Listed*	Endemic	+	+			+	+	+					+	+	+	+				+		
178	*Nothopegia travancorica*	T	Anacardiaceae	*Not Listed*	Endemic				+	+			+						+				+		+	
179	*Ochlandra rheedii*	S	Poaceae	*Not Listed*	Endemic	+					+		+							+						+
180	*Octotropis travancorica*	S	Rubiaceae	*Not Listed*	Endemic						+															
181	*Olea dioica*	T	Oleaceae	*Not Listed*	Endemic	+	+		+	+	+			+	+		+	+			+	+	+	+	+	
182	*Orophea erythrocarpa*	S	Anonaceae	*Not Listed*	Endemic				+																	
183	*Otonephelium stipulaceum*	T	Rubiaceae	*Not Listed*	Endemic							+														
184	*Pajanelia longifolia*	T	Bignoniaceae	*Not Listed*			+												+						+	
185	*Palaquium ellipticum*	T	Sapotaceae	*Not Listed*												+	+	+	+		+		+			

List of Plants Found in Designated Sampling Points (Continued)

No.	Species	Habit	Family	IUCN Red List	Distribution	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
186	*Paramignya monophylla*	C	Rutaceae	*Not Listed*							+						+									
187	*Pecteilis gigantea*	H	Oleaceae	*Not Listed*	Endemic																					
188	*Persea macrantha*	T	Lauraceae	*Not Listed*	Endemic				+									+	+							
189	*Pinanga dicksonii*	P	Poaceae	*Not Listed*	Endemic				+			+				+									+	
190	*Pittosporum dasycaulon*	T	Pittosporaceae	*Not Listed*		+																				
191	*Polyalthia fragrans*	T	Anonaceae	*Not Listed*	Endemic				+		+	+					+	+	+	+			+	+		
192	*Pongamia pinnata*	T	Fabaceae	Least Concern			+								+											
193	*Porana malabarica*	C	Convolvulaceae	*Not Listed*																				+		
194	*Prunus ceilanica*	T	Rosaceae	*Not Listed*	Endemic	+																				
195	*Psychotria dalzellii*	S	Rubiaceae	*Not Listed*	Endemic						+													+	+	
196	*Psychotria flavida*	S	Rubiaceae	*Not Listed*									+		+											
197	*Psychotria macrocarpa*	S	Rubiaceae	Endangered	Endemic		+		+							+			+	+				+		
198	*PsYchotria nigra*	S	Rubiaceae	*Not Listed*	Endemic		+									+	+	+			+	+				
199	*Psychotria truncta*	S	Rubiaceae	*Not Listed*	Endemic											+		+			+					
200	*Pterocarpus marsupium*	T	Fabaceae	Vulnerable A1cd			+								+											
201	*Pterospermum diversifolium*	T	Sterculiaceae	*Not Listed*	Endemic								+	+	+					+	+	+	+	+	+	+
202	*Pterospermum rubiginosa*	S	Sterculiaceae	*Not Listed*	Endemic																			+	+	
203	*Randia rugulosa*	L	Rubiaceae	*Not Listed*	Endemic											+										
204	*Raphidophora laciniata*	L	Araceae	*Not Listed*	Endemic													+					+	+		
205	*Reinderditiodendron anaimale*	T	Meliaceae	*Not Listed*	Endemic														+	+		+	+			
206	*Salacoa macrosperma*	L	Celastraceae	*Not Listed*	Endemic					+																
207	*Sarcostigma kleinii*	L	Icacinaceae	*Not Listed*	Endemic					+															+	
208	*Scheiflera micrantha*	L	Aralliaceae	*Not Listed*	Endemic		+																			
209	*Schliechera oleosa*	T	Aralliaceae	*Not Listed*																				+		
210	*Scolopia crenulata*	T	Flacourtiaceae	*Not Listed*	Endemic															+						
211	*Sideroxylon tomentosum*		Sapotaceae	*Not Listed*												+										
212	*Spatholobus parviflorus*	L	Fabaceae	Least Concern					+																	
213	*Spondias pinnata*	T	Anacardiaceae	*Not Listed*																			+			
214	*Sterculia alata*	T	Sterculiaceae	*Not Listed*							+			+	+	+		+		+						
215	*Sterculia guttata*	T	Sterculiaceae	*Not Listed*						+					+		+						+	+	+	
216	*Stereospermum personatum*	T	Bignoniaceae	*Not Listed*										+	+											
217	*Strychnos colubrina*	L	Loganiaceae	*Not Listed*	Endemic																		+			
218	*Symplocos cochinchinensis*	S	Symplocaceae	*Not Listed*									+					+								
219	*Symplocos racemosa*	T	Symplocaceae	*Not Listed*			+						+				+									
220	*Syzygium cumini*	T	Myrtaceae	*Not Listed*		+																		+		
221	*Syzygium densiflorum*	T	Myrtaceae	Vulnerable	Endemic															+						
222	*Syzygium gardneri*	T	Myrtaceae	*Not Listed*	Endemic													+			+	+	+		+	
223	*Syzygium hemisphericum*	T	Myrtaceae	*Not Listed*	Endemic																	+	+			
224	*Syzygium lanceolatum*	T	Myrtaceae	*Not Listed*	Endemic							+														
225	*Syzygium zeylanicum*	T	Myrtaceae	*Not Listed*	Endemic																					
226	*Tabernaemontana heyneana*	S	Apocynaceae	Lower Risk/near threatened			+								+											
227	*Terminalia paniculata*	T	Combretaceae	*Not Listed*		+									+			+						+		
228	*Tetrameles nudiflora*	T	Datiscaceae	Lower Risk/ least concern						+													+	+		
229	*Toddalia asiatica*	L	Rutaceae	*Not Listed*	Endemic																			+		
230	*Toona ciliata*	T	Meliaceae	Lower Risk/ least concern												+	+									
231	*Tragia hispida*	C	Urticaceae	*Not Listed*							+										+					
232	*Trema orientalis*	T	Urticaceae	*Not Listed*										+			+	+								
233	*Trewia paltycarpa*	T	Euphorbiaceae	*Not Listed*					+																	
234	*Tricalysia spherocarpa*	S	Rubiaceae	*Not Listed*	Endemic											+										
235	*Trichilia connaroides*	T	Meliaceae	*Not Listed*	Endemic		+													+				+		+
236	*Tylophora sps.*	C	asclepiadaceae	*Not Listed*															+							
237	*Vateria indica*	T	Dipterocarpaceae	Critically Endangered A1cd	Endemic	+	+		+	+	+	+	+	+		+	+	+	+	+	+			+	+	
238	*Ventilago madaraspatensis*	L	Rhamnaceae	*Not Listed*		+	+			+			+				+	+			+		+		+	
239	*Vepris bilocularis*	T	Rutaceae	*Not Listed*	Endemic		+						+			+							+			
240	*Vitex altissima*	T	Verbenaceae	*Not Listed*		+						+			+								+		+	
241	*Walsura trifolia*	T	Meliaceae	*Not Listed*	Endemic	+			+	+	+	+														+
242	*Wendlandia thyrsoidea*	S	Rubiaceae	*Not Listed*		+																			+	
243	*Xylopia parviflora*	S	Anonaceae	*Not Listed*	Endemic																			+		+
244	*Zanthoxylum rhetsa*	T	Rutaceae	*Not Listed*																			+	+		

T - Tree S- Shrub L - Liana C - Climber E - Endemic

5.2.3 FISHES

The tropical Asian rivers and streams are dominated by diverse riverine habitat leading to highly species rich fish communities. In the entire region, approximately 30 fish species were found across all the sampling sites (first and second phase). The current threatened status as per the IUCN criteria indicated that 1 species each as 'Critically Endangered' and 'Data deficient,' 2 species were 'Endangered,' 3 species were 'Vulnerable' category and more than 15 species were 'Least concern'. Results suggest that fishes have been utilizing diverse habitats depending upon their life stages. Since many fishes spawn during the onset of the monsoon, they prefer the least disturbed stream reaches for breeding purposes, which are often rich in dissolved oxygen, river substratum with adequate canopy cover. Critically endangered species such as Wynaad mahseer prefer shallow as well as deeper pools for feeding and breeding purposes. In the current study, this species was present only at two sites: Abibru hole and Shiradi gadi.

Since many stream fishes utilize diverse habitats for completing their life cycle, any habitat alteration will not only destroy their habitat but will also put them in greater risk of extinction. Fishes responds differently to water quality and stream related characteristics. For instance, headwater stream fishes are mostly habitat specialist feed on canopy insect, detritus and benthic insect. These fishes require rich dissolved oxygen, dense canopy cover and adequate substratum for feeding and breeding. Most generalist species found at a lower elevation floodplain area are specially adapted due to their life history strategies making them adapt to varied environments (low, medium and high disturbance areas).

One of the threats with any anthropogenic intervention in these habitats is the increase in turbidity and sedimentation in these streams. Most endemic fishes are sensitive to anthropogenic disturbance such as stream habitat alteration in the form of removal of river substrate, riparian vegetation and pollution. Removal of riparian vegetation is known to hasten soil erosion. Thus, sediment flow in the streams is likely to affect navigation ability of many migratory stream fishes. Heavy sediment also changes water quality, decreases dissolved oxygen and modifies prime river habitat (gravel bed changes into muddy habitat with sediment cover). The sites numbered 1, 4, 12, 14, 17 and 18 are very important for the survival of resident fishes such as Balitora mysorensis and Bhavania australis. A high level of precautionary measures with minimum damage to the stream habitat is therefore required. Selective logging or narrow strip cutting might cause minimum damage to the stream habitat.

The study results suggest that the stream fish fauna was approximately 10% of the total Western Ghats's fish fauna (330 species) known so far..

Table 5.2.3 List of Fishes Found in Designated Sampling Points

SPECIES AND FAMILY	SAMPLING POINTS																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
CYPRINIDAE																					
Barilius bakeri				5				21	15		15	3									
Barilius canarensis								5	5			1									
Devario malabaricus			2					16	7												
Haludaria melanampyx				6				1													
Garra mullya			6					2	1		2	1									
Garra stenorhynchus												1									
Tor khudree								3													
BALITORIDAE																					
Bhavania australis	4			1								4		11			2	1			
Balitora mysorensis												5									
Nemacheilus spp1	5		1					2							2		1	1	4	6	9
FISH COUNT	9		9	12				50	28		17	15		11	2		3	2	4	6	9
RICHNESS	2	0	3	3	0	0	0	7	4	0	2	6	0	1	1	0	2	2	1	1	1

5.2.4 BIRDS

With approximately 18% of the bird species endemic, two near threatened and one endangered species being observed in the study, the region does gather significance in terms of conservation priorities. Further, with approximately 25% of them having a globally declining trend, threat to the habitat at large could be potentially regressive. With 23 of 81 species being frugivores, they play a key role in dispersal of seeds and hence regeneration of the forests.

Table 5.2.4 List of Birds Found in Designated Sampling Points

Sampling Point 1

Sl No.	Common Name	Scientific Name	Endemicity	IUCN Status	Frugivore/insectivore	Population trends
1	Aisan Fairy-Bluebird	*Irena puella*	Non endemic	Least Concern	Frugivore	Decreasing
2	Tickel's Flower Pecker	*Dicaeum erythrorhynchos*	Non endemic	Least Concern	Frugivore	Stable
3	Rufous babbler	*Turdoides subrufa*	Endemic	Least Concern	Frugivore and insectivore	Stable
4	Malabar Whistling Thrush	*Myophonus horsfieldii*	Endemic	Least Concern	Omnivorous	Unknown
5	Greater racket tailed Drongo	*Dicrurus paradiseus*	Non endemic	Least Concern	Insectivore	Decreasing
6	Yellow Browed Bulbul	*Iole indicIole indicaa*	Non endemic	Least Concern	Omnivorous	Stable
7	White cheeked Barbet	*Psilopogon viridis*	Endemic	Least Concern	Frugivore	Stable
8	Red Whiskered Bulbul	*Pycnonotus jocosus*	Non endemic	Least Concern	Omnivorous	Decreasing
9	Malabar Grey Hornbill	*Ocyceros griseus*	Endemic	Least Concern	Frugivore	Decreasing
10	Orange Minivet	*Pericrocotus flammeus*	Non endemic	Least Concern	Insectivore	Stable
11	Oriental White Eye	*Zosterops palpebrosus*	Non endemic	Least Concern	Insectivore	Decreasing
12	Malabar Parakeet	*Psittacula columboides*	Endemic	Least Concern	Frugivore	Stable
13	Velvet fronted Nuthatch	*Sitta frontalis*	Non endemic	Least Concern	Insectivore	Decreasing
14	White bellied Treepie	*Dendrocitta leucogastra*	Endemic	Least Concern	Omnivorous	Stable
15	Grey fronted green Pigeon	*Treron sp.*	Non endemic	Least Concern	Frugivore	Decreasing
16	Yellow-footed green Pigeon	*Treron affinis*	Non endemic	Least Concern	Frugivore	Increasing
17	Indian Swiftlet	*Aerodramus unicolor*	Endemic to WG	Least Concern	Insectivore	Decreasing
18	Schimittar Babbler	*Pomatorhinus horsfieldii*	Non endemic	Least Concern	Insectivore	Increasing
19	Purple Sunbird	*Cinnyris asiaticus*	Non endemic	Least Concern	Nectar	Stable
20	Greater Coucal	*Centropus sinensis*	Non endemic	Least Concern	Insectivore	Stable
21	Pygmy Woodpecker	*Picoides nanus*	Non endemic	Least Concern	Insectivore	Increasing
22	Lesser flameback Woodpecker	*Dinopium benghalense*	Non endemic	Least Concern	Insectivore	Stable
23	Heart Spotted Woodpecker	*Hemicircus canente*	Non endemic	Least Concern	Insectivore	Decreasing
24	Brown Cheeked Fulvetta	*Alcippe poioicephala*	Non endemic	Least Concern	Insectivore	Decreasing
25	Jungle Crow	*Corvus macrorhynchos*	Non endemic	Least Concern	Omnivorous	Stable
26	White Breasted Kingfisher	*Halcyon smyrnensis*	Non endemic	Least Concern	Insectivore	Increasing
27	White rumped Munia	*Lonchura striata*	Non endemic	Least Concern	Frugivore/ seeds	Stable
28	Crested Serpent Eagle	*Spilornis cheela*	Non endemic	Least Concern	Snakes and lizards. It has also been observed to	Stable
29	Flame throated Bulbul	*Pycnonotus gularis*	Endemic	Not evaluated	Frugivore & insectivore	Unknown
30	Black Eagle	*Ictinaetus malaiensis*	Non endemic	Least Concern	Carnivore	Decreasing

Point 2

Sl No.	Common Name	Scientific Name	Endemicity	IUCN Status	Frugivore/insectivore	Population trends
1	White-cheeked Barbet	*Psilopogon viridis*	Endemic	Least Concern	Frugivore	Stable
2	Greater Flameback	*Chrysocolaptes guttacristatus*	Non endemic	Least Concern	Insectivore	Decreasing
3	Malabar Parakeet	*Psittacula columboides*	Endemic	Least Concern	Frugivore	Stable
4	Greater Racket-tailed Drongo	*Dicrurus paradiseus*	Non endemic	Least Concern	Insectivore	Decreasing
5	Red-whiskered Bulbul	*Pycnonotus jocosus*	Non endemic	Least Concern	Omnivorous	Decreasing
6	Puff-throated Babbler	*Pellorneum ruficeps*	Non endemic	Least Concern	Insectivore	Stable
7	Rufous Babbler	*Turdoides subrufa*	Endemic	Least Concern	Insectivore	Stable
8	Malabar Whistling-Thrush	*Myophonus horsfieldii*	Endemic	Least Concern	Omnivorous	Unknown
9	Southern Hill Myna	*Gracula indica*	non endemic	Unknown	Omnivorous	Unknown
10	Grey Wagtail	*Motacilla cinerea*	Non endemic	Least Concern	Crustaceans and aquatic invertebrates	Stable
11	Crested serpent Eagle	*Spilornis cheela*	Non endemic	Least Concern	Snakes and lizards. It has also been observed to	Stable
12	Flame throated Bulbul	*Pycnonotus gularis*	Endemic	Not evaluated	Frugivore & insectivore	Unknown
13	Crimson backed Sunbird	*Nectarinia minima*	Endemic	Least Concern	Nectar	Stable
14	Short-toed snake Eagle	*Circaetus gallicus*	Non endemic	Least Concern	Snakes and lizards. It has also been observed to	Stable
15	White rumped Munia	*Lonchura striata*	Non endemic	Least Concern	Frugivore/ seeds	Stable
16	Alpine Swift	*Tachymarptis melba*	Non endemic	Least Concern	Insectivore	Stable

Point 4

Sl No.	Common Name	Scientific Name	Endemicity	IUCN Status	Frugivore/insectivore	Population trends
1	Eurasian Collared Dove	*Streptopelia decaocto*	Non endemic	Least Concern	Frugivore	Increasing
2	Malabar Parakeet	*Psittacula columboides*	Endemic	Least Concern	Frugivore	Stable
3	Small green Bee-eater	*Merops orientalis*	Non endemic	Least Concern	Insectivore	Increasing
4	Yellow Wagtail	*Motacilla flava*	Non endemic	Least Concern	Crustaceans and aquatic invertebrates	Decreasing
5	Malabar whistling Thrush	*Myophonus horsfieldii*	Endemic	Least Concern	Omnivorous	Unknown
6	Rufous babbler	*Turdoides subrufa*	Endemic	Least Concern	Insectivore	Stable
7	Purple rumped Sunbird	*Nectarinia zeylonica*	Non endemic	Least Concern	Nectar	Stable
8	Grey Wagtail	*Motacilla cinerea*	Non endemic	Least Concern	Crustaceans and aquatic invertebrates	Stable
9	Dark fronted Babbler	*Rhopocichla atriceps*	Endemic to WG	Least Concern	Insectivore	Decreasing
10	Yellow Browed Bulbul	*Iole indica*	Non endemic	Least Concern	Omnivorous	Stable
11	Copper Smith Barbet	*Psilopogon haemacephalus*	Non endemic	Least Concern	Frugivore	Increasing
12	Purple Sunbird	*Cinnyris asiaticus*	Non endemic	Least Concern	Nectar	Stable
13	Heart spotted Woodpecker	*Hemicircus canente*	Non endemic	Least Concern	Insectivore	Decreasing
14	Red Whiskered Bulbul	*Pycnonotus jocosus*	Non endemic	Least Concern	Omnivorous	Decreasing
15	Crested Serpent Eagle	*Spilornis cheela*	Non endemic	Least Concern	Snakes and lizards. It has also been observed to	Stable
16	Orange Minivet	*Pericrocotus flammeus*	Non endemic	Least Concern	Insectivore	Stable
17	White- bellied Treepie	*Dendrocitta leucogastra*	Endemic	Least Concern	Omnivorous	Stable
18	White rumped Munia	*Lonchura striata*	Non endemic	Least Concern	Frugivore/ seeds	Stable
19	Flame throated Bulbul	*Pycnonotus gularis*	Endemic	Not evaluated	Frugivore & insectivore	Unknown
20	Velvet fronted Nuthatch	*Sitta frontalis*	Non endemic	Least Concern	Insectivore	Decreasing

List of Birds Found in Designated Sampling Points (Continued)

Point 5

Sl No.	Common Name	Scientific Name	Endemicity	IUCN Status	Frugivore/insectivore	Population trends
1	Malabar Parakeet	*Psittacula columboides*	Endemic	Least Concern	Frugivore	Stable
2	Malabar whistling Thrush	*Myophonus horsfieldii*	Endemic	Least Concern	Omnivorous	Unknown
3	Rufous Babbler	*Turdoides subrufa*	Endemic	Least Concern	Insectivore	Stable
4	Purple rumped Sunbird	*Nectarinia zeylonica*	Non endemic	Least Concern	Nectar	Stable
5	Dark fronted babbler	*Rhopocichla atriceps*	Endemic to WG	Least Concern	Insectivore	Decreasing
6	Yellow Browed Bulbul	*Iole indicIole indicaa*	Non endemic	Least Concern	Omnivorous	Stable
7	Copper Smith Barbet	*Psilopogon haemacephalus*	Non endemic	Least Concern	Frugivore	Increasing
8	Heart spotted Woodpecker	*Hemicircus canente*	Non endemic	Least Concern	Insectivore	Decreasing
9	Red Whiskered Bulbul	*Pycnonotus jocosus*	Non endemic	Least Concern	Omnivorous	Decreasing
10	Orange Minivet	*Pericrocotus flammeus*	Non endemic	Least Concern	Insectivore	Stable
11	White- bellied Treepie	*Dendrocitta leucogastra*	Endemic	Least Concern	Omnivorous	Stable
12	Flame throated Bulbul	*Pycnonotus gularis*	Endemic	Not evaluated	Frugivore & insectivore	Unknown
13	Jerdon's Leafbird	*Chloropsis jerdoni*	Non endemic	Least Concern	Frugivore & insectivore	Stable
14	Malabar Grey Hornbill	*Ocyceros griseus*	Endemic	Least Concern	Frugivore	Decreasing
15	Oriental White-eye	*Zosterops palpebrosus*	Non endemic	Least Concern	Insectivore	Decreasing
16	Greater Racket-tailed Drongo	*Dicrurus paradiseus*	Non endemic	Least Concern	Insectivore	Decreasing
17	Aisan Fairy-Bluebird	*Irena puella*	Non endemic	Least Concern	Frugivore	Decreasing
18	Black Eagle	*Ictinaetus malaiensis*	Non endemic	Least Concern	Carnivore	Decreasing

Point 6

Sl No.	Common Name	Scientific Name	Endemicity	IUCN Status	Frugivore/insectivore	Population trends
1	Jerdon's Leafbird	*Chloropsis jerdoni*	Non endemic	Least Concern	Frugivore & insectivore	Stable
2	Golden fronted leafbird	*Chloropsis aurifrons*	Non endemic	Least Concern	Frugivore & insectivore	Stable
3	Malabar Grey Hornbill	*Ocyceros griseus*	Endemic	Least Concern	Frugivore	Decreasing
4	Spangled Drongo/	*Dicrurus hottentottus*	Non endemic	Least Concern	Insectivore	Unknown
5	White Cheeked Barbet	*Psilopogon viridis*	Endemic	Least Concern	Frugivore	Stable
6	White rumped Munia	*Lonchura striata*	Non endemic	Least Concern	Frugivore/ seeds	Stable
7	Southern Hill Myna	*Gracula indica*	non endemic	Unknown	Omnivorous	Unknown
8	Coppersmith Barbet	*Psilopogon haemacephalus*	Non endemic	Least Concern	Frugivore	Increasing
9	Red Whiskered Bulbul	*Pycnonotus jocosus*	Non endemic	Least Concern	Omnivorous	Decreasing
10	Western Spotted Dove	*Spilopelia suratensis*	Non endemic	Least Concern	Frugivore	Increasing
11	White Bellied Treepie	*Dendrocitta leucogastra*	Endemic	Least Concern	Omnivorous	Stable
12	Grey Wagtail	*Motacilla cinerea*	Non endemic	Least Concern	Crustaceans and aquatic invertebrates	Stable
13	Orange Minivets	*Pericrocotus flammeus*	Non endemic	Least Concern	Insectivore	Stable
14	Rufous Babbler	*Turdoides subrufa*	Endemic	Least Concern	Insectivore	Stable
15	Aisan Fairy-Bluebird	*Irena puella*	Non endemic	Least Concern	Frugivore	Decreasing
16	Asian Palm Swift	*Cypsiurus balasiensis*	Non endemic	Least Concern	Insectivore	Stable
17	Indian Swiftlet	*Aerodramus unicolor*	Endemic to WG	Least Concern	Insectivore	Decreasing
18	Common Tailor Bird	*Orthotomus sutorius*	Non endemic	Least Concern	Insectivore	Stable
19	Oriental White-eye	*Zosterops palpebrosus*	Non endemic	Least Concern	Insectivore	Decreasing
20	Common Iora	*Aegithina tiphia*	Non endemic	Least Concern	Insectivore	Unknown
21	Oriental Magpie Robin	*Copsychus saularis*	Non endemic	Least Concern	Insectivore	Stable
22	Small blue Kingfisher	*Alcedo atthis*	Non endemic	Least Concern	Fishes and Crustaceans	Unknown
23	White-throated Kingfisher	*Halcyon smyrnensis*	Non endemic	Least Concern	Insectivore	Increasing
24	Little Spiderhunter	*Arachnothera longirostra*	Non endemic	Least Concern	Insectivore	Stable
25	White-browed Bulbul	*Pycnonotus luteolus*	Non endemic	Least Concern	Frugivore/ Insectivore	Stable
26	Yellow-browed Bulbul	*Iole indicIole indicaa*	Non endemic	Least Concern	Omnivorous	Stable
27	Flame throated Bulbul	*Pycnonotus gularis*	Endemic	Not evaluated	Frugivore/ Insectivore	Unknown
28	Barwinged flycatcher shrike	*Hemipus picatus*	Non endemic	Least Concern	Insectivore	Stable
29	White-cheeked Barbet	*Psilopogon viridis*	Endemic	Least Concern	Frugivore	Stable
30	Malabar Barbet	*Psilopogon malabaricus*	Endemic	Least Concern	Frugivore	Decreasing
32	Malabar Parakeet	*Psittacula columboides*	Endemic	Least Concern	Frugivore	Stable
33	Heart-spotted Woodpecker	*Hemicircus canente*	Non endemic	Least Concern	Insectivore	Decreasing
34	Greater Racket-tailed Drongo	*Dicrurus paradiseus*	Non endemic	Least Concern	Insectivore	Decreasing
35	Bronze Drongo	*Dicrurus aeneus*	Non endemic	Least Concern	Insectivore	Unknown
36	Grey Jungle Fowl	*Gallus sonneratii*	Endemic to India	Endangered	Frugivore/ Insectivore	Decreasing
37	Malabar Pied Hornbill	*Anthracoceros coronatus*	Endemic	Near Threatened	Frugivore	Decreasing
38	Jungle Crow	*Corvus macrorhynchos*	Non endemic	Least Concern	Omnivorous	Stable
39	White-bellied Treepie	*Dendrocitta leucogastra*	Endemic	Least Concern	Omnivorous	Stable
40	Greater Coucal	*Centropus sinensis*	Non endemic	Least Concern	Insectivore	Stable
43	Great Egret	*Ardea alba BirdLife*	Non endemic	Least Concern	Fishes and Crustaceans	Unknown
44	Little Cormorant	*Microcarbo niger*	Non endemic	Least Concern	Fishes and Crustaceans	Unknown
45	Dark fronted Babbler	*Rhopocichla atriceps*	Endemic to WG	Least Concern	Insectivore	Decreasing
46	Puff-throated Babbler	*Pellorneum ruficeps*	Non endemic	Least Concern	Insectivore	Stable
47	Black Kite	*Milvus migrans*	Non endemic	Least Concern	Carnivore	Unknown
48	Brahminy Kite	*Haliastur indus*	Non endemic	Least Concern	Carnivore	Decreasing
49	Shikra	*Accipiter badius*	Non endemic	Least Concern	Carnivore	Stable
50	Crested Serpent Eagle	*Spilornis cheela*	Non endemic	Least Concern	Snakes and lizards. It has also been observed to	Stable

List of Birds Found in Designated Sampling Points (Continued)

Point 7

Sl No.	Common Name	Scientific Name	Endemicity	IUCN Status	Frugivore/insectivore	Population trends
1	Greater Racket tailed Drongo	*Dicrurus paradiseus*	Non endemic	Least Concern	Insectivore	Decreasing
2	White-browed Bulbul	*Pycnonotus luteolus*	Non endemic	Least Concern	Frugivore/ Insectivore	Stable
3	Malabar Parakeet	*Psittacula columboides*	Endemic	Least Concern	Frugivore	Stable
4	White browed Wagtail	*Motacilla madaraspatensis*	Non endemic	Least Concern	Crustaceans and aquatic invertebrates	Stable
5	Stork billed Kingfisher	*Pelargopsis capensis*	Non endemic	Least Concern	Crustaceans and aquatic invertebrates	Decreasing
6	White Breasted Kingfisher	*Halcyon smyrnensis*	Non endemic	Least Concern	Insectivore	Increasing
7	Lesser Coucal	*Centropus bengalensis*	Non endemic	Least Concern	Frugivore/ Insectivore	Increasing
8	Crested serpent Eagle	*Spilornis cheela*	Non endemic	Least Concern	Snakes and lizards. It has also been observed to	Stable
10	Yellow browed Bulbul	*Iole indicIole indicaa*	Non endemic	Least Concern	Omnivorous	Stable
11	Greater Flameback	*Chrysocolaptes guttacristatus*	Non endemic	Least Concern	Insectivore	Decreasing
12	Alpine Swift	*Tachymarptis melba*	Non endemic	Least Concern	Insectivore	Stable
13	Brown Cheeked Fulvetta	*Alcippe poioicephala*	Non endemic	Least Concern	Insectivore	Decreasing

Point 8

Sl No.	Common Name	Scientific Name	Endemicity	IUCN Status	Frugivore/insectivore	Population trends
1	Greater Racket tailed Drongo	*Dicrurus paradiseus*	Non endemic	Least Concern	Insectivore	Decreasing
2	White-browed Bulbul	*Pycnonotus luteolus*	Non endemic	Least Concern	Frugivore/ Insectivore	Stable
3	Malabar Parakeet	*Psittacula columboides*	Endemic	Least Concern	Frugivore	Stable
4	White browed Wagtail	*Motacilla madaraspatensis*	Non endemic	Least Concern	Crustaceans and aquatic invertebrates	Stable
5	White Breasted Kingfisher	*Halcyon smyrnensis*	Non endemic	Least Concern	Insectivore	Increasing
6	Lesser Coucal	*Centropus bengalensis*	Non endemic	Least Concern	Frugivore/ Insectivore	Increasing
7	Crested serpent Eagle	*Spilornis cheela*	Non endemic	Least Concern	Snakes and lizards. It has also been observed to	Stable
8	Yellow browed Bulbul	*Iole indicIole indicaa*	Non endemic	Least Concern	Omnivorous	Stable
9	Greater Flameback	*Chrysocolaptes guttacristatus*	Non endemic	Least Concern	Insectivore	Decreasing
10	Alpine Swift	*Tachymarptis melba*	Non endemic	Least Concern	Insectivore	Stable
11	Yellow browed Bulbul	*Iole indicIole indicaa*	Non endemic	Least Concern	Omnivorous	Stable
12	Bronze Drongo	*Dicrurus aeneus*	Non endemic	Least Concern	Insectivore	Unknown
13	Aisan Fairy-Bluebird	*Irena puella*	Non endemic	Least Concern	Frugivore	Decreasing
14	Jerdon's Leafbird	*Chloropsis jerdoni*	Non endemic	Least Concern	Frugivore & insectivore	Stable

Point 9

Sl No.	Common Name	Scientific Name	Endemicity	IUCN Status	Frugivore/insectivore	Population trends
1	Greater Racket tailed Drongo	*Dicrurus paradiseus*	Non endemic	Least Concern	Insectivore	Decreasing
2	Malabar Parakeet	*Psittacula columboides*	Endemic	Least Concern	Frugivore	Stable
3	White browed Wagtail	*Motacilla madaraspatensis*	Non endemic	Least Concern	Crustaceans and aquatic invertebrates	Stable
4	White Breasted Kingfisher	*Halcyon smyrnensis*	Non endemic	Least Concern	Insectivore	Increasing
5	Lesser Coucal	*Centropus bengalensis*	Non endemic	Least Concern	Frugivore/ Insectivore	Increasing
6	Crested serpent Eagle	*Spilornis cheela*	Non endemic	Least Concern	Snakes and lizards. It has also been observed to	Stable
7	Yellow browed Bulbul	*Iole indicIole indicaa*	Non endemic	Least Concern	Omnivorous	Stable
8	Grey headed Bulbul	*Pycnonotus priocephalus*	Endemic	Near Threatened	Frugivore/ insectivore	Decreasing
9	Greater Flameback	*Chrysocolaptes guttacristatus*	Non endemic	Least Concern	Insectivore	Decreasing
10	Alpine Swift	*Tachymarptis melba*	Non endemic	Least Concern	Insectivore	Stable
11	Yellow browed Bulbul	*Iole indicIole indicaa*	Non endemic	Least Concern	Omnivorous	Stable
12	Bronze Drongo	*Dicrurus aeneus*	Non endemic	Least Concern	Insectivore	Unknown
13	Aisan Fairy-Bluebird	*Irena puella*	Non endemic	Least Concern	Frugivore	Decreasing
14	Jerdon's Leafbird	*Chloropsis jerdoni*	Non endemic	Least Concern	Frugivore & insectivore	Stable
15	Heart-spotted Woodpecker	*Hemicircus canente*	Non endemic	Least Concern	Insectivore	Decreasing
16	Black Eagle	*Ictinaetus malaiensis*	Non endemic	Least Concern	Carnivore	Decreasing

Point 10

Sl No.	Common Name	Scientific Name	Endemicity	IUCN Status	Frugivore/insectivore	Population trends
1	Purple rumped Sunbird	*Nectarinia zeylonica*	Non endemic	Least Concern	Nectar	Stable
2	White rumped Munia	*Lonchura striata*	Non endemic	Least Concern	Frugivore/ seeds	Stable
3	Tickel's Flower Pecker	*Dicaeum erythrorhynchos*	Non endemic	Least Concern	Frugivore	Stable
4	Asian Palm Swift	*Cypsiurus balasiensis*	Non endemic	Least Concern	Insectivore	Stable
5	Indian Swiftlet	*Aerodramus unicolor*	Endemic to WG	Least Concern	Insectivore	Decreasing
6	Common Tailor Bird	*Orthotomus sutorius*	Non endemic	Least Concern	Insectivore	Stable
7	Oriental White Eye	*Zosterops palpebrosus*	Non endemic	Least Concern	Insectivore	Decreasing
8	Common Iora	*Aegithina tiphia*	Non endemic	Least Concern	Insectivore	Unknown
9	Oriental Magpie Robin	*Copsychus saularis*	Non endemic	Least Concern	Insectivore	Stable
10	Little Spiderhunter	*Arachnothera longirostra*	Non endemic	Least Concern	Insectivore	Stable
11	Southern Hill Myna	*Gracula indica*	non endemic	Unknown	Omnivorous	Unknown
12	Red Whiskered Bulbul	*Pycnonotus jocosus*	Non endemic	Least Concern	Omnivorous	Decreasing
13	Yellow browed Bulbul	*Iole indicIole indicaa*	Non endemic	Least Concern	Omnivorous	Stable
14	Flame throated Bulbul	*Pycnonotus gularis*	Endemic	Not evaluated	Frugivore/ Insectivore	Unknown
15	Barwinged flycatcher shrike	*Hemipus picatus*	Non endemic	Least Concern	Insectivore	Stable
16	White cheeked Barbet	*Psilopogon viridis*	Endemic	Least Concern	Frugivore	Stable
17	Malabar Trogon	*Harpactes fasciatus*	Endemic to WG	Least Concern	Insectivore	Stable
18	Malabar Barbet	*Psilopogon malabaricus*	Endemic	Least Concern	Frugivore	Decreasing
19	Aisan Fairy-Bluebird	*Irena puella*	Non endemic	Least Concern	Frugivore	Decreasing
20	Jerdon's Leafbird	*Chloropsis jerdoni*	Non endemic	Least Concern	Frugivore & insectivore	Stable
21	Vernal Hanging Parrot	*Loriculus vernalis*	Non endemic	Least Concern	Frugivore	Stable
22	Malabar Parakeet	*Psittacula columboides*	Endemic	Least Concern	Frugivore	Stable
23	Orange Minivet	*Pericrocotus flammeus*	Non endemic	Least Concern	Insectivore	Stable
24	Greater Flameback	*Chrysocolaptes guttacristatus*	Non endemic	Least Concern	Insectivore	Decreasing
25	Greater Racket tailed Drongo	*Dicrurus paradiseus*	Non endemic	Least Concern	Insectivore	Decreasing
26	Bronze Drongo	*Dicrurus aeneus*	Non endemic	Least Concern	Insectivore	Unknown
27	White-bellied Treepie	*Dendrocitta leucogastra*	Endemic	Least Concern	Omnivorous	Stable
28	Lesser Coucal	*Centropus bengalensis*	Non endemic	Least Concern	Frugivore/ Insectivore	Increasing
29	White-bellied blue flycatcher	*Cyornis pallipes*	Endemic	Least Concern	Insectivore	Decreasing

List of Birds Found in Designated Sampling Points (Continued)

Point 11

Sl No.	Common Name	Scientific Name	Endemicity	IUCN Status	Frugivore/insectivore	Population trends
1	Orange Minivet	*Pericrocotus flammeus*	Non endemic	Least Concern	Insectivore	Stable
2	Golden oriole	*Oriolus oriolus*	Non endemic	Least Concern	Insectivore	Stable
3	Yellow browed Bulbul	*Iole indicIole indicaa*	Non endemic	Least Concern	Omnivorous	Stable
4	Crimson backed Sunbird	*Nectarinia minima*	Endemic	Least Concern	Nectar	Stable
5	Grey headed Bulbul	*Pycnonotus priocephalus*	Endemic	Near Threatened	Frugivore/ insectivore	Decreasing
6	Malabar whistling Thrush	*Myophonus horsfieldii*	Endemic	Least Concern	Omnivorous	Unknown
7	Velvet fronted Nuthatch	*Sitta frontalis*	Non endemic	Least Concern	Insectivore	Decreasing
8	Brown headed Barbet	*Psilopogon zeylanicus*	Non endemic	Least Concern	Frugivore	Stable
9	Purple Sunbird	*Cinnyris asiaticus*	Non endemic	Least Concern	Nectar	Stable
10	Aisan Fairy-Bluebird	*Irena puella*	Non endemic	Least Concern	Frugivore	Decreasing
11	Greater Flameback	*Chrysocolaptes guttacristatus*	Non endemic	Least Concern	Insectivore	Decreasing
12	Pygmy Woodpecker	*Picoides nanus*	Non endemic	Least Concern	Insectivore	Increasing
13	White-bellied Treepie	*Dendrocitta leucogastra*	Endemic	Least Concern	Omnivorous	Stable
14	Greater Racket tailed Drongo	*Dicrurus paradiseus*	Non endemic	Least Concern	Insectivore	Decreasing

Point 12

Sl No.	Common Name	Scientific Name	Endemicity	IUCN Status	Frugivore/insectivore	Population trends
1	Orange Minivet	*Pericrocotus flammeus*	Non endemic	Least Concern	Insectivore	Stable
2	Golden oriole	*Oriolus oriolus*	Non endemic	Least Concern	Insectivore	Stable
3	Yellow browed Bulbul	*Iole indicIole indicaa*	Non endemic	Least Concern	Omnivorous	Stable
4	Malabar whistling Thrush	*Myophonus horsfieldii*	Endemic	Least Concern	Omnivorous	Unknown
5	Crimson backed Sunbird	*Nectarinia minima*	Endemic	Least Concern	Nectar	Stable
6	Brown headed Barbet	*Psilopogon zeylanicus*	Non endemic	Least Concern	Frugivore	Stable
7	Purple Sunbird	*Cinnyris asiaticus*	Non endemic	Least Concern	Nectar	Stable
8	Pygmy Woodpecker	*Picoides nanus*	Non endemic	Least Concern	Insectivore	Increasing
9	White-bellied Treepie	*Dendrocitta leucogastra*	Endemic	Least Concern	Omnivorous	Stable
10	Greater Flameback	*Chrysocolaptes guttacristatus*	Non endemic	Least Concern	Insectivore	Decreasing
11	Common Flameback	*Dinopium javanense*	Non endemic	Least Concern	Insectivore	Decreasing

Point 13

Sl No.	Common Name	Scientific Name	Endemicity	IUCN Status	Frugivore/insectivore	Population trends
1	Short-toed snake Eagle	*Circaetus gallicus*	Non endemic	Least Concern	Snakes and lizards. It has also been observed to	Stable
2	Red Whiskered Bulbul	*Pycnonotus jocosus*	Non endemic	Least Concern	Omnivorous	Decreasing
3	Purple Sunbird	*Cinnyris asiaticus*	Non endemic	Least Concern	Nectar	Stable
4	Crimson backed Sunbird	*Nectarinia minima*	Endemic	Least Concern	Nectar	Stable
5	Dark fronted Babbler	*Rhopocichla atriceps*	Endemic to WG	Least Concern	Insectivore	Decreasing
6	Jerdon's Leafbird	*Chloropsis jerdoni*	Non endemic	Least Concern	Frugivore & insectivore	Stable
7	Loten's Sunbird/ Long-billed Sunbird	*Nectarinia lotenia*			Nectar	
8	Grey Wagtail	*Motacilla cinerea*	Non endemic	Least Concern	Crustaceans and aquatic invertebrates	Stable
9	Malabar whistling Thrush	*Myophonus horsfieldii*	Endemic	Least Concern	Omnivorous	Unknown
10	Orange Minivet	*Pericrocotus flammeus*	Non endemic	Least Concern	Insectivore	Stable

Point 15

Sl No.	Common Name	Scientific Name	Endemicity	IUCN Status	Frugivore/insectivore	Population trends
1	Flame throated Bulbul	*Pycnonotus gularis*	Endemic	Not evaluated	Frugivore/ Insectivore	Unknown
2	Crimson backed Sunbird	*Nectarinia minima*	Endemic	Least Concern	Nectar	Stable
3	Malabar Barbet	*Psilopogon malabaricus*	Endemic	Least Concern	Frugivore	Decreasing
4	Malabar Parakeet	*Psittacula columboides*	Endemic	Least Concern	Frugivore	Stable
5	Orange Minivet	*Pericrocotus flammeus*	Non endemic	Least Concern	Insectivore	Stable
6	Asian brown flycatcher	*Muscicapa dauurica*	Non endemic	Least Concern	Insectivore	Stable
7	White-bellied blue flycatcher	*Cyornis pallipes*	Endemic	Least Concern	Insectivore	Decreasing
8	Red Whiskered Bulbul	*Pycnonotus jocosus*	Non endemic	Least Concern	Omnivorous	Decreasing
9	Southern Hill Myna	*Gracula indica*	non endemic	Unknown	Omnivorous	Unknown
10	Little Spiderhunter	*Arachnothera longirostra*	Non endemic	Least Concern	Insectivore	Stable
11	Jerdon's Leafbird	*Chloropsis jerdoni*	Non endemic	Least Concern	Frugivore & insectivore	Stable

Point 16

Sl No.	Common Name	Scientific Name	Endemicity	IUCN Status	Frugivore/insectivore	Population trends
1	Flame throated Bulbul	*Pycnonotus gularis*	Endemic	Not evaluated	Frugivore/ Insectivore	Unknown
2	Crimson backed Sunbird	*Nectarinia minima*	Endemic	Least Concern	Nectar	Stable
3	Malabar Parakeet	*Psittacula columboides*	Endemic	Least Concern	Frugivore	Stable
4	Orange Minivet	*Pericrocotus flammeus*	Non endemic	Least Concern	Insectivore	Stable
5	Asian brown flycatcher	*Muscicapa dauurica*	Non endemic	Least Concern	Insectivore	Stable
6	White-bellied blue flycatcher	*Cyornis pallipes*	Endemic	Least Concern	Insectivore	Decreasing
7	Red Whiskered Bulbul	*Pycnonotus jocosus*	Non endemic	Least Concern	Omnivorous	Decreasing
8	Southern Hill Myna	*Gracula indica*	non endemic	Unknown	Omnivorous	Unknown
9	Little Spiderhunter	*Arachnothera longirostra*	Non endemic	Least Concern	Insectivore	Stable
10	Jerdon's Leafbird	*Chloropsis jerdoni*	Non endemic	Least Concern	Frugivore & insectivore	Stable
11	Greater Racket tailed Drongo	*Dicrurus paradiseus*	Non endemic	Least Concern	Insectivore	Decreasing
12	Greater Flameback	*Chrysocolaptes guttacristatus*	Non endemic	Least Concern	Insectivore	Decreasing
13	White-bellied Treepie	*Dendrocitta leucogastra*	Endemic	Least Concern	Omnivorous	Stable

List of Birds Found in Designated Sampling Points (Continued)

Point 17

Sl No.	Common Name	Scientific Name	Endemicity	IUCN Status	Frugivore/insectivore	Population trends
1	White cheeked Barbet	*Psilopogon viridis*	Endemic	Least Concern	Frugivore	Stable
2	Crimson backed Sunbird	*Nectarinia minima*	Endemic	Least Concern	Nectar	Stable
3	Malabar Parakeet	*Psittacula columboides*	Endemic	Least Concern	Frugivore	Stable
4	Greater Racket tailed Drongo	*Dicrurus paradiseus*	Non endemic	Least Concern	Insectivore	Decreasing
5	Greater Flameback	*Chrysocolaptes guttacristatus*	Non endemic	Least Concern	Insectivore	Decreasing
6	Common Flameback	*Dinopium javanense*	Non endemic	Least Concern	Insectivore	Decreasing
7	Dark fronted Babbler	*Rhopocichla atriceps*	Endemic to WG	Least Concern	Insectivore	Decreasing
8	Oriental White Eye	*Zosterops palpebrosus*	Non endemic	Least Concern	Insectivore	Decreasing
10	Brown Cheeked Fulvetta	*Alcippe poioicephala*	Non endemic	Least Concern	Insectivore	Decreasing
11	Spangled Drongo/ haird crested Drongo	*Dicrurus hottentottus*	Non endemic	Least Concern	Insectivore	Unknown
12	White rumped Munia	*Lonchura striata*	Non endemic	Least Concern	Frugivore/ seeds	Stable
13	Red spurfowl	*Galloperdix spadicea*	Endemic to India	Least Concern		

Point 18

Sl No.	Common Name	Scientific Name	Endemicity	IUCN Status	Frugivore/insectivore	Population trends
1	White cheeked Barbet	*Psilopogon viridis*	Endemic	Least Concern	Frugivore	Stable
2	Crimson backed Sunbird	*Nectarinia minima*	Endemic	Least Concern	Nectar	Stable
3	Malabar Parakeet	*Psittacula columboides*	Endemic	Least Concern	Frugivore	Stable
4	Greater Racket tailed Drongo	*Dicrurus paradiseus*	Non endemic	Least Concern	Insectivore	Decreasing
5	Greater Flameback	*Chrysocolaptes guttacristatus*	Non endemic	Least Concern	Insectivore	Decreasing
6	Little Spiderhunter	*Arachnothera longirostra*	Non endemic	Least Concern	Insectivore	Stable
7	Jerdon's Leafbird	*Chloropsis jerdoni*	Non endemic	Least Concern	Frugivore & insectivore	Stable
8	Asian brown flycatcher	*Muscicapa dauurica*	Non endemic	Least Concern	Insectivore	Stable
9	White-bellied blue flycatcher	*Cyornis pallipes*	Endemic	Least Concern	Insectivore	Decreasing
10	Flame throated Bulbul	*Pycnonotus gularis*	Endemic	Not evaluated	Frugivore/ Insectivore	Unknown
12	Tickel's Flower Pecker	*Dicaeum erythrorhynchos*	Non endemic	Least Concern	Frugivore	Stable
13	Malabar whistling Thrush	*Myophonus horsfieldii*	Endemic	Least Concern	Omnivorous	Unknown

Point 20

Sl No.	Common Name	Scientific Name	Endemicity	IUCN Status	Frugivore/insectivore	Population trends
1	Malabar Trogon	*Harpactes fasciatus*	Endemic to WG	Least Concern	Insectivore	Stable
2	Malabar Grey Hornbill	*Ocyceros griseus*	Endemic	Least Concern	Frugivore	Decreasing
3	Malabar Pied Hornbill	*Anthracoceros coronatus*	Endemic	Near Threatened	Frugivore	Decreasing
4	White cheeked Barbet	*Psilopogon viridis*	Endemic	Least Concern	Frugivore	Stable
5	Greater Flameback	*Chrysocolaptes guttacristatus*	Non endemic	Least Concern	Insectivore	Decreasing
6	Malabar Parakeet	*Psittacula columboides*	Endemic	Least Concern	Frugivore	Stable
7	Greater Racket tailed Drongo	*Dicrurus paradiseus*	Non endemic	Least Concern	Insectivore	Decreasing
8	Jerdon's Leafbird	*Chloropsis jerdoni*	Non endemic	Least Concern	Frugivore/ insectivore	Stable
9	Red Whiskered Bulbul	*Pycnonotus jocosus*	Non endemic	Least Concern	Omnivorous	Decreasing
10	Puff-throated Babbler	*Pellorneum ruficeps*	Non endemic	Least Concern	Insectivore	Stable
11	Rufous Babbler	*Turdoides subrufa*	Endemic	Least Concern	Frugivore and insectivore	Stable
12	Malabar whistling Thrush	*Myophonus horsfieldii*	Endemic	Least Concern	Omnivorous	Unknown
13	Southern Hill Myna	*Gracula indica*	non endemic	Unknown	Omnivorous	Unknown
14	Red Whiskered Bulbul	*Pycnonotus jocosus*	Non endemic	Least Concern	Omnivorous	Decreasing
15	White cheeked Barbet	*Psilopogon viridis*	Endemic	Least Concern	Frugivore	Stable
16	Crimson backed Sunbird	*Nectarinia minima*	Endemic	Least Concern	Nectar	Stable
17	Little Spiderhunter	*Arachnothera longirostra*	Non endemic	Least Concern	Insectivore	Stable
18	Golden fronted Leafbird	*Chloropsis jerdoni*	Non endemic	Least Concern	Frugivore/ insectivore	Stable
19	Grey headed Bulbul	*Pycnonotus priocephalus*	Endemic	Near Threatened	Frugivore/ insectivore	Decreasing
20	Black Eagle	*Ictinaetus malaiensis*	Non endemic	Least Concern	Carnivore	Decreasing

List of Birds Found in Designated Sampling Points (Continued)

Point 21						
Sl No.	Common Name	Scientific Name	Distribution	IUCN Status	Frugivore/insectivore	Population trends
1	Oriental White-eye	*Zosterops palpebrosus*	Non endemic	Least Concern	Insectivore	Decreasing
2	Orange Minivet	*Pericrocotus flammeus*	Non endemic	Least Concern	Insectivore	Stable
3	White-bellied Treepie	*Dendrocitta leucogastra*	Endemic	Least Concern	Omnivorous	Stable
4	Greater Coucal	*Centropus sinensis*	Non endemic	Least Concern	Insectivore	Stable
5	Crested Serpent Eagle	*Spilornis cheela*	Non endemic	Least Concern	Snakes and lizards. It has also been observed to	Stable
6	Western Spotted Dove	*Spilopelia suratensis*	Non endemic	Least Concern	Frugivore	Increasing
7	Oriental Magpie Robin	*Copsychus saularis*	Non endemic	Least Concern	Insectivore	Stable
8	White cheeked Barbet	*Psilopogon viridis*	Endemic	Least Concern	Frugivore	Stable
9	Malabar Parakeet	*Psittacula columboides*	Endemic	Least Concern	Frugivore	Stable
10	Aisan Fairy-Bluebird	*Irena puella*	Non endemic	Least Concern	Frugivore	Decreasing
11	Vernal Hanging Parrot	*Loriculus vernalis*	Non endemic	Least Concern	Frugivore	Stable
12	White Breasted Kingfisher	*Halcyon smyrnensis*	Non endemic	Least Concern	Insectivore	Increasing
13	Indian Swiftlet	*Aerodramus unicolor*	Endemic to WG	Least Concern	Insectivore	Decreasing
14	Purple Sunbird	*Cinnyris asiaticus*	Non endemic	Least Concern	Nectar	Stable
15	Jerdon's Leafbird	*Chloropsis jerdoni*	Non endemic	Least Concern	Frugivore & insectivore	Stable
16	Common Iora	*Aegithina tiphia*	Non endemic	Least Concern	Insectivore	Unknown
17	Asian Palm Swift	*Cypsiurus balasiensis*	Non endemic	Least Concern	Insectivore	Stable
18	Greater Flameback	*Chrysocolaptes guttacristatus*	Non endemic	Least Concern	Insectivore	Decreasing
19	Jungle Crow	*Corvus macrorhynchos*	Non endemic	Least Concern	Omnivorous	Stable
20	Purple rumped Sunbird	*Nectarinia zeylonica*	Non endemic	Least Concern	Nectar	Stable
21	Common Tailor Bird	*Orthotomus sutorius*	Non endemic	Least Concern	Insectivore	Stable
22	Ashy Drongo	*Dicrurus leucophaeus*	Non endemic	Least Concern	Insectivore	Unknown
23	Bronzed Drongo	*Dicrurus aeneus*	Non endemic	Least Concern	Insectivore	Unknown
24	Barwinged flycatcher shrike	*Hemipus picatus*	Non endemic	Least Concern	Insectivore	Stable
25	Yellow Browed Bulbul	*Iole indicIole indicaa*	Non endemic	Least Concern	Omnivorous	Stable
26	Malabar Whistling Thrush	*Myophonus horsfieldii*	Endemic	Least Concern	Omnivorous	Unknown
27	Grey Jungle Fowl	*Gallus sonneratii*	Endemic to India	Endangered	Frugivore/ Insectivore	Decreasing
28	Heart spotted Woodpecker	*Hemicircus canente*	Non endemic	Least Concern	Insectivore	Decreasing
29	Flame throated Bulbul	*Pycnonotus gularis*	Endemic	Not evaluated	Frugivore & insectivore	Unknown
30	Greater Racket tailed Drongo	*Dicrurus paradiseus*	Non endemic	Least Concern	Insectivore	Decreasing

Chapter 6 Environmental Considerations for Shiradi Ghats Bypass Project

6.1 Considerations for "Shiradi Ghats bypass"

The project area is located in the Western Ghats. It is mostly covered by forest and has rich in biodiversity. The most area of the project is designated as Reserved Forest by Karnataka State. There is a National Park designated by the Indian Government in the northern area of the project and a Wildlife Sanctuary in the south. These areas are also designated as the UNESCO world heritage sites. (Note: The Karnataka state government has not approved the proposed sites of UNESCO World Heritage Centre in Karnataka. Thus, UNESCO World Heritage Centre expresses the sites as "Proposed Sites" in its website.)

Judging from the above cited literatures, the results of the field survey and the interviews, the project site is a very important part of Western Ghats ecosystem especially regarding the following:

- Corridor of Big Mammals
- Habitats of Rare species of Amphibians and Fishes
- Above mentioned habitats consist of various endemic, rare and endangered plants

According to JICA Environmental and Social Guideline, such area is regarded as "Critical Natural Habitats".

Table 6.1.1 shows the result of the environmental and social impact assessment of Shiradi Ghats Bypass Project, which should be further studied before the implementation of the project.

Table 6.1.1 Environmental and Social Impact Assessment

Category		Environmental Item	Items		Reasons
			Construction	Operation	
Pollution Control	1	Air Pollution	B-	C	**Construction**: Air quality can be temporarily deteriorated due to the movement of construction equipment and the entrance of construction vehicles. **Operation**: Air quality can be negatively affected by emission gas from the traffic with the degree of the traffic volume increase. On the other hand, the overall negative impact on the air can be mitigated because the improved road will generate less emission as well as less dust.
	2	Water Pollution	A-	D	**Construction**: Construction of cut & fill part of bypass and construction roads could cause flow of earth and sand into the rivers and streams. This could cause the reduction of dissolved oxygen that leads to huge negative impact on the rare and endangered species of fish and amphibians. Also, the effluent from construction camps could cause negative impact on the local habitats in rivers and streams. **Operation**: No direct impact on water pollution is expected after the construction phase.
	3	Wastes	B-	D	**Construction**: Construction wastes such as construction waste soil and wood residue and household waste from construction camps are expected to be generated. **Operation**: There is little possibility of waste generation directly caused by the project after construction.

Category		Environmental Item	Items		Reasons
			Construction	Operation	
	4	Soil Pollution	B-	D	**Construction:** Soil can be polluted by outflow of construction oil and chemical substances. **Operation:** No possible source of soil pollution is expected after the construction phase.
	5	Noise & Vibration	A-	B+	**Construction:** Noise and vibration are expected to be generated due to operation of construction equipment and vehicles. Also, the usage of explosive for the tunnel could disturb the mammal migration between north and south ecosystem by its noise and vibration. **Operation:** The major part of the planned bypass consists of tunnels and bridges and thus, the bypass will contribute positive impact on the mammal migration by improving the accessibility of the ecosystems between north and south which is disturbed by the NH48 currently. However this is based on a premise that the current NH48 will be halted the service after the start of usage of the bypass.
	6	Subsidence	D	D	Operations which may cause subsidence are not expected.
	7	Odor	D	D	Operations which may cause odor are not expected.
	8	Sediment	A-	D	**Construction:** Construction of cut & fill part of bypass and construction roads could cause flow of earth and sand into the rivers and streams. It is necessary to take appropriate measures in order to prevent inflow of construction earth and sand to the rivers. **Operation:** No operations which may have negative impact on sediment is expected.
Natural Environment	9	Protected Areas	A-	B+	**Construction:** It can make a negative impact on the migration of animals between north and south by noise, vibration and light during construction period. **Operation:** The major part of the planned bypass consists of tunnels and bridges and thus, the bypass will contribute positive impact on the mammal migration by improving the continuity as well as accessibility of the ecosystems between north and south which is disturbed by the NH48 currently. However this is based on a premise that the current NH48 will be halted the service after the start of usage of the bypass.
	10	Ecosystem	A-	B+	**Construction:** The proposed alignments are located in the middle of the protected areas in north and south and a part of the ecosystem of the Western Ghats. Forest Clearance by the project can negatively impact the ecosystem. **Operation:** The major part of the planned bypass consists of tunnels and bridges and thus, the bypass will contribute positive impact on the mammal migration by improving the continuity as well as accessibility of the ecosystems between north and south which is disturbed by the NH48 currently. However this is based on a premise that the current NH48 will be halted the service after the start of usage of the bypass.
	11	Hydrology	A-	B-	**Construction & Operation:** Tunnel construction could modify the ground water movement that lead to lower the ground water level as well as surface water level. This could cause huge negatively impact on fauna and flora.

Category		Environmental Item	Items		Reasons
			Construction	Operation	
	12	Topography & Geology	B-	D	**Construction**: It is necessary to take appropriate measures to protect slopes in cut and fill sections during construction period (especially during rainy seasons). **Operation**: Impacts on topography and geology are not expected.
Social Environment	13	Resettlement	D	D	**Construction**: According to PWD, no resettlement is required. Thus, there is no negative impact expected by the project.
	14	Poor	C	D	**Construction**: Impact on poor is not expected at the moment. Detailed information should be collected in future survey.
	15	Indigenous or minority groups	D	D	There is no indigenous or minority groups around project area.
	16	Local economy such as employment and livelihood	B-	B-	**Construction**: Seasonal freshwater fishery has been conducted in the river basin and therefore, there is a possibility for the project to have negative impact on the fishery activity. **Operation**: There are not small number of small shops and restaurant around the Gundia bus stop along with NH48. Therefore, the project could have negative impact on local economy by changing the movement of cars passing NH48
	17	Land use, Local resource use	B-	C	**Construction**: Since the most of project area is designated as Reserved Forest by Karnataka Government, forest area need to be turned into non-forest area. **Operation**: No particular operations which may have negative impact on land use is expected.
	18	Water Rights	B-	C	**Construction**: River water will be utilized in construction phase and there is possibility of causing muddy water. Thus water use by neighboring inhabitants could be intervened. **Operation**: Operations which may have impact on water rights are not expected
	19	Existing infrastructures and Social services	C	D	**Construction**: Impact on existing infrastructures and Social services is not expected at the moment. Detailed information should be collected in future survey.
	20	Social institutions such as social infrastructure and local decision - making institutions	D	D	There would be no impact on social institutions such as social infrastructure and local decision making.
	21	Uneven distribution of benefits and damages	D	D	There would be no impact on uneven distribution of benefits and damages.
	22	Local conflict of interests	D	D	There would be no impact on local conflict of interests.
	23	Historical and cultural resources	D	D	There are no historical and cultural resources around project area.
	24	Landscape	C	D	Although it can be assumed that there will be no impact on landscape, negative impact may cause during construction phase by entrance of working vehicles.

Category		Environmental Item	Items		Reasons
			Construction	Operation	
	25	Gender	C	C	Impact on gender is not expected at the moment. Detailed information should be collected in future survey.
	26	Children's rights	C	C	Impact on children's right is not expected at the moment. Detailed information should be collected in future survey.
	27	Infectious diseases such as HIV/AIDS	C	C	There is possibility of spreading infectious diseases by inflow of construction workers.
	28	Working environment	B-	C	**Construction:** Attention should be paid to working environment to keep workers safe. **Operation:** Operations which may have impact on working environment are not expected during handover.
Others	29	Accidents	B-	C	**Construction:** Attention should be paid to prevent accidents. **Operation:** Increase of car accident can be expected by future traffic increase and faster driving speed.
	30	Climate change and trans-boundary impacts	D	D	There would be no impact on climate change and trans-boundary impacts.

6.2 Feasibility of the Project

The large part of planned bypass alignment is designed as tunnels and bridges to minimize the negative impact on environment. This design improves the continuity as well as the accessibility of the ecosystems between north and south which is disturbed by the NH48 currently. However, cut & fill part of the bypass as well as the construction roads could cause negative impacts on local habitats of rare and endangered species of amphibians and fishes.

Especially, the endemic, rare and endangered fish and amphibians are not migratory species rather live in specific area in the project area. Thus, degradation of habitats by the project implementation could result into the local extinction of those species which is regarded as "Significant conversion or degradation" according to JICA's Environmental and Social Guideline. In addition, the tunnel construction could lead this situation by affecting ground water in negative way.

Therefore, taking appropriate avoidance and mitigation measures is essential to implement the project.

By the result of the conducted field survey, distinctive environmental characteristics of fish and amphibian are 1) diversified environment given by rive/stream such as rapid flow, stagnation zone, shallow and deep water, 2) Tree Canopy covering the top of the water body as well as plants covering river banks, 3) appropriate water quality such as dissolved oxygen. Thus the following policies shall be followed as implementing the project.

- Minimize the chance to have the construction zone that cut across/go over the river/stream where there is a high possibility of being habitats of endemic, rare and endangered species of fish and amphibian.
- If the above avoiding measure could not be taken, secure the continuity of the existing habitats. For securing, lifecycle of the target species shall be counted. Plan the shortest construction term as well as avoid setting construction term during reproductive seasons.

- The canopy over the water body as well as the plant covering the riverbanks are the very important factors which consist the habitat. Thus, avoid or minimize cutting such areas. Especially cutting the shrubs in river banks can lead to the inflow of earth and sand into the water body.
- The inflow of earth and sand could cause lowering dissolved oxygen of the water body and this may lead to have big negative impact on local habitat. Take necessary measure to prevent the inflow of earth and sand.
- Mitigation measures can be taken only if there is any similar habitat adjacent to the construction site which creates the extent as well as the continuity. Thus field survey to confirm such existence as well as the continuity of possible habitat such as the cross section between construction road alignment and river/stream area shall be conducted in advance to the start of the construction.
- Monitoring activities during the construction phase and operation phase shall be constantly conducted and if any negative sign detected, stop the construction and review the implementation plan. Especially for the tunnel, any change of ground water movement shall be precisely monitored.

6.3 Necessary Steps to Implement the Project

6.3.1 Re-assessing Construction Road Alignment

By the results of this survey, many endemic, rare and endangered species found along the alignment of proposed construction roads. Satellite information as well as the data from PWD was utilized for designing of the alignment while not intensive research for the existing road was not conducted that is pointed out by PWD side. Therefore, it necessary for the further study to conduct 1) Assessment of utilization of existing road for construction road alignment, 2) Assessment of changing the design policy of construction road for maximizing the possibility of utilization of existing road, and 3) Conduction of intensive research for finding other existing road, abandoned road, trails to reassess the current construction road alignment.

6.3.2 Conducting Survey for Assessing the Existence of River/Stream in Cut & Fill Part of Bypass

Confirm the existence/absence of river/stream within the cut & fill part of the bypass alignment. If the existence of the river/stream is confirmed, conduct ecological field survey for fishes and amphibians as descried in following 6.3.3.

6.3.3 Conducting Ecological Field Survey

During the conduction of the field survey, existence of the species at particular sites was surveyed while the extent of the habitats as well as the number of individual species were not surveyed. Therefore, it necessary to conduct further ecological field survey to study the extent of the habitats.

6.3.4 Reviewing the Project

Conduct further data collection survey to review the project implementation plan of PWD. For its conduction, the above described items shall be conducted and the results should be feedback into the proposed plan of PWD. If any issues arise, take necessary measures. The following specific items shall be counted for the conduction of the further survey.

1) Effects of Cut and Fill

Cut and fill is proposed in the DPR for the east end of the alignment of the planned road. This could degrade the habitats of amphibians and fish species by diminishing streams and degrading water quality during the construction.

2) Effects of Construction Road

Habitat modification or conversion, fragmentation and attrition are the major threats to endemic amphibians of the Western Ghats. To avoid the "Significant conversion or degradation" by the implementation of the project, the following measures should be conducted precisely.

Mitigation measures suggested for habitat modification or conversion is to maintain immediate surroundings of a converted habitat as a buffer zone with least use. This reduces edge effects on amphibians.

Although the structures are designed to minimize the negative effects of the Project on the environment, the effects of the construction road and the construction itself shall be seriously considered as the following matters.

- Detailed survey for habitat continuity

  Detailed survey shall be conducted for confirming the continuity of the habitat that found at the cross section of the construction road and river/stream. If the particular habitat is very without any continuous area adjacent to the site, then abandon the alignment to secure the particular habitat for avoiding local extinction.

- Minimize the construction zone

  Try to minimize the utilization of new construction road instead utilize the existing road, trail and railroad as well as altering alignment as much as possible for avoiding its passing through primary forest area.

  Detailed survey for assessing existing road, trail and railroad as well as their feasibility shall be conducted.

- Considering construction terms

  Construction activity must be carried out during the lean period of particular species inhabiting at the construction site.

- Securing habitat of amphibians and fishes

  Especially for amphibians and fishes, try to avoid setting construction alignment that cuts across river/stream. If there is no alternative routes, tunnels (underpasses) must be installed to help in easy movement of amphibians across roads and streams to avoid occurring fragmentation/disconnection of habitats. Design culverts, underpasses, and overpasses to accommodate a variety of species. If the continuity of the habitat around the construction site is confirmed, transferring to the area shall also be considered. In addition, install a buffer zone to reduce edge effects on amphibians. The fragmentation must be to the least possible measure.

- Termination of the construction road

  The construction roads for the project should be deactivated or abandoned after the start of the bypass operation. This should be carried out in a systematic manner (replanting, removal of asphalt, and so on) and without leaving any trace of construction mark.

- Prevention of inflow of chemicals, earth and sand into rivers and streams

  During construction, minimize the use of contaminants (e.g., salts, petrochemicals, and herbicides) and unnecessary spillovers. The use of materials that are biodegradable is highly recommended. Also, prevent the occurrence of inflow of earth and sand into rivers and streams. This could cause the reduction of dissolved

oxygen that leads to huge negative impact on the rare and endangered species of fish and amphibians. Especially at the area where the alignment of the road cut across and river/stream, special consideration is required.

- Conduction of Monitoring

  There must be a systematic and objective monitoring of activities during the construction phase and operation phase. Monitoring should not be biased towards construction and it should be done to minimize damage to ecosystem.

3) Effects of Explosion

The blasts during the construction could affect the behavior of animals especially the migration between the north and south of Western Ghats ecosystem. Usage at night shall be prohibited especially. Consider utilizing a sound-proof door to mitigate noise and vibration of blasting for excavation.

4) Effects on Ground Water

The planned tunnels could affect the ground water. Thus, careful design as well as the monitoring activities will be required. If any unusual behavior of water is detected, stop the construction work immediately. Assess the cause of the behavior and feedback of the results of the assessment to the construction plan.

6.4 Possible Mitigation Measures

6.4.1 Construction Roads

1) Alignment of Construction Roads

The Shiradi Ghats bypass is a bypass road approximately 23km long and planned in high and steep mountains. In planning construction roads, it is important to consider the environment and to plan it efficiently by utilizing the existing roads and taking the following issues into consideration;

- The Shiradi Ghats bypass is planned on the other side of the river which runs along NH48. Thus, sites are limited where it is possible to plan construction roads from NH48. Moreover, the number of the existing roads near the Shiradi Ghats bypass which can be utilized as construction roads is also limited. Therefore, the possibility that the length of new construction roads become longer is high.
- As it is located in precipitous mountains, the slopes of cut and fill are likely to be large-scale.
- There are many mountain streams near the planned area and rare species are reported to exist. In addition, the planned area is designated as reserved forests.
- In light of the above, in the examination of alignment of construction roads, it is important to minimize the area for construction roads by making the alignments fit the geographical features and by not creating slopes of cut and fill as much as possible. In addition, for intersections with mountain streams and for sites with large-scale cut and fill, measures shown in the following 2) and 3) are also examined.

2) Measures for Intersections with Mountain Streams

For intersections of construction roads and mountain streams, it is necessary not to disturb the functions of mountain streams and the environment. Therefore, the construction roads shall be constructed by first confirming the current volume of water flow, installing corrugated steel pipes with cross section surface which is

big enough to flow the water volume, and covering the top with soil. The following figures show an example of a temporary road which utilizes corrugated steel pipes.


Source: http://www.animateur.co.jp/michishita/?cat=8

Figure 6.4.1 Temporary Road Utilizing Corrugated Steel Pipes

3) Reduction of Slope Areas of Fill by Geotextile Walls and Gabion Mattress

At sites where slopes of fill become multiple due to geographical constraints, areas of construction roads become larger and its impacts on the environment (tree cutting) also become bigger. However, it is possible to reduce areas of slopes of fill and areas of construction roads by utilizing Gabion Mattress and geotextile walls. The following figures show examples of fill construction utilizing Gabion mattress and geotextile walls.


Source: http://www.hodumi.co.jp/members/list/materials/frame_2.html

Figure 6.4.2 Examples of Fill Construction Utilizing Gabion Mattress and Geotextile Walls

6.4.2 Tunnel (Bypass)

1) Sound-proof Doors

A sound-proof door is installed at a portal of tunnel in order to mitigate noise and vibration of blasting for excavation. It is used when noise and vibration are judged to put impacts on surrounding houses, facilities and inhabitants. Its material and structure vary according to each manufacturer. At present, some sound-proof doors used in Japan are mobile. It is also possible to reduce the space to be polluted by gas and rocks generated in blasting by moving a sound-proof door as its tunnel face proceeds.

Source: http://www.tottorinishidouro-anzenkyougikai.com/category/area_b/04/page/5/

Figure 6.4.3 Installation of Sound-proof Door

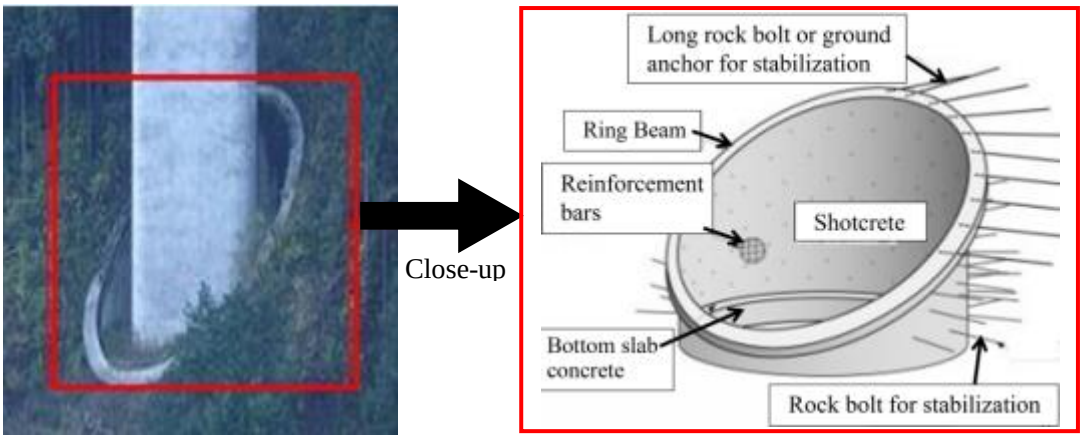
2) Controlled Blasting

In case vibration, noise and low frequency air vibration put negative impacts on surrounding houses, facilities and inhabitants, controlled blasting can be utilized as one option. Controlled blasting is a measure for mitigation of vibration and noise of blasting, for example by reducing explosive quantity of one row by increasing the number of rows of a blasting cap, by reducing explosive quantity of one blast by shortening the length of one excavation, and by changing the type of explosives.

6.4.3 Bridges (Bypass)

1) Bamboo-Sprit Type Concrete Sheet Pipe Method

Bamboo-sprit type concrete sheet pipe method is a method characterized by vertical excavation which reinforces surrounding mountains with rock bolts and shotcrete by each excavation, having a ring beam constructed by shotcrete on a slope as a guide. As its planar shape is circle, it is possible to minimize areas of excavation and to minimize changes of land surface. The following figures show a summary design of a bamboo-sprit type concrete sheet pipe method.



Source: Presentation Material of Former JICA Expert for India (some information was added by the study team)

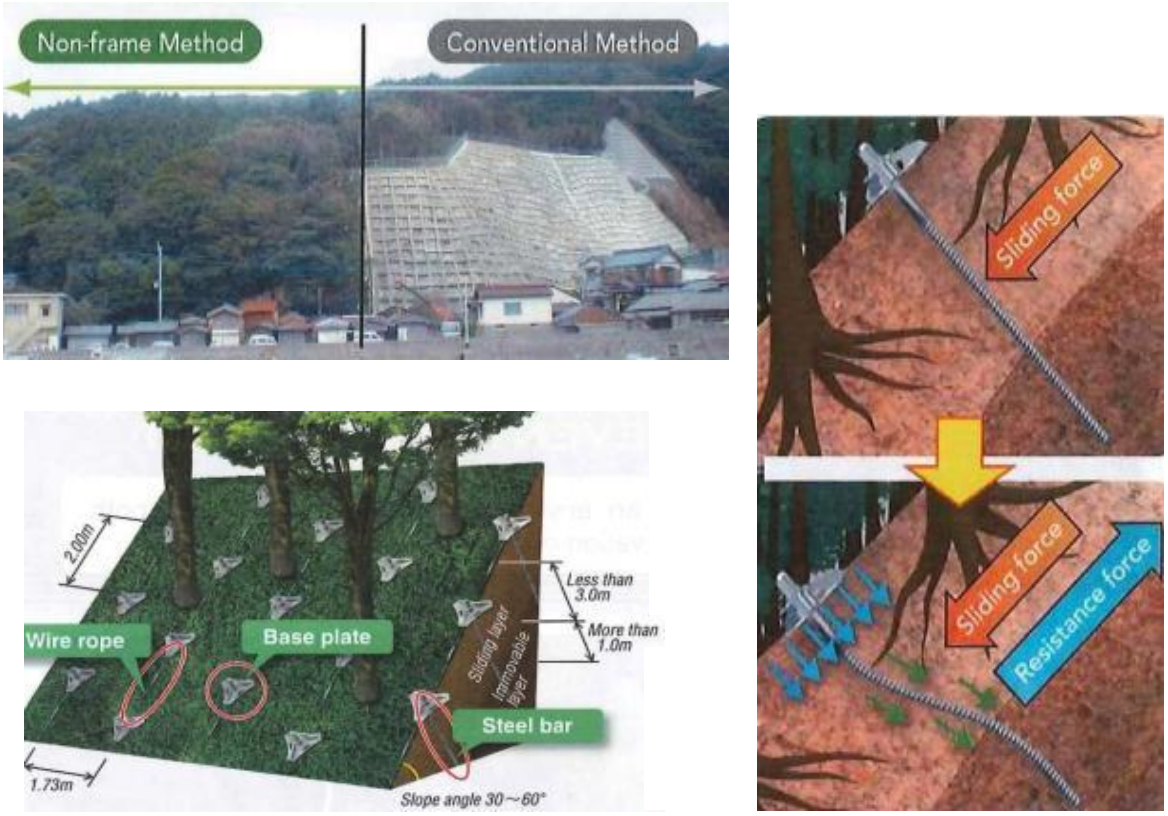
Figure 6.4.4 Bamboo-Sprit Type Concrete Sheet Pipe Method

6.4.4 Slopes (Bypass)

1) Non-Frame Method

Non-frame method is applicable as a countermeasure to prevent landslides without cutting trees at a large scale.

In case of application of this method to the project, the maximum effect shall be exerted if applied to construction roads which necessitate large-scale cut.



Source: Study on Road Improvement Project for Shiradi Ghats Stretch in India, METI 2015

Figure 6.4.5 Non-Frame Method

6.5 Response from PWD

6.5.1 The Cut and Fill Section

The Cut and fill section proposed at the eastern part of the alignment where no other possibilities workout economically and the area is fully under Private Land. The area is surveyed and no major flowing stream/ nala/ river occurs in proposed cut & fill area. Please refer Figure 1.4.1 or PWD DPR where alignment has been superimposed on the contour map for better understanding of the topography of the area. The minor gulley's and drains shall be provided with cross drainage structures for effective flow which are there only during monsoon. The effect of construction road and construction would be mitigated through hard fencing at the stream side and identified habitat places for the wild life. The water quality would remain unchanged as no possibility of entrance of the project staff in the stream. Also any construction water may require to discharge at all directly to the stream/ Nala should undergo sedimentation process. The air borne dust could be controlled through effective water sprinkling at the work places.

6.5.2 Effects of Construction Road

Please refer f Figure 1.4.1 or PWD DPR. As advised the reserve forest boundaries, location of streams, existing road path in the forest area that is being used by the Railways for their network improvement, railway lines with existing

structures and proposed bypass alignment is shown in the drawing.

6.5.3 Effects of Explosion

Yes, the blast could affect the behavior of animals in the project cycle but this can be significantly reduced and controlled by controlled blasting technique available. Also there are technics like Presplitting by using chemical which is non pollutant and noiseless, which would help in fragmentation of hard rock and mechanical excavation can be carried out. The excavation procedure also suits the proposed tunnel construction methodology "NATM".

6.5.4 Effects on Ground Water

For unrestricted ground water flow path, suitable measures have already taken in the tunnel design. Please refer to a part of our DPR submission. Suitable drainage measure with waterproofing system is already in place to mitigate the hazard.

Note: Above DPR is provided as attached electric files of the Final Report.

6.5.5 Waste Disposal Site

Disposal sites have been identified beyond Forest Area near Sakleshpur & Hassan Railway Station and Near Subramanya Railway station.

6.5.6 Orientation of Stakeholders toward the Project

No negative orientation was observed for the Shiradi Ghats Bypass Project. Several organizations consider the Project positive because the bypass could improve the discontinuity of Western Ghats Ecosystems disturbed by existing National Road No. 48.

6.5.7 Others

Other comments addressed previous section will be recorded in the EMP report as mandatory action.

Chapter 7 Environmental Considerations for Yettinahole Project

7.1 Considerations for "Yettinahole Project"

The project area is located in the Western Ghats. It is mostly covered by forest and has rich in biodiversity. The most area of the project is designated as Reserved Forest by Karnataka State. There is a National Park designated by the Indian Government in the northern area of the project and a Wildlife Sanctuary in the south. These areas are also designated as the UNESCO world heritage sites. (Note: The Karnataka state government has not approved the proposed sites of UNESCO World Heritage Centre in Karnataka. Thus, UNESCO World Heritage Centre expresses the sites as "Proposed Sites" in its website.)

Judging from the above cited literatures, the results of the field survey and the interviews, the project site is a very important part of Western Ghats ecosystem especially regarding the following:

- Corridor of Big Mammals
- Habitats of Rare species of Amphibians and Fishes
- Above mentioned habitats consist of various endemic, rare and endangered plants
- Source of the Water for the Ecosystem

According to JICA Environmental and Social Guideline, such area is regarded as "Critical Natural Habitats".

Table 7.1.1 shows the result of the environmental and social impact assessment of Yettinahole Project, which should be further studied before the implementation of the project.

Table 7.1.1 Environmental and Social Impact Assessment

Category		Environmental Item	Items		Reasons
			Construction	Operation	
Pollution Control	1	Air Pollution	B-	C	**Construction**: Air quality can be temporarily deteriorated due to the movement of construction equipment and the entrance of construction vehicles. **Operation**: No direct negative impacts on environment is expected from the weirs. The pumping system could cause negative impact on air quality due to the usage of engine of the system while the area is not residential area. Thus virtually little negative impact is expected.
	2	Water Pollution	A-	D	**Construction:** Construction of weirs and construction roads could cause flow of earth and sand into the rivers and streams. This could cause the reduction of dissolved oxygen that leads to huge negative impact on the rare and endangered species of fish and amphibians. Also, the effluent from construction camps could cause negative impact on the local habitats in rivers and streams. **Operation:** No direct impact on the water quality is expected.
	3	Wastes	B-	C	**Construction:** Construction wastes such as construction waste soil and wood residue and household waste from construction camps are expected to be generated. **Operation:** No wasted is expected from the intake facility of the project.

Category		Environmental Item	Items		Reasons
			Construction	Operation	
	4	Soil Pollution	B-	D	**Construction:** Soil can be polluted by outflow of construction oil and chemical substances. **Operation:** No soil pollution or contamination is expected.
	5	Noise & Vibration	B-	C	**Construction:** Noise and vibration are expected to be generated due to operation of construction equipment and vehicles. **Operation:** Noise and vibration are expected to be generated by the operation of pumping system while the area is not residential area. Thus virtually little negative impact is expected.
	6	Subsidence	D	D	Operations which may cause subsidence are not expected.
	7	Odor	D	D	Operations which may cause odor are not expected.
	8	Sediment	A-	B-	**Construction:** Construction of weirs and construction roads could cause flow of earth and sand into the rivers and streams. It is necessary to take appropriate measures in order to prevent inflow of construction earth and sand to the rivers. **Operation:** Weirs disturb the supply of sediment from the upstream and thus this could cause negative impact on downstream ecosystem by reducing sediment.
Natural Environment	9	Protected Areas	A-	A-	**Construction:** It can make a negative impact on the migration of animals between north and south by noise, vibration and light during construction period. **Operation:** As if there is big discrepancy of precipitation amount between the simulated figure and the actual measurement, the project could have big negative impact on the ecosystem in downstream and this could degrade the continuity as well as accessibility of north and south ecosystems which are protected areas.
	10	Ecosystem	A-	A-	**Construction:** The intake area of the project are located in the middle of the protected areas in north and south and a part of the ecosystem of the Western Ghats. Forest Clearance by the project can negatively impact the ecosystem. **Operation:** As if there is big discrepancy of precipitation amount between the simulated figure and the actual measurement, the project could have big negative impact on the ecosystem in downstream by reducing the amount of water which supposed to be supplied for maintaining the system. The weir disturb the movement of migratory fish species.
	11	Hydrology	C	A-	**Operation:** As if there is big discrepancy of precipitation amount between the simulated figure and the actual measurement, the project could have big negative impact on the ecosystem in downstream by reducing the amount of water. This could lower the water level of downstream.
	12	Topography & Geology	B-	D	**Construction:** It is necessary to take appropriate measures to protect slopes in cut and fill sections during construction period (especially during rainy seasons). **Operation:** Impacts on topography and geology are not expected.
Social Environment	13	Resettlement	C	C	**Pre Construction Phase:** In this current condition, little information is acquired ant thus, detailed information should be collected in future survey while the intake facilities are planned to be installed in the deep forest area where little resident is expected to live.
	14	Poor	C	D	**Construction:** Impact on poor is not expected at the moment.

Category		Environmental Item	Items		Reasons
			Construction	Operation	
					Detailed information should be collected in future survey.
	15	Indigenous or minority groups	D	D	There is no indigenous or minority groups around project area.
	16	Local economy such as employment and livelihood	C	A+	**Operation:** Since the intake facilities are planned to be installed in the forest area, little negative impact is expected on the local economy while the area in eastern side of the Western Ghats will receive the supplied water and this will deliver huge positive impact on agriculture as well as industries.
	17	Land use, Local resource use	B-	B-	**Operation:** Since the project area is designated as Reserved Forest by Karnataka Government, forest area need to be turned into non-forest area.
	18	Water Rights	C	A-	**Operation:** As if there is big discrepancy of precipitation amount between the simulated figure and the actual measurement, the project could cause negative impact on the water utilization in downstream area due to the reduced amount of water supply.
	19	Existing infrastructures and Social services	C	D	**Construction:** Impact on existing infrastructures and Social services is not expected at the moment. Detailed information should be collected in future survey.
	20	Social institutions such as social infrastructure and local decision - making institutions	D	A-	As if there is big discrepancy of precipitation amount between the simulated figure and the actual measurement, the project could cause negative impact on the local decision making authorities by triggering legal issues caused by unevenly distributed benefit/loss between east side and west side.
	21	Uneven distribution of benefits and damages	D	A-	As if there is big discrepancy of precipitation amount between the simulated figure and the actual measurement, the project distribute benefit for eastern side of the Western Ghats region and could cause loss of water supply for the western side.
	22	Local conflict of interests	D	A-	As if there is big discrepancy of precipitation amount between the simulated figure and the actual measurement, the project could cause local conflict unevenly distributed benefit/loss between east side and west side.
	23	Historical and cultural resources	D	D	There are no historical and cultural resources around project area.
	24	Landscape	B-	B-	Negative impact may be caused during construction phase by entrance of working vehicles. Weir can cause negative impact on landscape.
	25	Gender	C	C	Impact on gender is not expected at the moment. Detailed information should be collected in future survey.
	26	Children's rights	C	C	Impact on children's right is not expected at the moment. Detailed information should be collected in future survey.
	27	Infectious diseases such as HIV/AIDS	C	C	There is possibility of spreading infectious diseases by inflow of construction workers.
	28	Working environment	B-	C	**Construction:** Attention should be paid to working environment to keep workers safe. **Operation:** Operations which may have impact on working environment are not expected during handover.
Others	29	Accidents	B-	C	**Construction:** Attention should be paid to prevent accidents. **Operation:** Increase of car accident can be expected by future

Category		Environmental Item	Items		Reasons
			Construction	Operation	
					traffic increase and faster driving speed.
	30	Climate change and trans-boundary impacts	D	D	There would be no impact on climate change and trans-boundary impacts.

For Yettinahole Project, the possible intake amount of water is simulated based assumed precipitation data with support of circumstantial information. Therefore, the assessment results would be totally different whether the assumed data is right or not.

Considering this, the following shall be reviewed immediately and the re-assessment shall be conducted accordingly.

7.1.1 Precipitation data which connects to Inflow estimation

The calculation of the inflow has been estimated from only one old rainfall monitoring station, without calibration, owned by a private plantation that has not been checked directly by WRD.

Besides, WRD did not utilize existing rainfall monitoring data of KSNDMC: Karnataka State Natural Disaster Monitoring Center allocated to the area close to the Project site.

There is a huge discrepancy between above precipitation amount, more than 6,000mm/year, and that of KSNDMC around 1,500mm to 2,000mm/year.

Therefore, immediate evaluation shall be conducted regarding the validity of the utilized data while so far no evaluation has been made. Supporting data such as cross section with its calibration record, flow rate, H-Q curbs and others will be evaluated as well. The survey team recommends to conduct direct monitoring by setting new rainfall monitoring stations in the basin.

7.1.2 Transportation Loss

Open canals are proposed to transport water toward the destination for vast distance, and the loss of the water is calculated as 10% with no evaporation, no infiltration, or the possibility of illegal utilization of water. This shall be assessed.

7.1.3 Fauna and Flora Data

Sufficient secondary information regarding fauna and flora has not been given in the DPR. There is a discrepancy regarding the confirmed species with the other conducted survey.

Therefore, careful evaluation of acquired information will be conducted.

7.1.4 Legal issues against the Project

Several legal actions against this Project have been taken, but no concrete information has reached the Study Team. The team would like to ask the proponent to supply relevant information in a mutual way.

7.2 Response from KNNL

7.2.1 Precipitation data which connects to Inflow estimation

Regarding the availability of Yield, the National Institute of Hydrology (NIH), Belgaum, Govt. of India was entrusted to estimate the dependable yield of the proposed project. According to NIH, 23.41 TMC of water is available at 50% dependability in the catchment area with annual rainfall of 4880 mm for the period 1993-2012.

Three existing rain gauge stations at Hongadalla, Kadumanehalla and Kottanahalli were considered while calculating the yield estimations. Therefore, the data used for yield calculation is in order. Correlations with actual stream flow measurements by KPCL show that the yield calculations is conservative.

Further, Karnataka State Natural Disaster Monitoring Centre (KSNDMC) in their letter dated: 12.02.2016 stated that "the weighted average rainfall for the entire Yettinahole catchment is 5138 mm", detailed report is enclosed as KNNL_Annexure-1. KSNDMC has only recently established some telemetric rain gauge stations in the Yettinahole catchment, data for which are available only for 2015, which is not sufficient.

Further, CWC under letter dated: 10-4-2015 stated that "The approach adopted by the project authorities for assessing the yield stress based on observed data of 4 sites near weir sites.".

7.2.2 Transportation Loss

During the calculation for requirement of water, 5% losses for Transmission & storage and 5% losses for Treatment & Distribution was considered.
Further, open canals are lined canals the infiltration rate is nil and in this canal water will flow only during the monsoon season during this period the evaporation loss is very meagre. This meagre evaporation quantum will be analyzed in future while during the filling the tanks.

7.2.3 Fauna and Flora Data

It is respectfully submitted that, the existing species and data on water quality pertaining to the project area (weir site) was collected and presented in Chapter 3 of the Environmental Management Plan. The extract of the same is enclosed as KNNL_Annexure-2**.**
There are plenty of secondary details, published literature and reports available for the entire Western Ghats or pockets where different institutes or individuals conducted the research studies. However, the published secondary data for Western Ghats may not be the representative data for the project sites. Hence, data was collected pertaining to weir locations and wherever necessary secondary data pertaining to weir locations was incorporated in the report. Further, the experts involved in preparation of the EMP were well aware of the Western Ghats and conducted plenty of research works in the area. Also, published papers in peer reviewed journals on Western Ghats. Therefore, the comments of JICA are noted for further guidance if necessary.
The aquatic ecology studies were conducted by Shri. M F Rahman, Scientist (Retd.), Central Inland Fisheries

Research Institute, Govt. of India who is renowned expert in the field of aquatic ecology and has got immense experience in the field. He was worked for many projects across India and also in Western Ghats since 40 years and involved with the Fisheries Dept., Govt. of Karnataka in identifying fish sanctuaries in Western Ghats as well as in Karnataka.

The biodiversity studies of the project were conducted by Dr. B C Nagaraj who is renowned expert in the field of ecology and biodiversity and obtained his post-doctoral degree from Indian Institute of Science, Bangalore. He was worked with many infrastructure projects across Karnataka and also in Western Ghats since 20 years.

The publications of the above experts are enclosed under KNNL_Annexure-3.

7.2.4 Legal issues against the Project

Legal Note enclosed separately as KNNL_Annexure-4.

Note: Above KNNL Annexures are provided as attached electric files of the Final Report.

DATA COLLECTION SURVEY ON NATURAL ENVIRONMENT OF THE WESTERN GHATS

Date / Time	January 7, 2016, Thursday / 11:15 - 12:50
Venue	Karnataka Forest Department (KFD)
Participants	Mr. Vinay Luthra (Principal Chief Conservator of Forests, KFD), and other ※Refer to the attached Attendee List The Study Team: Mr. Kiyota, Ms. Toyoshima, Mr. Hatano, Mr. Karanth
Agenda	Courtesy call, request to submit related information, etc.
Discussed Items	The Study Team visited Mr. Vinay Luthra, Principal Chief of Conservation of forests, Karnataka Forest Department (KFD: responsible for the authorization agency for forestry use) and other officers concerned. During the meeting, the Study Team requested KFD to provide their cooperation including sharing the related information to conduct the Study, and discussed other related matters. The discussed items are as follows: • KFD gathers data on Biodiversity (flora & fauna) in the Western Ghats. For the information on fauna, they conduct the population survey once in two years. For the information on flora, they plan to conduct a field survey on 21 to 25 January. It is possible to include the target area of this Study within the survey area. The date will be utilized as Inventory data. Since the data amount is large, KFD requested the Study Team to select the target areas and submit the request for the data collection. • The State level manages national parks and conservation areas. The national government issues authorizations, and formulates laws and regulations. They have Management Plans for the national parks and conversation areas and the Working Plans for protected forests. • The major concern raised by the bypass construction is the possible influence on the movement of elephants and larger mammals (Mr. Luthra). Since monkeys also move, it is required to consider the continuity of crown band. • (About Diversion Project) if the water is lifted and stores during the flood season (Peak is June to August, until November), the quantity of water to be supply is sufficient. Mr. GV. Ranga Rao believes that there is no problem with water balance. ※ It was not clear if Mr. GV. Ranga Rao's comment refers to the Yettinahole Project. • To make ecosystem resources sustainably available to local residents, they collect data on flora in order to clarify the limited species (Karnataka Biodiversity Board). • They are willing to provide any available data to the Study Team. List of requested data needs to be submitted. Period

DATA COLLECTION SURVEY ON NATURAL ENVIRONMENT OF THE WESTERN GHATS

Attendee List

Name of the project: Information Collection Study on Natural Environment of the Western Ghats in India
Date & Time: 7 Jan 2016, 11:15-12:50
Venue: Karnataka Forest Department
Attendee:

No.	Name	Affiliation
1	Mr. Vinay Luthara	Principal Chief Conservator of Forests (PCCF) Karnataka (Head of Forest Force)
2	Dr. Ravi Ralph	PCCF, Wildlife and Chief Wildlife Warden
3	Mr. Avur Reddy	Assistant PCCF
4	Mr. G.V. Ranga Rao	CCF Hassan
5	Dr. Sanjay Biyjur	CCF Mangalore
6	Mr. B.N. Hareesh	ACF Puttur
7	Mr. Raghavan	Superintending Engineer, PWD
8	Mr. B.T. Jwalendra Kumar	Executive Engineer, PWD
9	Mr. Hanvmanth A.M.	Additional Engineer, PWD
10	Mr. Akhilesh Kumar Gupta	Team Leader, GEOCONSULT India
11	Mr. Sudip Ganguly	Hydrologist, GEOCONSULT India
12	Mr. Mayank Kumar	Env. Expert, Asia Pacific Infracon
13	Ms. Meenakshi Negi	Additional Principal Chief Conservator of Forests (Working plan)
14	Mr. B. Kumar	Chief Conservator of Forests, ICT Centre
15	Mr. R. K. Singh	Karnataka Biodiversity Board
16	Mr. P. N. Karanth	IJCCIK
17	Mr. D. Kiyota	JICA Study Team (JST)
18	Ms. J. Toyoshima	JST
19	Mr. T. Hatano	JST

Meeting Atmosphere

DATA COLLECTION SURVEY ON NATURAL ENVIRONMENT OF THE WESTERN GHATS

Date / Time	January 8, 2016 , Friday / 10:30 - 11:00
Venue	Dr. Ramachandra's office, Center for Ecological Sciences, Indian Institute of Science (IISc)
Participants	Dr. T.V. Ramachandra (Professor, Energy & Wetlands Research Group, IISc)他 ※Refer to the attached Attendee List The Study Team: Mr. Kiyota, Ms. Toyoshima. Mr. Hatano, Mr. B.T. Jwalendra Kumar (PWD)
Agenda	Interviews with officers concerns, request to submit related information, etc.
Discussed Items	The Study Team visited Dr. T.V. Ramachandra, an Ecological researcher in the Western Ghats region, and learned the basics knowledge on the local ecology. Also the Study Team requested Dr. Ramachandra's cooperation to the Study including providing information and materials. Dr. Ramachandra's basic attitude • Oppose to any kind of environmental distraction. Dr. Ramachandra complained that PWD does not pay enough attention and environmental consideration regarding to the project is insufficient. • These projects results in losing regional employment opportunities including fishery, therefore, it cannot be said that infrastructure projects contribute the local/regional development. Providing Data • Dr. Ramachandra publishes results on the local ecosystem on the website and he requested the Study Team to search them. NGO and public institutions are also publishes information/results. Research Gate: https://www.researchgate.net/profile/T_V_Ramachandra Lab website: http://wgbis.ces.iisc.ernet.in/biodiversity • Collaborative research with Mangalore University Note by the note taker: Following is the possible researcher Prof. M. RAJASHEKHAR (Applied Botany) (http://www.mangaloreuniversity.ac.in/prof-m-rajashekhar) Request from Dr. Ramachandra • Encourage to conduct field visits which will assist you to understand the importance of the local ecosystem. Period

DATA COLLECTION SURVEY ON NATURAL ENVIRONMENT OF THE WESTERN GHATS

Attendee List

Name of the project: Information Collection Study on Natural Environment of the Western Ghats in India

Date & Time: 8 Jan 2016, 10:30-11:00

Venue: Dr. Ramachandra's office, Center for Ecological Sciences, Indian Institute of Science (IISc)

Attendee:

No.	Name	Affiliation
1	Dr. T.V. Ramachandra	Professor, Energy & Wetlands Research Group, IISc
2	Mr. B.T. Jwalendra Kumar	Executive Engineer, PWD
3	Mr. D. Kiyota	JICA Study Team (JST)
4	Ms. J. Toyoshima	JST
5	Mr. T. Hatano	JST

Note: A Dr. Ramachandra's staff joined (name unknown)

Dr. T.V. Ramachandra

DATA COLLECTION SURVEY ON NATURAL ENVIRONMENT OF THE WESTERN GHATS

Date / Time	January 8th , 2016 11:15 - 12:00
Venue	Reading Room, Center for Ecological Sciences, Indian Institute of Science (IISc)
Participants	Dr. Raman Sukumar (Professor, Center for Ecological Sciences, IISc), and other ※Refer to the attached Attendee List The Study Team; Mr. Kiyota, Ms. Toyoshima, Mr. Hatano Mr. B.T. Jwalendra Kumar (PWD)
Agenda	Interviews with officers concerns, request to submit related information, etc.
Discussed Items	The Study Team visited Dr. Raman Sukumar, an Ecological researcher in the Western Ghats region, and learned the basics knowledge on the local ecology. Also the Study Team requested Dr. Raman's cooperation to the Study including providing information and materials. • Dr. Sukumar's Research Area Wildlife Ecology Asian elephant ecology and management/Social and reproductive biology of Asian elephants/Wildlife-human conflict Tropical forest ecology Diversity, structure and dynamics of tropical forests/Fire ecology in seasonally dry tropical forests/Invasive plant ecology/Seed dispersal in tropical forests/ Climate variability and forest dynamics Climate change Reconstructing Quaternary climate change/Assessing impacts of future climate change on forests and biodiversity Conservation biology Conservation of elephants and forests • Member of National Biodiversity Authority • He is in a position to accept implementation of infrastructure projects as long as appropriate mitigation measures are taken. He has cooperated with the assessment of small-scale gas pipeline project. • The concerns in the Western Ghats region include the habitat of wildlife, especially the elephants (also tigers). The elephant's habitat on the south side of the bypass project site is currently saturated, and it is a concern that the bypass may hinder the northward movement of the elephants. • At COP21 on December 2015 in Paris, the Indian government has decided to operate eight Long-Term Ecosystem Observation Stations (LTEO), including stations located in the Western Ghats region. Article「India to have 8 new observatories to study climate change」 http://www.thehindu.com/sci-tech/energy-and-environment/india-to-have-8-new-observatories-to-study-climate-change/article7960634.ece Period

DATA COLLECTION SURVEY ON NATURAL ENVIRONMENT OF THE WESTERN GHATS

Attendee List

Name of the project: Information Collection Study on Natural Environment of the Western Ghats in India

Date & Time: 8 Jan 2016, 11:15-12:00

Venue: Reading Room, Center for Ecological Sciences, Indian Institute of Science (IISc)

Attendee:

No.	Name	Affiliation
1	Dr. Raman Sukumar	Professor, Center for Ecological Sciences, IISc
2	Mr. B.T. Jwalendra Kumar	Executive Engineer, PWD
3	Mr. D. Kiyota	JICA Study Team (JST)
4	Ms. J. Toyoshima	JST
5	Mr. T. Hatano	JST

Note: A Dr. Sukumar's staff joined (name unknown)

Dr. Raman Sukumar

DATA COLLECTION SURVEY ON NATURAL ENVIRONMENT OF THE WESTERN GHATS

Date / Time	January 11, 2016, Monday 14:00 - 15:00
Venue	Centre for Wildlife Studies Office
Participants	Dr. U. Karanth (Director) ※ Refer to the Attendee List The Study Team: Mr. Kiyota, Ms. Toyoshima. Mr. Hatano, Mr. P. N. Karanth
Agenda	Interviews with officers concerns, request to submit related information, etc.
Discussed Items	The Study Team visited Centre for Wildlife Studies (CWS), a NGO which conducts ecosystem investigation training in India including the Western Ghats region. The Study Team conducted interview on ecology and requested to provide the related information and documents. The discussed items are as follows: • Conducting investigative research on tiger's ecology (habitat, population, and migration route, etc.). The research targets also include elephant and feral dogs. The migration length of tiger could reach to 300 km. The current population is about 400. Tigers and elephants migrate along valleys. • The factors of convers are: 1) exploitation of natural resources, 2) substances (harmful) brought by freight cars. Dr. Karanth is positively interested in new bypass, especially the tunnel construction. Wall (sound isolation) could block animals' migration. The new infrastructure projects (especially road) with appropriate mitigation measures are acceptable. ※ Indian government has a plan to plant tree "Green Road Corridors Plan" along highway. (http://www.thehindu.com/news/national/ green-road-corridors- planned-will-help-create-jobs-too/article7686248.ece) • The foundation of N48 was constructed during British rule (more than 100 years ago). It is our understanding that the alignment was decided with the consideration of environment. However, it is difficult to maintain the road due to steep slope and large rainfall. • Blasting for tunnel construction is NG. It disrupts animals. • The increased number of small-scale hydropower generation is the current concern. Weirs could obstruct the movements of animals. ※ It might be a part of their concern that the project is not subject to EIA. • Related information and data are available at http://cwsindia.org. Inquiries are welcomed. Period

DATA COLLECTION SURVEY ON NATURAL ENVIRONMENT OF THE WESTERN GHATS

Attendee List

Name of the project: Information Collection Study on Natural Environment of the Western Ghats in India

Date & Time: 11 Jan 2016, 14:00-15:00

Venue: Centre for Wildlife Studies Office

Attendee:

No.	Name	Affiliation
1	Dr. U. Karanth	Director, CWS
2	Mr. M. C. Vinay Kumar	CWS
3	Mr. S. Vaidyanathan	Senior Fellow, Foundation for Ecological research, Advocacy and Learning (FERAL)
4	Mr. R. R. Nayak	Senior Research Fellow, FERAL
5	Mr. P. N. Karanth	IJCCIK
6	Mr. D. Kiyota	JICA Study Team (JST)
7	Ms. J. Toyoshima	JST
8	Mr. T. Hatano	JST

Meeting Atmosphere

DATA COLLECTION SURVEY ON NATURAL ENVIRONMENT OF THE WESTERN GHATS

Date / Time	January 11, 2016, Monday 16:00 - 17:00
Venue	Regional Office of MoEF
Participants	Mr. S. M. Somashekar (CCF) ※Refer to the attached Attendee List The Study Team: Mr. Kiyota, Ms. Toyoshima. Mr. Hatano, Mr. P. N. Karanth
Agenda	Interviews with officers concerns, request to submit related information, etc.
Discussed Items	The Study Team visited the regional office of Ministry of Environment, Forest and Climate Change. During the meeting, the Study Team learned about the role of the central government, and requested their cooperation to the activities in the Western Ghats region and provision of related information and documents. The discussed items are as follows: • The Main role of MoEF is formulation and implementation of higher level policies and programs for environmental conservation and protection. About forest, MoEF has authority to decide whether the target group of trees is classified as forest (protection target) or not. The rotation of officers is every 4 to 5 years. • If the Shiradi Ghat Bypass is completed, utilization of the existing road will be decreased and it is expected to contribute to be eco-friendly. • In the decision of the alighnment, they hope to reduce the deforestration areas as much as possible. For that purpose, they welcomed a combination with the exisiting for the section from the starting point to the tunnnel. • National Highways Authority of India is responsible for the national road. Period

DATA COLLECTION SURVEY ON NATURAL ENVIRONMENT OF THE WESTERN GHATS

Attendee List

Name of the project: Information Collection Study on Natural Environment of the Western Ghats in India

Date & Time: 11 Jan 2016, 16:00-17:00

Venue: Regional Office of the National Ministry of Environment, Forestry and Climate Change (MoEF)

Attendee:

No.	Name	Affiliation
1	Mr. S. M. Somashekar	Chief Conservator of Forests, MoEF
2		Staff, MoEF
3	Mr. P. N. Karanth	IJCCIK
4	Mr. D. Kiyota	JICA Study Team (JST)
5	Ms. J. Toyoshima	JST
6	Mr. T. Hatano	JST

Meeting Atmosphere

DATA COLLECTION SURVEY ON NATURAL ENVIRONMENT OF THE WESTERN GHATS

Date / Time	January 13, 2016, Wednesday 11:00 - 12:00
Venue	Karnataka Biodiversity Board (KBB), at KFD
Participants	Mr. R. K. Singh (APCCF & Member Secretary) ※Refer to the attached Attendee List The Study Team: Mr. Kiyota, Ms. Toyoshima. Mr. Hatano, Mr. P. N. Karanth
Agenda	Interview with officers concerns, request to submit related information, etc.
Discussed Items	The Study Team visited Karnataka Biodiversity Board (KBB) and learned the role of KBB, and their activities in the Western Ghats region, and requested to provide related information and documents. The discussed items are as follows: • The main roles of KBB are to documents voluminous information about biodiversity within the state, and formulate and operate the system to the sustainable utilization and development. There are 13 members. • KBB identifies rare species and endangered species through field surveys, and specifies species which required to be protected from the viewpoint of sustainable usage, and protects them. In addition, they also tie up with industries such as pharmaceutical companies. • KBB designates 16 kinds of animals and plants each as an endangered species. • Soil and moisture content are investigated during field surveys to identify which species are suitable to live in the area. • Farmers use land (farm land) freely, and overuse of groundwater is a concern. • Related regulations (Karnataka Biological diversity Rules, 2005, etc.) can be obtained from the following link: http://www.kbb.kar.nic.in/actsrules.htm • Recommended to contact Dr. Gururaja of IISc, a frog expert. • The Study Team borrowed some useful books. Period

DATA COLLECTION SURVEY ON NATURAL ENVIRONMENT OF THE WESTERN GHATS

Attendee List

Name of the project: Information Collection Study on Natural Environment of the Western Ghats in India

Date & Time: 13 Jan 2016, 11:00-12:00

Venue: Karnataka Biodiversity Board (KBB), at KFD

Attendee:

No.	Name	Affiliation
1	Mr. R. K. Singh	APCCF & Member Secretary, KBB
2	Mr. P. N. Karanth	IJCCIK
3	Mr. D. Kiyota	JICA Study Team (JST)
4	Ms. J. Toyoshima	JST
5	Mr. T. Hatano	JST

Meeting Atmosphere

DATA COLLECTION SURVEY ON NATURAL ENVIRONMENT OF THE WESTERN GHATS

<table>
<tr><td>Date / Time</td><td>January 13, 2016, Wednesday 12:50 - 13:40</td></tr>
<tr><td>Venue</td><td>Karnataka State Department of Forest, Ecology and Environment</td></tr>
<tr><td>Participants</td><td>Mr. Ramachandra (Secretary to Government (Ecology and Environment))
※Refer to the attached Attendee List
The Study Team: Mr. Kiyota, Ms. Toyoshima. Mr. Hatano, Mr. P. N. Karanth</td></tr>
<tr><td>Agenda</td><td>Interview with officers concerns, request to submit related information, etc.</td></tr>
<tr><td>Discussed Items</td><td>The Study Team visited Mr. Ramachandra, Secretary to Government (Ecology and Environment) of Karnataka State Department of Forest, Ecology and Environment (KS_DFEE), and learned the role of the department. In addition, the Study Team requested to cooperate with the activities in the Western Ghats region and provide related information and document. The discussed items are as follows:

• KS_DFEE is responsible to prepare EIA of category B project and issue Environmental Clearance (EC) within the state. On the other hand, Category A project is under the jurisdiction of the Central Government. According to the notice of EIA (2006), category classification of highway is as follows:

<table>
<tr><td rowspan="2">Project Activity</td><td colspan="2">Category Classification</td><td rowspan="2">Other conditions</td></tr>
<tr><td>A（Central Government Jurisdiction）</td><td>B（The State Government Jurisdiction）</td></tr>
<tr><td>Highway</td><td>For the case of i) new national highway, ii) existing national highway, which stretch is 30 km or more, and requires land acquisition with an additional road width of 20 m or more and passes through 2 states or more.</td><td>For the case of i) new state highway, ii) existing national and state highways, which stretch is 30 km or more, and requires land acquisition with an additional road width of 20 m or more.</td><td>General condition only</td></tr>
</table>

• The project applicable for Category A requires obtaining EC from MoEF under the review by the Environmental Appraisal (EAC). The Category B project requires to obtain EC from the State Government Environmental Impact Assessment Committee under the review by the State government’s environmental licensee.

• For other role regarding to the ecosystem, there is licensing of People’s Biodiversity Register (PBR: registration system for persons with information on local biological resources (availability, content, traditional values, etc.)

• It seems that data and documents could be obtained from CAB Abstracts (http://www.cabdirect.org : paid service. It is a comprehensive information source that records international research information on agriculture and related applied sciences).

• They acknowledged the research cooperation and will be responding by the request from the Study Team.

Period</td></tr>
</table>

DATA COLLECTION SURVEY ON NATURAL ENVIRONMENT OF THE WESTERN GHATS

Attendee List

Name of the project: Information Collection Study on Natural Environment of the Western Ghats in India

Date & Time: 13 Jan 2016, 12:50-13:40

Venue: Karnataka State Department of Forest, Ecology and Environment

Attendee:

No.	Name	Affiliation
1	Mr. Ramachandra	Secretary to Government (Ecology and Environment)
2	Mr. P. N. Karanth	IJCCIK
3	Mr. D. Kiyota	JICA Study Team (JST)
4	Ms. J. Toyoshima	JST
5	Mr. T. Hatano	JST

Meeting Atmosphere

DATA COLLECTION SURVEY ON NATURAL ENVIRONMENT OF THE WESTERN GHATS

Date / Time	January 13, 2016, Wednesday 18:00 - 18:40
Venue	Gubbi Labs LLP, IISc
Participants	Dr. K. V. Gururaja (Chief Scientist)※Refer to the attached Attendee List The Study Team: Mr. Kiyota, Ms. Toyoshima. Mr. Hatano, Mr. P. N. Karanth
Agenda	Interview with officers concerns, request to submit related information, etc.
Discussed Items	The Study Team visited Dr. Gururaja, a researcher of frog's habitat in the Western Ghats. During the meeting, the Study Team conducted interview and requested the related information and documents. The discussed items are as follows: • In the area, about 150 species have been confirmed for last 20 years. In 2011, a new species have been newly found (the name is unknown). • Frogs live in streams. During flood, they are moved due to the external force. Many species are isolated. Therefore, it is often found that endemic species inhabit in each valley line. • Field surveys were conducted in 2007, 2009, 2011 and 2013 during the monsoon period. • In Dr. Gururaja's personal opinion: 1) support the road construction with the tunnel base, 2) not favorable to the hydropower project, 3) interested in whether the flow of streams which is habitat for frogs could be secured or not. • There is data of road kill. Dr. Gurujraja will provide related information including research paper with the habitat location information. • He will cooperate when there is an additional survey lead by JICA. Dr. Gururaja's research paper can be obtained from the following link: http://www.gururajakv.net/publications.html Period

DATA COLLECTION SURVEY ON NATURAL ENVIRONMENT OF THE WESTERN GHATS

Attendee List

Name of the project: Information Collection Study on Natural Environment of the Western Ghats in India
Date & Time: 13 Jan 2016, 18:00-18:40
Venue: Gubbi Labs LLP, IISc
Attendee:

No.	Name	Affiliation
1	Dr. K. V. Gururaja	Chief Scientist, Gubbi Labs LLP in IISc
2	Mr. P. N. Karanth	IJCCIK
3	Mr. D. Kiyota	JICA Study Team (JST)
4	Ms. J. Toyoshima	JST
5	Mr. T. Hatano	JST

Meeting Atmosphere

DATA COLLECTION SURVEY ON NATURAL ENVIRONMENT OF THE WESTERN GHATS

Date / Time	February 5, 2016, Friday 16:00 - 18:30
Venue	Nature Conservation Foundation
Participants	Dr. Sanjay Gubbi, Scientist, Nature Conservation Foundation The Study Team: Ms. Toyoshima, Meena Nambier
Agenda	Information gathering regarding to the bio-diversity
Discussed Items	About Nature Conservation Foundation ・Nature Conservation Foundation is a NGO which conducts scientific researches and conservation activities of wildlife. The activity area covers the whole of India. There are about 150 staffs including many scientists. In Karnataka, there are three offices, one (1) office in Mysore and two (2) offices in Bangalore. Dr. Gubbi's background and research activities ・He has been working at Nature Conservation Foundation for last 5 years, before that he was conducting researches at Center for Wildlife Studies. ・His research is specialized in large feline species such as tiger, especially familiar with the influence of the road on wildlife. He has conducted many surveys in the target area of the bypass project. ・In order to secure the connectivity of ecosystem in Pushupagiri and Kudremukhu, he proposed to the state government to expand the both protected areas and to conserve the conservation forest in the target area, and actively promotes the proposal. ・ He is also a committee member of the State's Standing Committee of the National Board of Wildlife, and is in the position to review all development plans. About the Bypass Project ・ Dr. Gubbi considered that since this meeting was not requested by a formal letter, it is an informal meeting. About the comments provided in this meeting, Dr. Gubbi requested not to use or refer them in reports etc. without his permission. For the provided information and materials which have already published can be utilized freely. ・The project's target area is a part of Mysore Elephant Reserve. ・The recommendations of Karnataka Elephant Task Force is approved by Karnataka High Court. Among the recommendations, it is said that the development plan within the Asian Elephant habitat should be reviewed because there is a concern to increase the Elephant-human conflict. ・The plan to expand the protected are in Pushpagiri and Kudremukhu has been approved by the state government, and it is only waiting to be notified. However, it has not yet been notified since then. Dr. Gubbi thinks that this project is the cause of not being notified. (The Study Team explained that if the project's target area officially becomes the protected area, the possibility of JICA's investment is very low.) ・For the bypass project, since a tunnel will be constructed, the impact on the

	wildlife would be smaller, and Dr. Gubbi has no particular reason to object. The impact will be at least smaller than the one caused by the existing roads. However, it is important to secure the continuity of Pushpagiri and Kudremukhu, at the time when the project is implemented; making the abovementioned conservation forest a protected area should be a precondition. ・When designing roads, opinions of experts who are familiar with wildlife behavior should be incorporated as to the design and location of structures will not block the movement of wildlife. ・In the conservation forest within the project's target area, there are residents who make their living by freshwater fishery, and there are concerns that the project may impact on their living. Dr. Gubbi will introduce a researcher specialized in freshwater fish who has conducted surveys within the target area, and suggests the Study Team to contact her and gather information from her. Period
	1. High Court Order (About the proposal of Karnataka Elephant task Force) dated on October 8, 2013. 2. Report of the Karnataka Elephant Task Force Submitted to the High Court of Karnataka 3. Several public documents on the expansion project of Pushupagiri and Kudremukhu 4. Management of roads for efficient maintenance and nature conservation (Microsoft PowerPoint file) 5. Other research papers: 6 papers

Attendee List

Name of the project: Information Collection Study on Natural Environment of the Western Ghats in India
Date & Time: 5 Feb 2016, 16:00-18:30
Venue: House of Mr. Sanjay Gubbi
Attendee:

No.	Name	Affiliation	Contact
1	Mr. Sanjay Gubbi	Nature Conservation Foundation	+91-80-41139131 gubbi@ncf-india.org
2	Ms. J. Toyoshima	JICA Study Team (JST)	
3	Ms. Meena	JST	

DATA COLLECTION SURVEY ON NATURAL ENVIRONMENT OF THE WESTERN GHATS

Date / Time	February 8, 2016, Monday10:00 - 11:30
Venue	House of Mr. Yellappa Reddy
Participants	Mr. Yellappa Reddy (Former Forest Officer in Hassan) The Study Team: Ms. Toyoshima, Meena Nambier
Agenda	Interview with officers concerns, request to submit related information, etc.
Discussed Items	About the provision of literatures on ecosystem in the study area • Mr. Reddy has worked as Forest Officer in Hassan area for over 20 years and he shows deep understanding of local residence and wildlife. But he has not published any scientific papers. • According to Mr. Reddy, the research papers about the ecology of this area have been published without the correct understanding. • Mr. Reddy is a member of local committee of environmental affairs and he has expressed opposition to the Yettinahole Project for the following reasons. 1. The hydrological information described in DPR is not trustworthy. 2. Even if intake is possible, it is unknown how to pump up the water. It is not realistic. 3. The water intake would impact on the groundwater level in the area, and it could have a serious effect on the cultivation of spices (pepper, cardamom, etc.) and farmers. 4. The project has been supported by the contractor's and other's lobbying activities as well as politicians, therefore, the environmental impact is not properly considered. 5. Forest Department does not have appropriate information and technologies to understand and assess the environmental impact. • The following paper written by Dr Madhyastha (a researcher who Mr. Reddy is trusted in) might be valuable: —Flora of Hassan by Saldanah （1960s.）— Period

DATA COLLECTION SURVEY ON NATURAL ENVIRONMENT OF THE WESTERN GHATS

Attendee List

Name of the project: Information Collection Study on Natural Environment of the Western Ghats in India
Date & Time: 8 Feb 2016, 10:00-11:30
Venue: House of Mr. Sanjay Gubbi
Attendee:

No.	Name	Affiliation	Contact
1	Mr. Yellappa Reddy	Former Forest Officer in Hassan	+91-80-41139131 gubbi@ncf-india.org
2	Mr. D. Kiyota	JICA Study Team (JST)	
3	Ms. Meena	JST	

DATA COLLECTION SURVEY ON NATURAL ENVIRONMENT OF THE WESTERN GHATS

Date / Time	February 8, 2016, Monday 14:00 - 15:30
Venue	House of Ms. Suman Jhumani
Participants	Ms. Suman Jhumani (Researchers for Wildlife Conservation (RWC)) The Study Team: Mr. Kiyota, Ms. Toyoshima, Mr. Karanth、Ms. Meena
Agenda	Interview with officers concerns, request to submit related information, etc.
Discussed Items	About the provision of literatures on ecosystem in the study area • The data (rainfall mount) which is described in DPR of Yettinahole is one of the data from Kaadumane Estate (Private Company), and the specified maximum rainfall amount is intentionally used which is stretched interpretation. • Although the area of the catchment (river basin) is considered to be an accurate value, however it is hard to say that the rainfall mount allocated to the each basin is accurately calculated. It is different from the condition of ground surface in the field, and it is not consistent with the value of DPR which is calculated to have the same Runoff Coefficient. • There are many endemic fish species, including Anguilla Bengalensis (a type of eel). Also, there are migrant species as well. Mahseer (Cyprinidae) is a dominate species (often seen) in this area. In this area, there are migratory fishermen, who travel from Manga roll and other areas, and stayed for several months to run their fishery business. Therefore, they might be impacted by the project. • Several small-scale power generation dams have been constructed. The size of the power generation dam is regulated by the amount of power generation; however the height of the dam is not regulated. The height of the power generation dam is usually higher than the one specified for the large-scale dam. • Currently, there are four (4) lawsuits against the Yettinahole Project. • Blasting could affect the behavior of elephants. ―Provided Literatures― ・Endemic Species in India (Zoological Survey of India 2013) ・Biodiversity and Ecological Significance of Gundia River Catchment (IISc, 2007) Period

Attendee List

Name of the project: Information Collection Study on Natural Environment of the Western Ghats in India

Date & Time: 8 Feb 2016, 10:00-11:30

Venue: House of Mr. Sanjay Gubbi

Attendee:

No.	Name	Affiliation	Contact
1	Mr. Yellappa Reddy	Researchers for Wildlife Conservation (RWC)	sumanjumani@gmail.com
2	Mr. P. N. Karanth	IJCCIK	98450-54050
3	Mr. D. Kiyota	JICA Study Team (JST)	
4	Ms. J. Toyoshima	JST	
5	Ms. Meena	JST	