



Final Report

**CFS I : MASTER PLAN
FOR ECOLOGICAL LINKAGES**





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ABBREVIATION

ADB	-	Asian Development Bank
ASEAN	-	Association of Southeast Asian Nations
CARICOM	-	Caribbean Community
CATIE	-	Tropical Agricultural Research and Higher Education Centre
CC	-	Carrying Capacity
CFS	-	Central Forest Spine
CDM	-	Clean Development Mechanism
CERs	-	Certified Emission Reductions
CIFOR	-	Centre for International Forestry Research
CSR	-	Corporate Social Responsibility
CVM	-	Centre for Veterinary Medicine
DARA	-	Development Authority for Pahang Tenggara
DID	-	Department of Irrigation
DLM	-	Director of Lands and Mines
DOA	-	Department of Agriculture
DOF	-	Department of Forestry
DOT	-	Department of Transport
DWNP	-	Department of Wildlife and National Parks
EAR	-	Ecological Assessment Report
EC	-	Ecological Corridors
ECER	-	Eastern Corridor Economic Region
ECTU	-	Elephant Capture & Translocation
EFB	-	Empty Fruit Bunches
EIA	-	Environment Impact Assessment
EIRR	-	Expected Internal Rate Of Return
EMS	-	Environmental Management System
EPU	-	Economic Planning Unit
ESA	-	Environmentally Sensitive Area
EU	-	European Union
EWG	-	Expert Working Group
FOA	-	Food and Agriculture Organization
FELCRA	-	Federal Land consolidation and Rehabilitation Authority
FELDA	-	Federal Land Development Authority
FDPM	-	Forestry Department of Peninsular Malaysia



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FR	-	Forest Reserve
FSC	-	Forest Stewardship Council
FT	-	Financial Times
FRIM	-	Forest Research Institute Malaysia
GIS	-	Geographic Information System
GEF	-	Global Environment Facility
GNI	-	Gross National Income
Ha	-	Hectare
HEC	-	Human Elephant Conflicts
HPU	-	Highway Planning Unit
HSK	-	Hutan Simpan Kekal
HWC	-	Human Wildlife Conflicts
IAMF	-	International Association for Mediterranean Forests
ICM	-	Integrated Catchment Management
ICIMOD	-	International Centre for Integrated Mountain Development (ICIMOD)
ICRAF	-	World Agro-forestry Centre
IFC	-	International Finance Corporation
IMT-GT	-	Indonesia Malaysia Thailand Growth Triangle
IPM	-	Integrated Pest Management
ITTO	-	International Tropical Timber Organization
IUCN	-	World Conservation Union
IUFRO	-	International Union of Forest Research Organizations
JBIC	-	Japan Bank for International Cooperation
JHEOA	-	Jabatan Hal Ehwal Orang Asli
JKR	-	Jabatan Kerja Raya
JNPC	-	Johor National Parks Corporation
JPBD	-	Jabatan Perancang Bandar dan Desa
Kg.	-	Kampung
KKR	-	Kementerian Kerja Raya
Km	-	Kilometre
KTM	-	Keratapi Tanah Melayu
MAS	-	Malaysia Airlines System
MC&I	-	Malaysia Criteria and Indicators
MHA	-	Malaysia Highway Authority
MNS	-	Malaysia Nature Society



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MOF	-	Ministry of Finance
MTTC	-	Malaysia Timber Certificate Council
MyCat	-	Malaysian Conservation Alliance for Tigers
LA	-	Local Authority
LAC	-	Limits of Acceptable Change
LKPP	-	Lembaga Kemajuan Perusahaan Pertanian
LPA	-	Local Planning Authority
MC&I	-	Malaysian Criteria and Indicators
MNS	-	Malaysian Nature Society
MP	-	Malaysia Plan
MPOB	-	Malaysia Palm Oil Board
MTCC	-	Malaysian Timber Certification Council
NBBC	-	National Biodiversity and Biotechnology Council
NFA	-	National Forest Act
NGOs	-	Non Government Organisation
NFC	-	National Forest Council
NLC	-	National Land Code
NLC	-	Nation Land Council
NPP	-	National Physical Plan
NPPC	-	National Physical Planning Council
NRE	-	Natural Resources Environment
NTFP	-	Non-Timber Forest Products
ODA	-	Official Development Assistance
ODS	-	Ozone Depleting Substances
PAS	-	Protected Areas System
PAM	-	Protected Areas Management
PERHILITAN-	-	Department of Wildlife and National Parks
PFR	-	Permanent Forest Reserve
PFR	-	Protected Forest Reserve
PL	-	Primary Linkages
POME	-	Palm Oil Mill Effluent
POPs	-	Persistent Organics Pollutants
PWD	-	Public Work Department
REDD	-	Reducing Emissions Deforestation Degradation
RELA	-	Ikatan Relawan Rakyat Malaysia
RSPO	-	Roundtable Sustainable Palm Oil



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RISDA	-	Rubber Industry Smallholders Development Authority
SA	-	State Authority
SADC	-	Southern Africa Development Community
SFD	-	State Forestry Department
SEPPSF	-	South East Pahang Peat Swamp Forest Complex
Sg.	-	Sungai
SL	-	Secondary Linkages
SPAN	-	Suruhanjaya Perkhidmatan Air Negara
TCPD	-	Town Country Planning Department
TEV	-	Total Economic Value
TKPM	-	Tanaman Kekal Pengeluaran Makanan
UNDP	-	United Nation Developments Programme
UNEP	-	United Nation Environment Programme
UNFCC	-	United Nations Farmework Convention on Climate Change
UNIDO	-	United Nations Industrial Development Organization
UPP	-	Unit Pencegah Penyeludup
USA	-	United State of America
UUM	-	Univerity Utara Malaysia
WCS	-	Wildlife Conservation Society
WFP	-	World Food Programme
WHO	-	World Health Organisation
WTP	-	willingness to pay
WWF	-	World Wildlife

executive summary



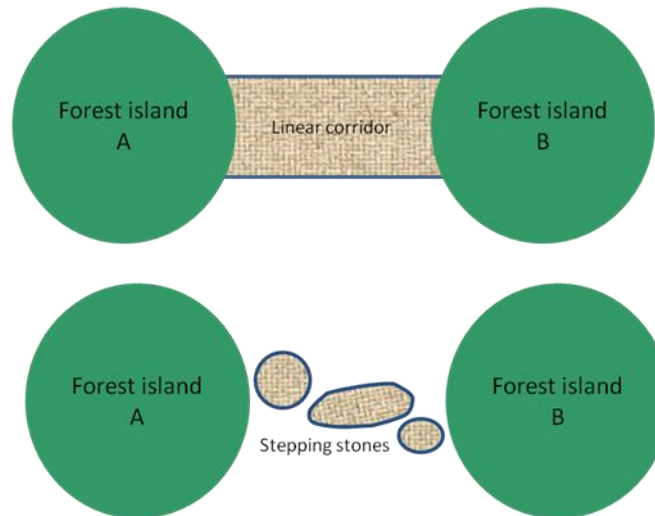


Central FOREST SPINE : MASTER PLAN FOR ECOLOGICAL LINKAGES

EXECUTIVE SUMMARY

1. The main objectives of the study are to restore the connectivity of the forest complexes in the CFS, to formulate viable land use and management guidelines for sustainable development in and adjacent to the Ecological Corridors identified, and to propose an effective implementation mechanism to execute the programmes set out.
2. The primary basis for this study is drawn largely from Policy 19 of the National Physical Plan (NPP) which states that “A Central Forest Spine (CFS) shall be established to form the backbone of the Environmentally Sensitive Area Network” and associated Measure 4 which advocates that “Studies shall be undertaken to determine the possibility of re-establishing the integrity and connectivity of forests and wetlands through the implementation of linkages between the four major forest complexes”.
3. The CFS1 Masterplan takes a far-sighted objective of re-establishing, maintaining and enhancing connectivity between the most significant remaining areas of forests in Peninsular Malaysia. Once established, this Central Forest Spine shall form a physically and functionally unbroken link of forests from Johor to the Thai border, henceforth connecting with certain protected areas in Thailand.
4. The overriding benefit will be related to arresting the negative impacts of forest fragmentation on biodiversity, thereby helping to ensure the conservation of the entire gamut of species found in our forests, as well as to maintain the host of ecological processes taking place within it.
5. The study area of CFS1 covers the northern Peninsular Malaysia, stretching from the state of Kedah on the West until Terengganu in the East, i.e. states of Kedah, Perak, Kelantan, Terengganu and Pahang together with adjoining southern Thailand (i.e. transboundary linkages). The CFS1 encompasses an area of about 3 million hectares. It occupies largely the forest complexes of Banjaran Titiwangsa - Banjaran Bintang - Banjaran Nakawan, and northern side of Taman Negara - Banjaran Timur.
6. The importance and need of connectivity between fragmented forest complexes includes:-
 - a) Conservation of Environment and Biodiversity;
 - b) Protection and Management of Water Catchment;
 - c) Exploitation of Nature-based Tourism and Recreational Potentials;
 - d) Integrated Management of Interstate Forest; and
 - e) Enhancement of International Level Prestige.
7. Human activity, particularly the clearing of native vegetation for other non-forest land uses such as agriculture, settlement and infrastructure development, is breaking-up the natural habitat into unconnected parts. Forest fragmentation and edge effects from deforestation have pervasive and deleterious impact on biodiversity and ecosystem. In particular, habitat fragmentation usually leads to habitat destruction, thus reducing the amount and diversity of plants and animals. As a result, the issues and challenges faced in the CFS1 are as follows:-

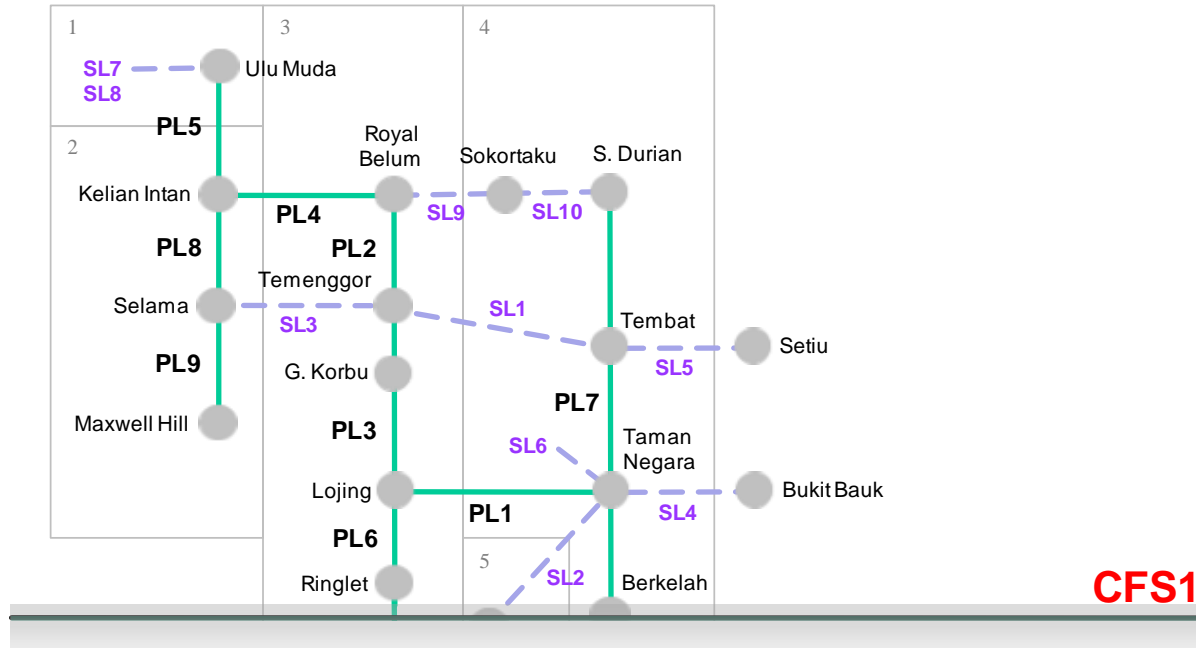
- a) Reduction of Forest Cover;
 - b) Fragmentation of Forest;
 - c) Environmental Degradation to Highland Areas;
 - d) Damage to the Water Catchment and River System;
 - e) Damage to Potential Recreation and Tourism Areas;
 - f) Loss of Tourism Development Resource and National Natural Heritage; and
 - g) Elimination of Potential Medical Resource, Education and Research.
8. The CFS1 Masterplan will be a contributory initiative to the overall *Vision* for the CFS1 which envisages ***“To Establish A Viable And Contiguous Or Connected Conservation Area Comprising Both Forest And Non Forest Areas That Will Be Maintained As The Green Lung Of The Environmentally Sensitive Area Network In Peninsular Malaysia”***.
 9. Essentially, ecological corridors must provide forest cover, food, water, protection from dangers and minimal disturbance for the species that use them. The design of the corridors should be appropriate to the species that use them. For example, an elephant would not be able to climb on an overhead wire crossing.
 10. Two types of Ecological Corridors, i.e. *primary linkage* or *secondary linkage*, have been created in CFS1. Each corridor can take the form of either a contiguous *linear corridor* (i.e. unbroken stretches of forested habitats connecting forest islands) or *“stepping stones”* (i.e. patches of suitable habitats) as indicated in the Figures below.



11. Primary linkages (PL) are identified in areas where it is crucial to re-establish forest connectivity in order to achieve the main Central Forest Spine link. These areas are inevitably located between the most important blocks of forests. Primary linkages are normally linear corridors, and cater for movement of large mammals.

12. Secondary linkages (SL) are complementary to the primary linkages. They are identified in areas where it is unfeasible to create a primary linkage due to physical, land use, biological and socio-economic constraints such as vast areas of non-forested land or long distances between forests, or high human population and activities, but it is still important to maintain some level of connectivity, albeit weaker, between forests. Secondary linkages are usually stepping stones, and meant to be used by small animals, birds and insects.
13. Nine PLs have been identified in CFS1 as listed below and depicted in the schematic diagram (please refer to the Fact Sheet Primary Links in para. 3.2 for details). However, after the Steering Committee Meeting, this study has identified additional Primary Linkages which are PL10 and PL11 (see Schematic Diagram). PLs are usually in narrow stretches where non-forest land use is still minimal, and there are patches of remaining State land forest and scrub. In most cases, major and often costly interventions, such as acquisition of private land, reforestation, construction of viaducts / underpasses along highways etc., will be required to establish these corridors. In this connection, the PLs identified are:
- CFS1-PL1 : Tanum FR (Greater Taman Negara) – Sg Yu FR (Main Range);
 CFS1-PL2 : Temengor FR (Main Range) – Royal Belum State Park (Main Range);
 CFS1-PL3 : Lojing FR (Main Range) – Sg Brok FR (Main Range);
 CFS1-PL4 : Padang Chong FR (Bintang Hijau) – Sg Kuak FR (Main Range);
 CFS1-PL5 : Ulu Muda FR (Ulu Muda) – Gunung Inas FR (Bintang Hijau);
 CFS1-PL6 : Ulu Jelai FR (Main Range) – Hulu Lemoi FR (Main Range);
 CFS1-PL7 : Taman Negara – Tembat FR (Greater Taman Negara);
 CFS1-PL8 : Kenderong FR (Bintang Hijau) – Bintang Hijau (Hulu Perak) FR (Bintang Hijau);
 CFS1-PL9 : Bintang Hijau Larut Matang FR – Bintang Hijau Kuala Kangsar FR;
 CFS1-PL10: Bukit Larut FR – Bubu FR; and
 CFS1-PL11: Jerangau FR – Jerangau FR.
14. Ten SLs have been identified in CFS1 as outlined below and presented in the schematic diagram (please see the Fact Sheet Secondary Links in para. 3.3 for details). However, after the Steering Committee Meeting, this study has identified additional Secondary Linkages which are SL11, SL12 and SL13 (see Schematic Diagram). SLs are usually designed to follow river corridors. Stepping stones are generally cheaper to maintain, but may require significant cooperation of landowners and managers in the area in terms of adopting land use management practices that are appropriate to the secondary linkage. In this respect, the SLs identified are:
- CFS1-SL1: Lebir FR – Relai FR – Ulu Temiang FR – Jentiang FR - Serasa FR – Gunung Stong State Park;
 CFS1-SL2: Krau WR – Bencah FR – Som FR – Yong FR;
 CFS1-SL3: Bintang Hijau (Hulu Perak) FR – Papulut FR – Piah FR;
 CFS1-SL4: Taman Negara Forest Complex – Terengganu coast;
 CFS1-SL5: Taman Negara Forest Complex – Terengganu coast 2;
 CFS1-SL6: Taman Negara – Chiku FR;
 CFS1-SL7: Ulu Muda FR – Pedu FR – Chebar FR;
 CFS1-SL8: Ulu Muda FR – Rimba Telui FR;
 CFS1-SL9: Jeli FR - Sg. Sator FR - Sokortaku FR;
 CFS1-SL10: Chabang Tongkat FR - Ulu Sat FR - Temangan FR;
 CFS1-SL11: Bukkit Kinta FR – Bujang Melaka FR;
 CFS1-SL12: Bubu FR – Matang Mangroves; and
 CFS1-SL13: Gunung Bongsu FR – Gunung Inas FR.

Schematic Diagram of Ecological Corridors in CFS1



Forest Complexes:

1. Kedah-Singgora Range
2. Bintang Hijau Range
3. Main Range
4. Greater Taman Negara
5. Benom massif
6. Cini – Bera
7. South East Pahang Peat Swamp Forest
8. Endau-Rompin - Sedili

- Primary Linkage (PL)
- - - Secondary Linkage (SL)

15. As corridors are ecological conservation areas for biodiversity particularly wildlife, the CFS1 Masterplan has drawn up land use guidelines in controlling and managing existing and new development on a sustainable manner in the core area and buffer zone of designated ecological corridors; guidelines on sustainable agricultural management and sustainable eco-tourism development which can be implemented by other relevant agencies, landowners and local communities; and infrastructure guidelines for the planning and designing of wildlife crossings for linear infrastructure especially roads. For new highways, wildlife crossing physical structures shall be incorporated into the road design.
16. With respect to settlement and village development, certain land use activities and development will be normally permitted according to the type of ecology corridor and the planning control area within each corridor identified. These planning controls are as follows:



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a) Primary Corridor

- 1) Restricted development and no human settlement. For existing human settlement and activities within the primary corridor, it shall be relocated and private land affected will be acquired, if necessary.
- 2) Types of development that are permitted subject to the full compliance to the relevant guidelines stipulated within the primary corridor are:-
 - Facilities for forest and wildlife management;
 - Scientific research;
 - Infrastructure & utilities development; and
 - Selected agriculture development.
- 3) Installation of suitable fencing and other acceptable mitigating measures shall be taken around the adjacent settlement area to ensure human safety and property security.

b) Secondary Corridor

- 1) No new expansion and intensification of existing settlement except it meets local needs.
 - 2) Types of permissible development subject to the full compliance to the relevant guidelines stipulated are:-
 - Within designated human settlement, appropriate development and human activities without serious auditory and olfactory disturbance;
 - Facilities for forest and wildlife management;
 - Scientific research;
 - Infrastructure & utilities development; and
 - Selected agriculture development.
 - 3) Installation of suitable fencing and other acceptable mitigating measures shall be taken around the existing human settlement and adjacent developed area.
17. The implementation mechanism, in terms of appropriate implementing agencies, legal instruments and implementing strategies, will provide the necessary viable platforms upon which the proposed ecological corridors can be created.
18. The options for the implementing strategy are not mutually exclusive, and may need to be applied in combination with other options in achieving the ecological corridors The various options considered are as follows:-
- 1) Option 1: Acquisition of Private Land in the Corridors and Reserve it for Public Purpose;
 - 2) Option 2: Purchase of Land and Secure State Land as Ecological Corridors;
 - 3) Option 3: Integrating Roads and Railways within the Ecological Crossing;
 - 4) Option 4: Establishing Ecological Corridors on Private Land;
 - 5) Option 5: Establishing the Corridor as Protected Lands; and
 - 6) Option 6: Establishing Ecological Corridors along Riparian Reserves.



19. The key implementing agencies would require the collaborative effort of the agencies responsible for the corridor, i.e. the Forestry Department, Wildlife Department, State Parks Corporation, State Director of Land and Mines, in addition to infrastructure agencies and the key players in the plantation sector.
20. The overall programme for implementation however will have to be done by the Ministry of Natural Resources and Environment which will have to bid for funds under the 5 year Malaysia Plans. Both from a functional point of view and the availability of expertise, the NRE appears to be in the most suitable position to take the leadership role in preparing an overall programme for the implementation of the Master Plan.
21. Four sources of finances identified as important for the development of the ecological linkages are: (i) Federal Funds; (ii) State Funds; (iii) Private Sector Funds; and (iv) International, multilateral and bilateral sponsors.

Part I main report

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THE IMPORTANCE OF ECOLOGICAL LINKAGES **2**

MASTER PLAN FOR ECOLOGICAL LINKAGES **3**

GENERAL GUIDELINES FOR ECOLOGICAL CORRIDORS **4**

IMPLEMENTATION **5**



01

introduction

Background
Objectives Of The Study
Study Area
Importance Of Connectivity
Vision
Approach And Methodology
Study Output
Outline Of This Report





1.0 INTRODUCTION

1.1 BACKGROUND

The central highlands of Peninsular Malaysia are well endowed with large expanses of forests and wetlands with a rich diversity of flora and fauna and associated ecosystems. Much of this natural heritage has been relatively well protected and maintained. However, land development, infrastructure provision and other economic activities in the past have led to environmental problems, e.g. loss of forest cover and forest fragmentation, in some parts of the central highlands.

The sustainable planning and management of the natural resources and the environment is vital to the quality of human life and overall well-being of the country. Maintaining the integrity of the forest and wildlife ecosystems is crucial to the viability of the eco-tourism industry. Protecting the forest contiguity is essential for the development of resource-based industry. Both sectors are central to the economy of the country. Consequently, it is imperative to conserve and use wisely the natural resources by protecting the environmentally sensitive areas. At the same time, it is important to undertake economic activities in a responsible way to sustain the natural environment.

The main policy framework for this study is drawn from Policy 19 of the National Physical Plan (NPP)¹ which states that:-

A Central Forest Spine (CFS) shall be established to form the backbone of the Environmentally Sensitive Area Network.

This policy statement is supported by two measures that form the basis of this project:

- **Measure 4: Studies shall be undertaken to determine the possibility of re-establishing the integrity and connectivity of forests and wetlands through the implementation of linkages between the four major forest complexes; and**
- **Measure 5: Rivers shall be used as connective corridors to maintain the integrity and connectivity of forest ecosystems.**

In order to translate and apply this national land use planning policy and measures at the local level, a special study has been commissioned by JPBD, Peninsular Malaysia. The huge CFS land complex is divided into two sub-areas, i.e. CFS-1 and CFS-2, to be studied by two teams of private consultants separately. To ensure that the CFS area is planned and managed in a holistic and integrated manner, JPBD will undertake to coordinate and put together consistently the recommendations of the two studies at a later stage.

The main purpose of the preparation of this master plan is a beginning step to realize the importance of community awareness to maintain and conserve ecological linkages to global interest. This master plan is a document or masterpiece that will guide

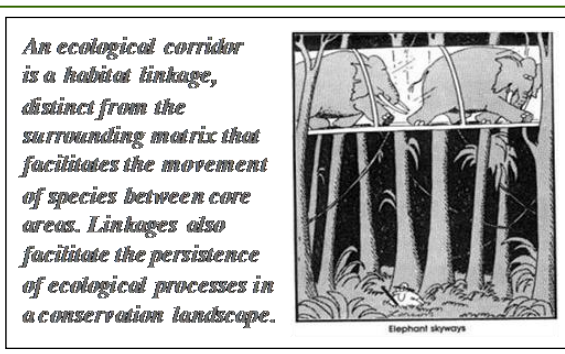
¹ Source: *National Physical Plan, 2005-2020*, Federal Department of Town and Country planning, Peninsular Malaysia.

and reference to the implementing agencies to ensure that the ecological linkages is protected and maintained for future biodiversity. At this stage, this study has identified Primary and Secondary Linkages and its Implementation Plan as well as its costing. However, in the future, the strategy and implementation plan for each Primary Linkages and Secondary Linkages can be revised accordingly to the current needs.

1.2 OBJECTIVES OF THE STUDY

The objectives of the study, as spelt out in the Terms of Reference, are as follows:-

- To restore the connectivity and continuity of the Forest Complexes in the CFS;
- To recommend viable rules and guidelines in controlling and managing development on a sustainable basis in the Ecological Corridors identified;
- To propose an effective implementation mechanism and identify the financial resources necessary to implement these programmes;
- To study the possibility of establishing a coordination and monitoring committee for overseeing the development programmes and conservation of the Ecological Corridors; and
- To enhance the awareness and commitment of all parties in maintaining the connectivity and integrity of the CFS for improving the country's biodiversity resources.



For the purpose of this study, it is important to note that comprehensive forest and wildlife planning and management *within* the forested areas, including those gazetted for biodiversity protection, e.g. national park and Permanent Forest Estate under the National Forestry Act, is beyond the scope of this project. The details of non-land use planning aspects are more appropriately dealt with by the respective departments under their jurisdictions and legislations, e.g. forest resources by Forestry Department and wildlife matters by Department of Wildlife and National Park. However, in preparing this plan for creating viable ecological corridors, it will take into account the impacts of wildlife habitats and wildlife movement routes in the forested areas on determining the location and design of the ecological corridors as well as their related development control guidelines.

As such, this study will focus primarily on the formulation of a plan and design guidelines for developing and managing functional ecological corridors on state land forest areas, riparian reserves and private alienated land (i.e. outside Forest Types A and B refer to Chapter 4.5) and ensure that it is implemented with the support of the relevant stakeholders. In addition, it will provide acceptable land use and development control guidelines and planning standards in and near these corridors, particularly in the designated buffer zone. The main aim of the ecological corridors is to encourage and facilitate wildlife movement between fragmented forest complexes and forest islands for biodiversity conservation; and at the same time, to reduce wildlife-human conflicts.

1.3 STUDY AREA

The study area covers the whole designated CFS-1 area. It is situated in northern Peninsular Malaysia, stretching from the state of Kedah on the West until Terengganu in the East, i.e. states of Kedah, Perak, Kelantan, Terengganu and Pahang. The area identified is north of Latitude 4° 10', i.e. north of Tapah (**Figure 1.1**). In addition, it will assess the possibility of linking up with adjoining southern Thailand (i.e. transboundary linkages) which constitutes an integral part of the total ecosystem for this CFS-1 region.

The CFS-1 encompasses an area of about 3 million hectares. It occupies largely the forest complex of Banjaran Titiwangsa - Banjaran Bintang - Banjaran Kedah-Singgora, and northern side of Taman Negara - Banjaran Timur.

The 28 districts involved in the CFS-1 study area are shown in **Table 1.1** and **Figure 1.1** and **Figure 1.2**.

Table 1.1: Districts in CFS-1

State	District	State	District
Kedah Darul Aman	Kubang Pasu	Kelantan Darul Naim	Jeli
	Padang Terap		Pasir Putih
	Sik		Machang
	Pendang		Tanah Merah
	Baling		Kuala Krai
	Kulim		Gua Musang
Perak Darul Ridzuan	Hulu Perak	Terengganu Darul Iman	Besut
	Selama		Setiu
	Larut dan Matang		Hulu Terengganu
	Kuala Kangsar		Dungun
	Kinta		Kemaman
	Batang Padang	Pahang Darul Makmur	Lipis
	Cameron Highlands		
	Jerantut		

Figure 1.1: Location of CFS-1 Study Area

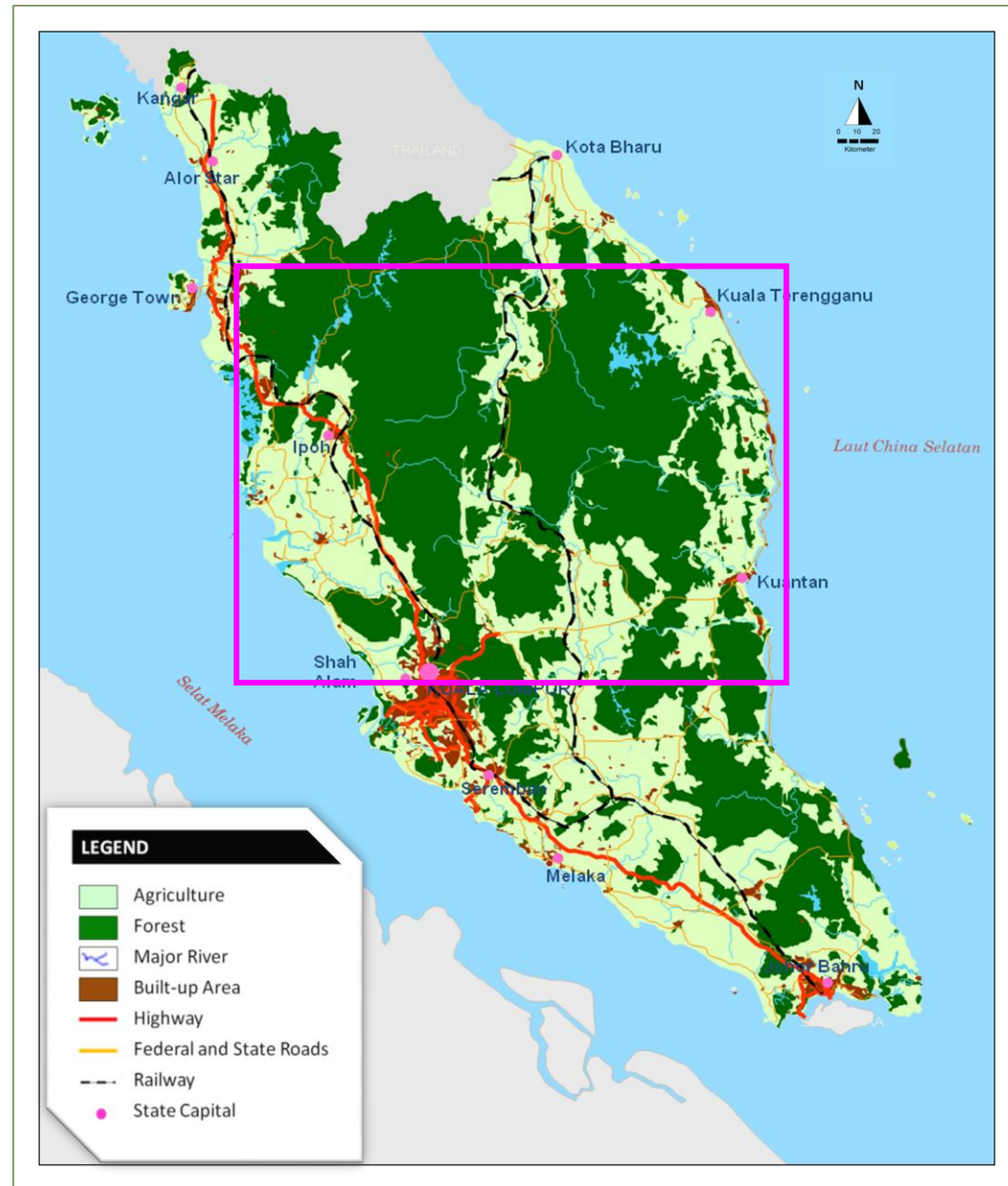
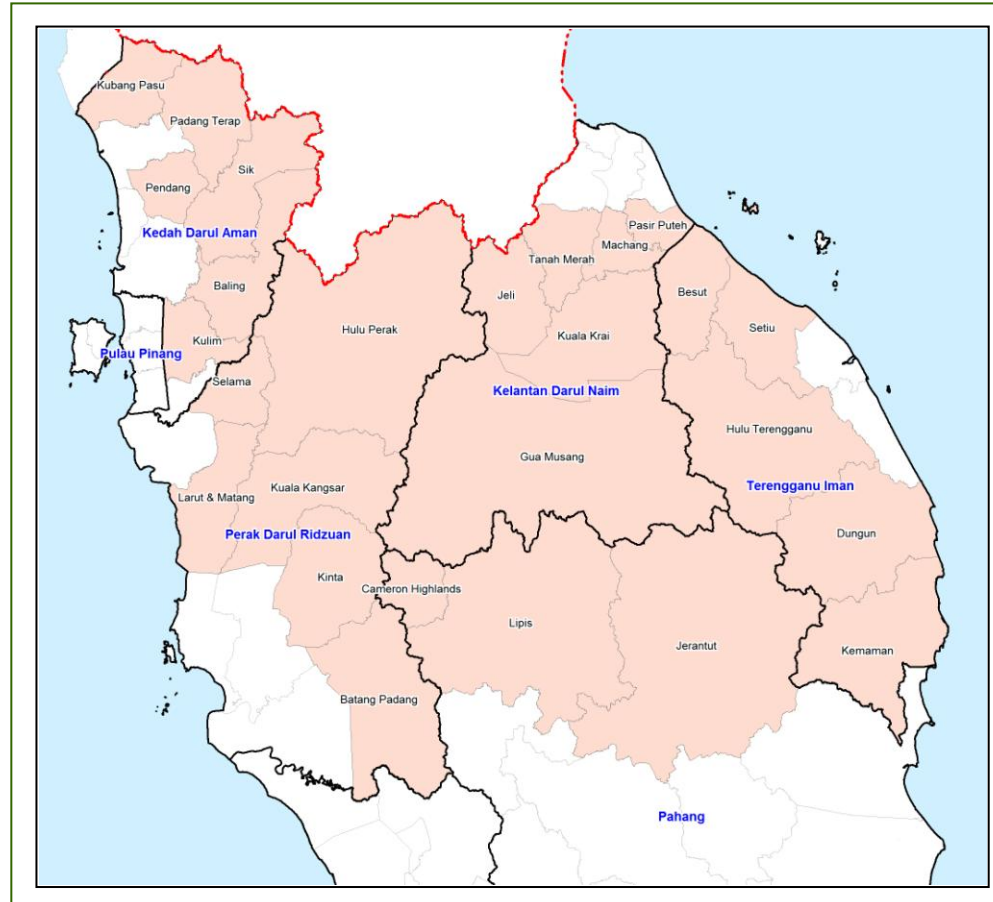


Figure 1.2: Districts within CFS-1 Study Area



1.4 NEED FOR ECOLOGICAL CORRIDOR IN CFS-1 AREA

The CFS-1 is a living biodiversity treasure chest. It is a unique natural heritage, such as the Taman Negara National Park, Royal Belum State Park and Krau Wildlife Sanctuary, which has evolved over millions of years. It is the home for many plants and animal species, including elephants, endangered tigers and rhinoceros, many of which are indigenous only in this part of the world.

However, the integrity and connectivity of the forests in this CFS-1 area has been experiencing constant threats, particularly the destruction, fragmentation and degradation of wildlife's habitat forests, from various uncontrolled human land use activities and development pressures, especially highway construction, agriculture activities and urban development, occurring in its vicinity. The loss of biodiversity threatens our food supplies, ecotourism opportunities and essential ecological functions, e.g. plant pollination by birds and flood prevention.



1.4.1 Importance of Connectivity

The creation and maintenance of a contiguous larger CFS-1 area through the establishment of ecological corridors between forest complexes and forest islands will bring numerous benefits to the participating states in particular and the country in general.

Forest plays an important role in maintaining the ecosystem balance of the environment. The forest provides natural eco-habitat for flora and fauna, food for wildlife and conserves genetic resources. Besides the important ecological and biodiversity functions performed, the forest contributes significantly in mitigating climate change (carbon sink) and minimizing flood damage to agriculture land. Therefore, the CFS-1 area functions in strengthening and stabilizing the environment, besides conserving biodiversity.

In this respect, the importance of connectivity is as follows:

- a) Conservation of Environment and Biodiversity;
- b) Protection and Management of Water Catchment;
- c) Exploitation of Nature-based Tourism and Recreational Potentials;
- d) Promotion of Integrated Management of Interstate Forest; and
- e) Enhancement of International Level Prestige.

1.4.2 Issues and Challenges in the CFS-1 Area

Habitat destruction through deforestation is considered the most important reason for animal species extinction. The forest cover of total land in Peninsular Malaysia has dwindled significantly from 77% in 1946 to 44.6% in 2005². This is due largely to indiscriminate clearing and unsustainable exploitation by various land uses and economic activities, such as commercial agriculture development, urban growth, logging, and other development projects. Thus, the decline of forest area has jeopardized considerably biodiversity and wildlife conservation.

Fragmentation of forest is seen as one of the major threats to ecological processes and biodiversity conservation. In the largely remote rural areas in CFS-1 area, forest fragmentation are due largely to infrastructure facilities, particularly road construction, and large-scale agricultural activities. These have caused large forest areas to be broken up into smaller parts, thus posing an obstacle to the healthy growth and expansion of the natural habitat.

To protect the natural environment and to conserve the biodiversity in the CFS-1 area, the following issues and challenges need to be addressed, viz:

- a) Reduction of Forest Cover;
- b) Fragmentation of Forest;
- c) Environmental Degradation to Highland Areas;
- d) Damage to the Water Catchment and River System;

² Source: Forestry Statistics Peninsular Malaysia, 2005

- e) Damage to Potential Recreation and Tourism Areas;
- f) Loss of Tourism Development Resource and National Heritage; and
- g) Potential Medical Resource, Education and Research.

1.5 VISION

In the year 2020, the CFS-1 is the largest and most valuable contiguous permanent forests supported by adjacent buffer zones in Peninsular Malaysia dedicated to the conservation of biological diversity and sustainable use of natural resources. The CFS-1 area includes forest reserves, totally protected areas (e.g. national park and wildlife reserve), forested ecological corridors and their associated buffer zones (environmentally-sensitive non-forested areas). It will showcase to the world on how we plan and manage effectively the environmentally sensitive areas in the country.

This study is an eye opener as to show the importance to conserve and preserve the ecological linkages. Conservation and preservation of ecological linkages is very important in order to protect and maintain future biodiversity in sustainable development. It also indirectly helps implementing agencies in the interests of maintaining biodiversity in sustainable development.

This Masterplan would be a contributory initiative to the overall vision for the CFS which is:

“TO ESTABLISH A VIABLE AND CONTIGUOUS OR CONNECTED CONSERVATION AREA COMPRISING BOTH FOREST AND NON FOREST AREAS THAT WILL BE MAINTAINED AS THE GREEN LUNG OF THE ENVIRONMENTALLY SENSITIVE AREA NETWORK IN PENINSULAR MALAYSIA”

Within the four major forest complexes (i.e. Banjaran Titiwangsa-Banjaran Bintang-Banjaran Nakawan, Taman Negara-Banjaran Timur, South East Pahang Peat Swamp Forest-Chini-Bera Wetlands, and Endau-Rompin National Park-Kluang Wildlife Reserves) and forest islands, perpetual protection of the environmental integrity of the forest areas will be assured and thus, the plants and animal species will be left to evolve and thrive freely in their natural habitat. Through the implementation of viable ecological corridors and other mitigating measures, e.g. electric fencing, between the four major forest complexes and forest islands, the movement of wildlife and seed dispersal between these patches will be enabled and facilitated. At the same time, the development of human settlements / gateway towns, land uses and human activities in the adjoining buffer zone will be tightly controlled and strictly managed to support the achievement of the objectives and functions of the CFS.

In this respect, this will minimize or prevent the invasion of wildlife into the adjacent agricultural areas as well as settlement areas, resulting in minimal or even no human-wildlife conflict. It is envisaged that the vibrant human settlements will provide a high quality of life for the environmentally sensitive community.

To achieve this vision, the strategy necessarily involves a partnership of the community, business, voluntary organisation and government to protect the environmentally sensitive areas in the CFS. Through the smart partnership, a harmonious balance between residential neighbourhoods, natural areas and appropriate economic activities, which include sustainable agriculture development and low impact ecotourism activities together with visitor accommodation, within the CFS area will be sensitively created and maintained. The surrounding natural environment, including wildlife habitat and indigenous vegetation, of the human settlements is a key asset particularly as the primary source of economic activity, e.g. nature-based tourism, for the community. Only by being environmentally responsible, the CFS can continue to be economically viable and also maintain a



high quality of life for its residents.

1.6 APPROACH AND METHODOLOGY

The Vision Statement flows from the Objectives of the Study as set out in the Terms of Reference. It provides the direction for the ensuing key activities of this Plan to identify and establish viable ecological corridors in restoring the connectivity and continuity of the Forest Complexes in the CFS-1 area and their related development control guidelines.

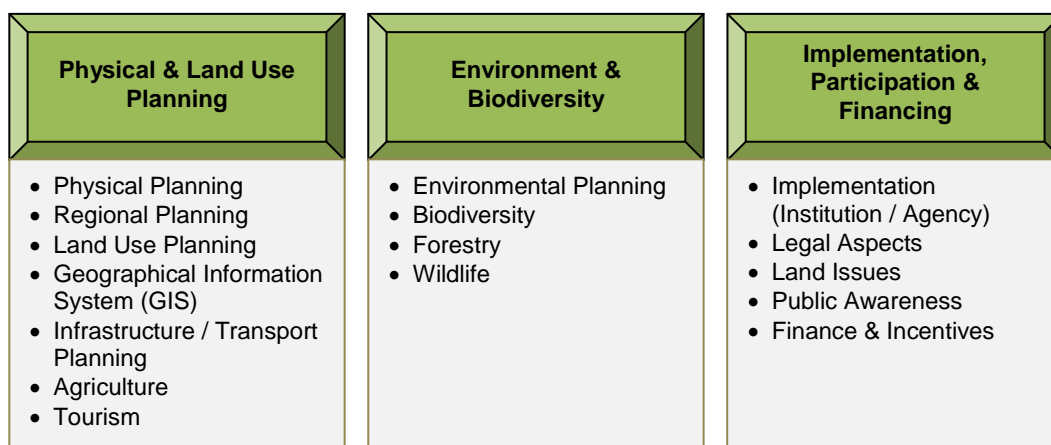
1.6.1 Scope of Work

To achieve the study's objectives and plan's vision, four key activities have been carried out in formulating the ecological linkage proposals for the study:-

- 1) Formulate overall ecological linkages masterplan for the CFS-1, and develop detailed ecological linkages action plan for selected priority corridors within the CFS-1. The planning process involves:
 - Identify gaps (i.e. infrastructure development, agricultural activity, urban and settlement development) in forests connectivity;
 - Identify possible corridors where these gaps can be reduced or closed; and
 - Determine feasibility of creating connectivity or ecological corridors taking into consideration of physical aspects, administrative jurisdiction, implementation mechanism and financial implications.
- 2) Formulate land use and management control guidelines in and near designated ecological corridors, particularly for areas between fragmented forests where physical connectivity cannot be established. These take the form of:
 - Land use control and guidelines for areas between the fragmented forest complexes to be further taken up and incorporated in the statutory local plans by the local planning authorities as part of development control process; and
 - Guidelines on sustainable agricultural management and sustainable eco-tourism which can be implemented by other relevant agencies, landowners and local communities;
- 3) Identify funding and implementation mechanism to facilitate the implementation of CFS-1 study proposals; and
- 4) Develop Communication and Awareness Plan. This is designed to:
 - Relate the technical and beneficial aspects of the CFS-1 study to all Stakeholders; and
 - Raise awareness and understanding of the objectives of CFS-1 and the importance of connecting the Central Forest Spine.

1.6.2 Study Approach

The study aims to formulate a plan for developing and managing the ecological corridors; and to ensure that it is implemented with the support of the relevant stakeholders. There are three components to the study:-

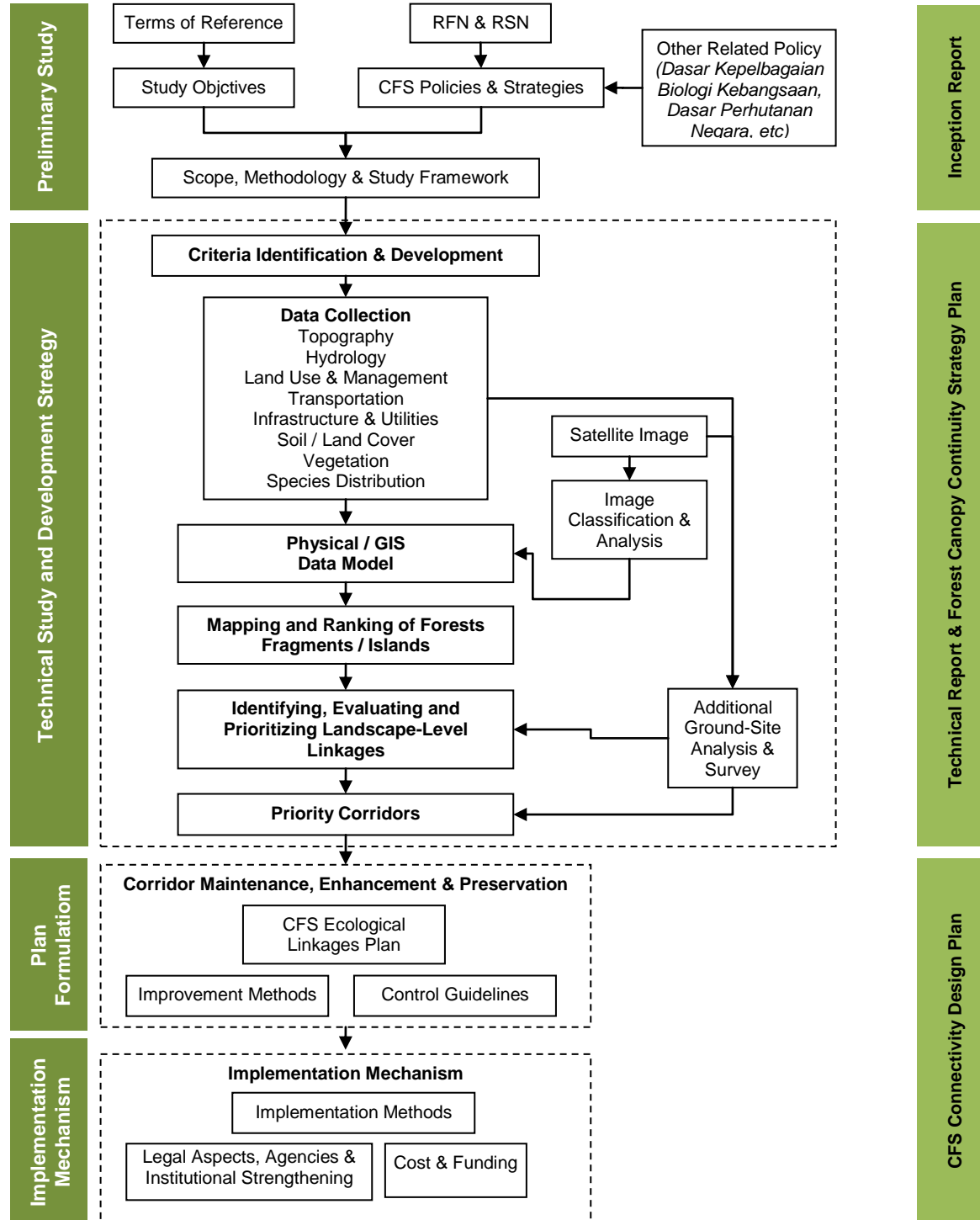


This study has been undertaken in four (4) stages. The report submissions are as follows:-

No	Stages	Report
1	Preliminary Stage	Study Approach
2	Technical Study & Development Strategy	Findings Report & Connectivity Strategy
3	Plan Formulation	Draft CFS 1 Master Plan for Ecological Linkages
4	Implementation Mechanism	Final CFS 1 Master Plan for Ecological Linkages

The stages of analysis are depicted in **Figure 1.3**.

Figure 1.3 : Study Approach





FINAL REPORT

1.7 STUDY OUTPUT

1) CFS-1 Spatial Framework Masterplan for Ecological Linkages

It is an overall spatial plan / map that shows all locations of possible ecological corridors and ranked according to importance and feasibility. It will also indicate the type of connectivity at each location to be established and show existing forest connections that are at threat.

2) Detailed Plans for 3 Priority Ecological Corridors

Detailed Plans will be done for 3 Priority Ecological Corridors. It is proposed that both 'Contiguous Linear Corridor' and the 'Stepping Stone Corridor' will be included in the Detailed Plans. The plans will demarcate the areas to be reforested, roads to be realigned, and facilities to be provided etc.

3) Land Use Control Guidelines

Land use control guidelines will be formulated for areas adjacent / surrounding the core area of the proposed ecological corridors (i.e. buffer zones), as well as within the core area of the ecological corridors, e.g. illegal encroachment by local communities. The main purpose is to ensure that the functions and effectiveness of the corridors are not compromised. These could be in the form of management guidelines, e.g. modify the land development practice, and spatial controls consistent with the conservation objectives.

4) Implementation Plan

The implementation plan brings together coherently the various components of the implementation mechanism -legal, agencies, organization and funding- to ensure that the CFS-1 Master Plan can be implemented. All four aspects have to be integrated. The various sources of funding or combination of revenue sources would have to link with existing legislative and administrative framework as well as with the proposed organizational structure in order to be more effective.

5) Communications and Awareness Plan

This plan/ programme aims to raise awareness about the CFS-1 and ecological corridors. The plan will strategize how to communicate the relevant information to affected stakeholders (both for the CFS-1 Master Plan and priority corridors). During the course of the study, awareness brochures and other relevant public information material will also be prepared and distributed.



1.8 OUTLINE OF THIS REPORT

This report contains nine chapters that address different components of the study:

Part I: Main Report

Part I covers the overall masterplan for all the linkages within CFS1 area. These include the importance of ecological linkages, masterplan for the ecological linkages, generic guideline to apply in all corridors and implementation plan for the CFS-1 Masterplan.

Chapter 1: Introduction

Provides the background information, study objectives, plan vision, needs statement, approach and methodology, and outputs for the study.

Chapter 2: Importance of Ecological Linkages

Discusses the rationale and principles behind ecological corridors, the concept of ecological linkages in the CFS Masterplan, reasons to have the ecological linkages and examples from other countries for the corridor development.

Chapter 3: Masterplan for the Ecological Linkages

Explains how and why the 19 corridors have been chosen. In addition, the details of the development proposals of the corridors (Primary Linkages and Secondary Linkages) are presented in the Fact Sheet, such as description, implementation strategies, threat/constraints and expected benefit. Trans-boundary Linkages are also being discussed in this chapter.

Chapter 4: General Guidelines for the Ecological Linkages

Provides the guidelines which cover animal crossings, ecotourism, settlement and village development, agriculture activities, forest management and reforestation and river reserve for the corridors.

Chapter 5: Implementation Plan

Indicates the institutional framework, implementation strategies, finance and funding mechanisms, monitoring and review programme, legal implications as well as the awareness, education and communication programmes for the corridors.



Part II: Case Study

Part II discusses the case study for 3 priority ecological corridors, i.e. PL1, PL2 and SL2. In this part, environment cost and benefits are discussed as well. This part includes 4 chapters as follows:-

- Chapter 6: PL1 Case study- Tanum FR (Greater Taman Negara) – Sg Yu FR (Main Range)**
Provides the corridor profile, development strategy and enabling initiatives such as financial requirements, institutional support and etc. for the PL1.
- Chapter 7: PL2 Case study- Temenggor FR (Main Range) – Royal Belum State Park (Main Range)**
Provides the corridor profile, development strategy and enabling initiatives such as financial requirements, institutional support and etc. for the PL2.
- Chapter 8: SL2 Case study- Krau WR – Bencah FR – Som FR – Yong FR**
Provides the corridor profile, development strategy and enabling initiatives such as financial requirements, institutional support and etc. for the SL2.
- Chapter 9: Environmental Cost and Benefit**
This Chapter provides the effects, in terms of environmental cost and benefits, for the development of a wildlife crossing based on case study on PL2.

02

the importance of ecological linkages

Fragmentation Of Natural Habitats
Forests And Fragmentation In Peninsular Malaysia
Ecological Linkages
The Concept Of Ecological Linkages In The CFS Masterplan
Examples From Other Countries
Existing Wildlife Habitats And Key Animal Species



2.0 THE IMPORTANCE OF ECOLOGICAL LINKAGES

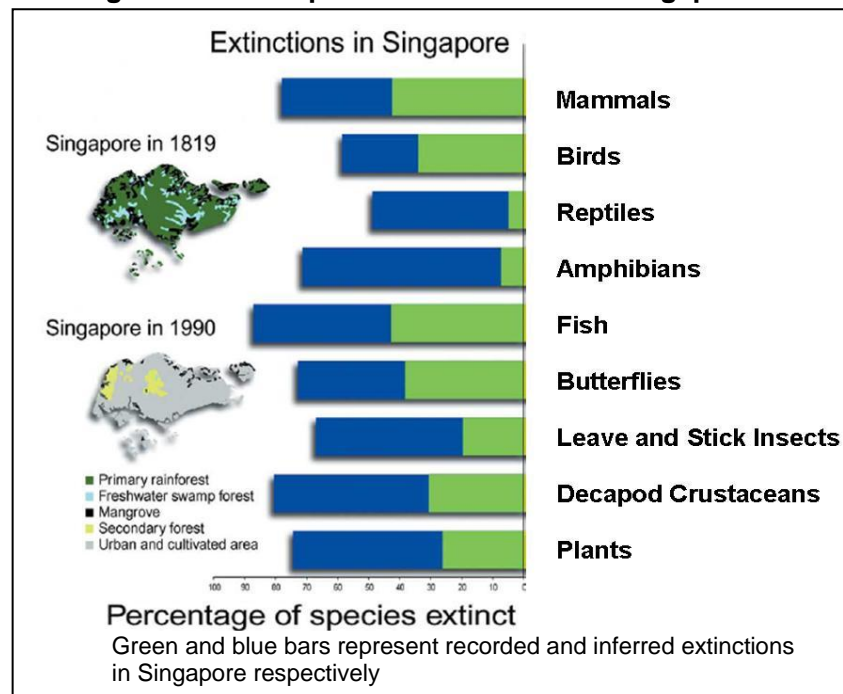
2.1 FRAGMENTATION OF NATURAL HABITATS

Habitat fragmentation is the breaking-up of natural habitat into unconnected parts. It occurs naturally by climatic and geological processes that alter the landscape, such as sea level rise, when a river changes course or a landslide creates a barrier. Such natural events, however, generally occur over such great expanses of time that most life forms can be adapted to the changes.

Habitat fragmentation caused by human activity, on the other hand, due to the clearing of native vegetation for other non-forest land-uses, usually impacts large areas over short periods of time.

Forest fragmentation and edge effects from deforestation have been identified as one of the most pervasive and deleterious processes occurring in the tropics today¹. Their impact on biodiversity can in some cases be very dramatic (**Figure 2.1**).

Figure 2.1: Population Extinctions in Singapore



Navjot S. Sodhi et al., TRENDS in Ecology and Evolution, Vol. 19, No.12, Dec. 2004, pp. 654-660.

Note :

Modified

Habitat fragmentation has the following effects:-

¹ Gascon C., B.G. Williamson and G.A.B. da Fonseca 2000, Receding Forest Edges and vanishing Reserves, Science 288, pp. 1356-1358.



- Reduction in the total extent of the habitat, due to clearance within the original area;
- Decrease in the average size of each patch of habitat, from the original large, unbroken patch to smaller and smaller patches as they are broken up;
- Functional isolation of different parts of the original habitat, due to the inability of some (but not all) of the original native species to move (or disperse) between patches;
- Increase in the amount of edge habitat in proportion to the total remaining area, because the boundary/area ratio increases as patch size decreases (See Box 2); and
- Absolute decrease in the amount of interior habitat (See Box 2).

Thus, habitat fragmentation usually includes habitat destruction: it reduces the amount of available habitat for plants and animals. Plants and some animals are invariably destroyed along with the habitat. Species that are very limited in terms of local distribution and/or are very rare are at risk of local extinction if their particular piece of habitat is destroyed. If they do not occur anywhere else, this would mean global extinction. This is not as far-fetched as it sounds. For example, some species of plants and snails are only known from one or two limestone outcrops in Malaysia. Clearing the surrounding vegetation and burning off the forest on top of the outcrop is a common occurrence that can wipe out a large percentage of the animals and plants on each one.

Mobile animals (especially birds and mammals) may retreat into remnant patches of habitat, but such areas have often already reached or exceeded carrying capacity, in terms of the available food, space and shelter. This causes a period of heightened competition which eventually settles down as some of either the “immigrants” or the original occupants are eliminated, and the populations revert to carrying capacity.

The numbers of species in habitat fragments and their population sizes invariably decline overall, for several reasons:

- i) For many species, the remaining fragments are too small to provide adequate resources (e.g. food, space or salt licks). Of these species, those that can move between fragments may survive, whereas those that cannot do so will die out.
- ii) Habitats are not uniform and most habitat destruction is for agriculture which requires suitable land for crops. The remaining fragments are therefore seldom representative of the environment as a whole. E.g., fertile lowlands may be eliminated, leaving only habitats on steep or infertile land.
- iii) There is a founder effect from which species happened to be present when a fragment was created: the probability is that the smaller the fragment, the fewer species will happen to be in it. Furthermore, those species that are only represented by a few individuals will be more likely to die out.
- iv) Small patches of habitat can only support small populations of animals and plants and they are more vulnerable to



extinction. Minor fluctuations in resources, climate or other factors that would be unremarkable and quickly corrected in large populations can be catastrophic in small, isolated populations. It is generally believed that certain key population aspects (e.g., individual fitness and fecundity) will drop when population size decreases. In the context of isolated small fragmented habitats, factors that contribute to such a drop may be related to the difficulty in locating suitable mates (especially for rare large mammals such as the Malayan tigers and Sumatran rhinoceros), relatively lower group defense against predators and group foraging ability (e.g., wild dog), the collapse of social integration among animals living in groups (e.g., primates), and the unbalanced sex ratio compared with a large population in contiguous forest. This effect is more marked in fragments that cannot be “rescued” by immigration from similar habitat nearby. This has been shown to happen on a very small scale (e.g., frogs over a few hundred metres), as well as over long distances (e.g., large predators).

- v) Fragmentation creates more access points for human interference, which brings about disturbance, hunting, harvesting of forest resources, etc., all of which impact on animals and plants.
- vi) Even those species that can move from one fragment to another may suffer if the crossing points present dangers. This is likely to be the case, if animals have to negotiate roads, railways, plantations, etc.
- vii) In small populations, in-breeding can result in genetic drift (change in the gene frequencies of a population due to chance events rather than adaptation). In such instances, the population's genetic variation is reduced, and potential for beneficial adaptations that otherwise can be retained through the process of natural selection in large populations is lost. Furthermore, deleterious genes can easily become fixed in the population, thereby threatening its survival.

In summary, forest patch size is critical to the viability of its natural biodiversity (at all levels of genetic, species and ecosystem diversity).

Box 1: Pollination And Seed Dispersal

Pollination and seed dispersal are two important processes, which ensure the health and survival of plants, and consequently of animals and the forest as a whole, due to the fact that plants are the primary producers in the food chain, and form the basic structure of tropical rainforest habitats.

In dense tropical rainforests where wind is scarce, most of the plants rely on animals for pollination and seed dispersal. Insects, birds and bats pollinate the plants by transferring pollen from flower to flower in their quest for food (nectar and/or pollen); while fruit-eating animals (frugivores) disperse seeds throughout the forest via their droppings.

In order to ensure the continued propagation of plants, it is important to ensure that these animals are able to move safely through the forests, as well as between different patches of forest. To complicate matters, many of the animals are specialists i.e. they only pollinate or disperse seeds of a select number of species. Consideration should also be given to the specific needs of the various species to move through or between forests.

Some animal groups which serve as pollinators:

- Insects – including bees, butterflies, moths, beetles
- Bats – particularly fruit bats
- Birds – including sunbirds, flowerpeckers, and spiderhunters

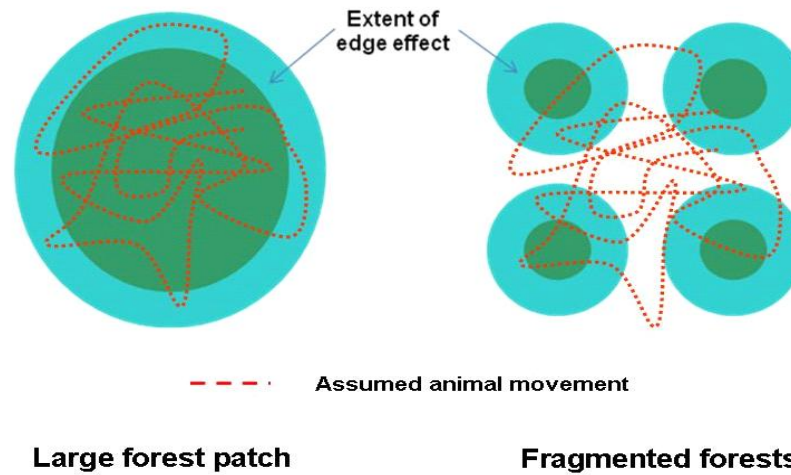
Some animal groups which serve as seed dispersers:

- Bats – particularly fruit bats
- Primates – including leaf monkeys, macaques, and gibbons
- Rodents – including rats, squirrels and flying squirrels, porcupines
- Sun bears
- Civets
- Ungulates – Including most deer species and wild boar
- Birds – including hornbills

Box 2 : Edge Effect

Forest fragmentation results in an increased proportion of the remaining forest being located in proximity to the forest edge. Detrimental “edge effects” due to increased exposure to wind, sunshine, and increase in temperature extend into interior forest areas from these transition zones. The negative impacts of edge effects on ecosystems include shifts in plant and animal community composition and changes in diversity, increased incursion of predators and competitors, increased chance of passive emigration of key species from the core habitat, increased rates of tree mortality, fire susceptibility, altered microclimates, and increased carbon emissions, primarily from increased mortality of large trees.

While the majority of these effects are thought to extend no further than 1 km, some may extend as far as 5–10 km into intact forest areas.

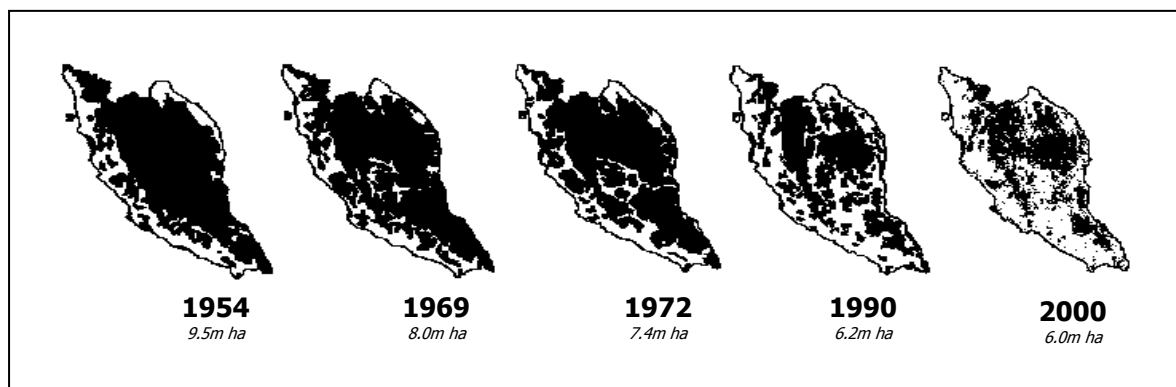


2.2 FORESTS AND FRAGMENTATION IN PENINSULAR MALAYSIA

Prehistoric Peninsular Malaysia was completely covered with a mosaic of different types of natural forest, each with its own complement of species and natural movement of animals and plants (via pollen and seeds) between them. Although the original forests were not homogenous, dipterocarp forests made up almost 90% of these areas, spanning the length and breadth of the peninsular.

With the advent of agriculture, roads and settlements, especially over the last 50 years, forest cover has declined, and remaining forests have become increasingly fragmented (**Figure 2.2**). This trend has taken place predominantly in the lowland dipterocarp forest along the coasts (especially along the western and southern coastal plains) and following the main rivers and roads.

Figure 2.2: Fragmentation of Natural Forest Cover in Peninsular Malaysia, 1954-2000



Sources: 1954, 1969 & 1972 – Jomo *et al.* (2004) after Aitken *et al.* (1982: 161);
 1990 – Jomo *et al.* (2004) after Anon (1992);
 2000 – Stibig *et al.* (2002: 11).

2.3 ECOLOGICAL LINKAGES

A viable solution to offset the most deleterious effects of habitat fragmentation is to link the most important fragments/forest islands through the establishment of “ecological linkages”. The potential advantages include:

- increased immigration rates of populations between forest islands, thus increasing effective population sizes;
- increased foraging areas for many species;
- increased possibilities of finding refuges from fires, floods, predators, etc.; and
- maintenance of ecological processes at the landscape level.

Ecological linkages would function as wildlife corridors, which may take a variety of forms, such as artificially replanted (purpose-built) forests, riparian strips along watercourses, mosaics of mixed land-use such as traditional kampung and dusun

areas, road and railway reserves, and secondary growth on abandoned land. The effectiveness of such links depends on the wildlife species involved. For example, whereas small animals may move along road reserves, these are unlikely to be suitable for large species.

In summary, corridors must provide cover, food, water, protection from dangers and minimal disturbance for the species that use them. The design of the corridors should be appropriate to the species that use them. For example, a gibbon will not be able to use a tunnel or a low underpass, whereas an elephant would not be able to climb on an overhead wire crossing.

2.4 THE CONCEPT OF ECOLOGICAL LINKAGES IN THE CFS MASTERPLAN

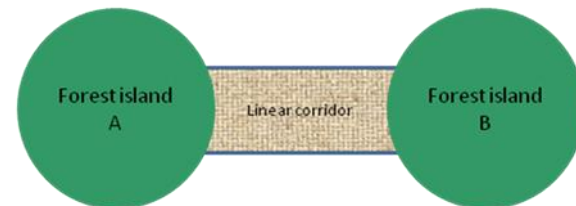
The CFS Masterplan takes a far-sighted objective of re-establishing, maintaining and enhancing connectivity between the most significant/important remaining areas of forests in Peninsular Malaysia. Once established, this “Central Forest Spine” shall form a physically and functionally unbroken link of forests from Johor to the Thai border connecting with certain protected areas in Thailand.

The overriding benefit would be related to arresting the negative impacts of forest fragmentation on biodiversity, thereby helping to ensure the conservation of the entire gamut of species found in our forests, as well as maintain the host of ecological processes taking place within it. An additional objective would be to create “stepping stones” to increase habitat connectivity for some but not all species. For this purpose, “ecological linkages” are identified in areas where it is important to establish connectivity, in order to form the CFS. Two types of ecological linkages have been distinguished, i.e. primary and secondary linkages.

2.4.1 Primary Linkages

Primary linkages are identified in areas where it is crucial to re-establish forest connectivity in order to achieve the main Central Forest Spine link. These areas are inevitably located between the most important blocks of forests; usually in narrow stretches where non-forest land use is still minimal, and there are patches of Stateland forest and scrub remaining. Due to their locations, these areas are usually also important corridors for large mammals which use these areas to move from one forest to another.

Primary linkages take the form of linear corridors, i.e. unbroken stretches of forested habitats connecting forest islands. In most cases, major (and costly) interventions such as, acquisition of private land, reforestation, construction of viaducts along highways etc. would be required to establish these corridors.

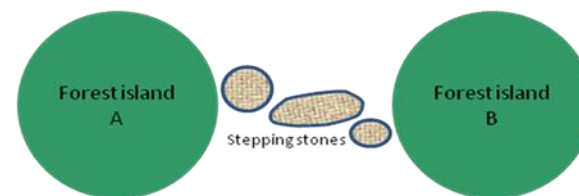


2.4.2 Secondary Linkages

Secondary linkages are complementary to primary linkages. They are identified in areas where it is unfeasible to create a primary linkage (e.g. due to vast areas of non-forested land or long distances between forests, or high human population), but it is still important to maintain some level of connectivity (albeit weaker) between forests.

Secondary linkages are not meant to cater for movement of large mammals, but are to be used by small animals, birds and insects. They are also beneficial to plants through pollination and seed dispersal (see Box 1).

Secondary linkages take the form of stepping stones, i.e. patches of suitable habitats, and are usually designed to follow river corridors. Stepping stones are generally cheaper to maintain, but may require significant cooperation of landowners and managers in the area in terms of adopting land use management practices that are appropriate to the secondary linkage.



Box 3 : How Wide Is Enough?

“How wide should a linkage be?” A common response to this frequently asked question would be, “the wider the better!” The width of linkages is a particularly important issue because of the influences it has on the effectiveness of the linkage in terms of connectivity. In particular, wider is better for the following reasons:-

- reduces the area affected by edge effects (See Box 2);
- increases the potential for greater diversity of habitats, and greater abundance and diversity of wildlife in the linkage; and
- increases the likelihood that the linkage will cater for landscape species (e.g. tigers, elephants) which require large amount of space.

A common follow-up question is “So how wide is enough?” The simple answer to this is that a linkage is wide enough when it effectively achieves the specific level of connectivity for which it was intended (e.g. for tigers, or birds, or ecological processes etc.). However, determining this is a daunting task, particularly in situations where there is little detailed knowledge of the fauna or the local ecosystem, and there are competing demands for land use.

Although optimum widths (and layout) may only be determined through empirical information gained through long term study of the ecology of wildlife in the intended linkages, Harris and Scheck (1991) have proposed the following rule of thumb:-

“When the movement of entire assemblages is considered, and/or when little is known of the biology of the species concerned, and/or the corridor is intended to function over decades, the appropriate width must be measured in kilometers”.

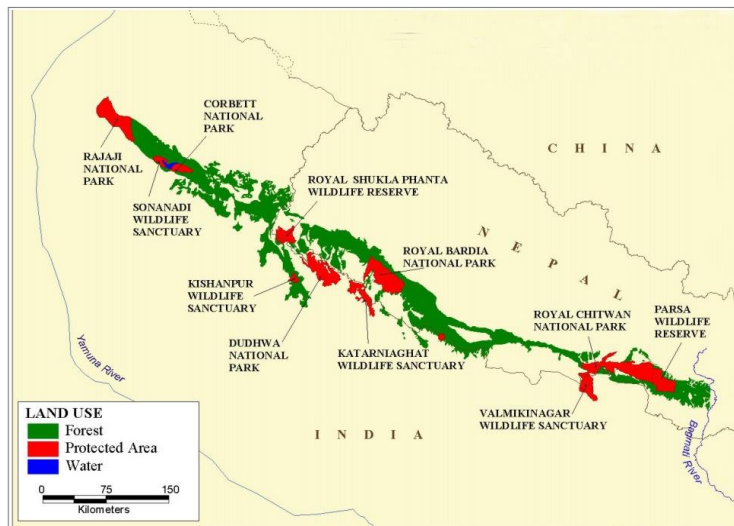
This is clearly something of an ideal that addresses the issue from the biodiversity angle and it has to be modified to take account of other land-use factor. In the current context, it is unlikely to be possible to have such broad connectivity along the entire lengths of many of the linkages that are proposed in this study. Therefore, the widest link that is possible in practice is recommended in each case.

2.5 EXAMPLES FROM OTHER COUNTRIES

There are numerous examples of corridors and wildlife crossings that have been successfully implemented throughout the world. While most of the earlier initiatives were done in Europe and the US, there are a growing number of corridor initiatives being done in Asia. Two case studies are given in the following boxes.

Of high relevance to the CFS, the Wildlife Conservation Society (WCS) and the Panthera Foundation (UK) have announced a proposal to create a corridor for tigers to roam freely in Asia. The corridor (about 8,000 km) would extend from Bhutan through northeast India, Myanmar, Thailand, Malaysia, Laos, Cambodia and Vietnam. It would allow tigers to move from one area to another, and facilitate genetic exchange between what would have been isolated populations under threat of inbreeding.

TERAI ARC LANDSCAPE (TAL)



Box 4: The Terai Arc: A Landscape for Tiger Conservation in the Himalayan Foothills

The Terai Arc is made up of grassland-savanna ecosystems along the foothills and valleys of the Himalayas. Over 6.7 million people depend on the area for their livelihood, and over 4.5 million heads of free-ranging livestock roam the forests. Large mammals in the TAL include the tiger (*Panthera tigris*), greater one-horned rhinoceros (*Rhinoceros unicornis*) and Asian elephant (*Elephas maximus*). Habitat fragmentation and degradation are one of the main threats to the survival of these animals. The Terai Arc Landscape (TAL) initiative aims to restore forests and link 11 protected areas encompassing an area of over 49,500km², from the Parsa Wildlife Reserve in Nepal to the Corbett National Park in India.

The first step in the planning process was a study to assess the feasibility of establishing potential corridors between protected areas. The tiger was used as a proxy species to design the habitat linkages between the core areas. The ecological requirements and behavioural characteristics of tigers were used in a GIS based cost-distance model to identify the most likely/feasible corridors tigers would use in the landuse matrix. Based ground surveys and a GIS tiger dispersal model, six bottlenecks were identified for restoration in the corridors. Extensive consultations were then held with various stakeholders to discuss the concept and feasibility of the corridor plan, acquire local knowledge, and build support.

A 10 year strategic plan was developed with the participation of all the key donors working in TAL, particularly in the natural resource management sector. Support from Nepal's government was garnered when TAL was included in Nepal's 10th 5-year plan (2002-2007) as the government's conservation strategy in the Terai, which 'formalised' government endorsement of the TAL program.

It is important to note that most of the TAL corridors were state forests. The primary means of restoration was through community forestry, where the management plans emphasised on conservation objectives rather than just extraction prescriptions. The TAL program was able to facilitate the handing over of state forest in strategic areas as community forests, thus reconciling sustainable benefits to the local communities and biodiversity objectives.

Box 5: The Qinghai-Tibet Railway: Protecting the Antelope

With the rapid development of north-west China, conflicts between development of transportation infrastructure and conservation have become more acute. Heavy traffic on the Golmud-Lhasa highway and the construction of the Qinghai-Tibet railway across key migration corridors have disturbed the migration of Tibetan antelopes, or chiru, (*Pantholops hodgsonii*) which is an endangered species endemic to the Tibet-Qinghai Plateau. Every June, female Tibetan antelope migrate northwestwards in large numbers to give birth to their young along the banks of the Zhounai and Taiyang Lakes in the Kekexili Reserve. They then make the return trip south with their offspring a couple of months later.

The Qinghai-Tibet railway runs along the eastern boundary of the Kekexili Wildlife Protection Reserve, which protects some 17,000 square miles of grasslands on the south side of the Kunlun Mountains. Railway planners have tried to avoid criticism about further endangering the species by incorporating "chiru protection" measures into the railway's design. Around 33 underpasses - trestle bridges, mostly - have been incorporated into the railway at key points where the antelopes are believed to cross during their seasonal migration. At these locations, the antelopes could theoretically use the underpasses to traverse the rail route without risking crossing over the tracks. However, there have been doubts by wildlife experts whether the antelopes would actually use the underpasses, since their instincts may instead prompt them to climb up to the high ground of the rail, or if significant numbers would be struck by passing trains, since the noise and vibration would scare the skittish creatures off the tracks.

In June 2002 (and again in August), construction work on the plateau section of the railway was halted for four days to allow migrating antelopes to cross the site. Workers and machines were evacuated, and marker flags that frighten antelopes when they flap in the breeze were removed for that period.

Results from monitoring between 2003 and 2004 show that the efficiency of passages greatly improved, and that use of crossings was affected by a number of factors such as the structure of the passage, presence of wolves, recovery of vegetation following damage during construction.



Thirty ethnic Tibetan wildlife officials employed by the Qinghai provincial government have been posted at five wildlife protection stations along the highway and railway construction site. Their job is to patrol the sites, stop traffic when herds of antelope cross and randomly search trucks for contraband pelts. A Sichuan-based grassroots Chinese NGO "Green River" is also making an important contribution to protecting the antelope by maintaining Suonandajie Station, which is located adjacent to the railway construction for scientific research and public education activities. The Station's outreach efforts target local Tibetan herders, as passing tourists (who are rare), and the thousands of truck drivers and construction workers working adjacent to the Kekexili Reserve.



2.6 EXISTING WILDLIFE HABITATS AND KEY ANIMAL SPECIES

2.6.1 Tropical Rainforest

The tropical rainforests of Malaysia are generally divided into six different habitat types: **(Figure 2.3)**

1) Upper Montane Forest (Montane Ericaceous Forest)

This forest type, often known as mossy forest, occupies the few peaks that tower over 1,700 meters in Malaysia. The foliage consists of a single layer of tress, dominated mainly by low rhododendrons with gnarled branches that grow to little over one meter in the cold and damp misty conditions. It is often clad with lichens, mosses, ferns and liverworts. Some other ericaceous species found in these forests include the *Vaccinium* spp. and *Pieris ovalifolia*. These ecological conditions are also conducive for the growth of pitcher plants, gentians, violets and anemones associated with the colder climates of temperate latitudes. From an environmental point of view this type of forest is important in minimizing erosion on slopes, preventing landslides and water retention.

2) Lower Montane or Oak Laurel Forest

Rich in oak and laurel species, hence the name of the forest type. Myrtle and other temperate staples such as the magnolia, rhododendron, raspberry and an assortment of tree ferns, orchids, lichens and mosses replace dipterocarp species. The common genera present in the forest are *Quercus*, *Litocarpus*, *Castanopsis*, *Cinnamomum*, *Litsia* and *Lindera*. Several species of birds like eagles, hawks and hornbills occur in this kind of mist-shrouded and damp forest.

3) Hill Dipterocarp Forest

Hill Dipterocarp Forests cloth the greater part of inland Malaysian mountain ranges from 300 to 800 metres above sea-level. Species, including numerous dipterocarp trees that occur on the lowlands are also found here. The main difference between the lowland and highland dipterocarp forests lies in the flora composition. Highland species of dipterocarp such as *meranti seraya* (*Shorea curtisii*) are only found in the hills and shows a preference for ridge tops. Along the steep slopes, the understorey is rich in palms such as *Arenga westerhoutii*, *Oncosperma horrida*, *Orania macrocladus* and stemless palms like *Licuala* spp. The ground flora is rich with species of *Alocasia*, *Colocasia* and *Donax*.

4) Lowland Dipterocarp Forest

Lowland forests occupy land up to elevations of 300 metres above sea-level. This multi-storied moist tropical rainforest, dominated by dipterocarps, is rich in species diversity. In a single hectare, over 240 species of trees can sometimes be found, with shrubs, herbs, woody climbers and other plants. Examples of large trees found here are *jelutong* (*Dyera costulata*), *merbau* (*Intsia palembanica*) and *sepetir* (*Sindora* spp.). Large mammals such as the Asian elephant, Malayan tiger, Malayan tapir, Sumatran rhinoceros, Malayan sun bear and common wild boar inhabit these forests.

5) Peat Swamp Forest

Peat Swamp Forest is a dark and soupy soil held together by a dense mass of decomposing tree parts. Peat swamps develop in small river valleys but are most extensive as coastal basins which form around flat estuarine plains and river deltas. The environment is generally harsh, with a highly acidic substrate, poor in minerals and subject to periods of varying water levels. The upper layer is discontinuous and dominated by a few tree species, such as *ramin* (*Gonystylus bancanus*), *durian paya* (*Durio carinatus*) and a few species of *meranti*. The middle or under-storey layer is composed of a mixture of small to medium sized tree species, particularly those of *kelat* (*Syzygium* or *Eugenia* spp.), *kayu arang* (*Diospyros* spp.) and *merbulan* (*Blumeodendron tokbrai*). The lower shrub layer is colonized mainly by the *kelubi* (*Eleiodoxa conferta*) and *pinang raja* (*Cyrtostachys renda*) palms.

6) Mangrove Forest

Occurs along the coasts, depending both on saline sea-water and mineral-rich fresh water. These fast growing forests are home to a rich variety of wildlife, especially water birds like the very rare milky stork and other small mammals such as smooth otter, leopard cat, common wild boar, long-tailed macaque and the silvered leaf monkey.

Among these the lowland dipterocarp forest type is of great importance in terms of biodiversity conservation because of its rich assemblage of species and contains a large proportion of Malaysian fauna, thus securing connectivity for this type of forest and preventing further degradation and fragmentation will ensure the long-term survival of many species of vertebrates and invertebrates. Its significance for the preservation of our distinctive native land mammals have been noted decades ago by wildlife biologists.^{2 3} (See Figure 2.3)

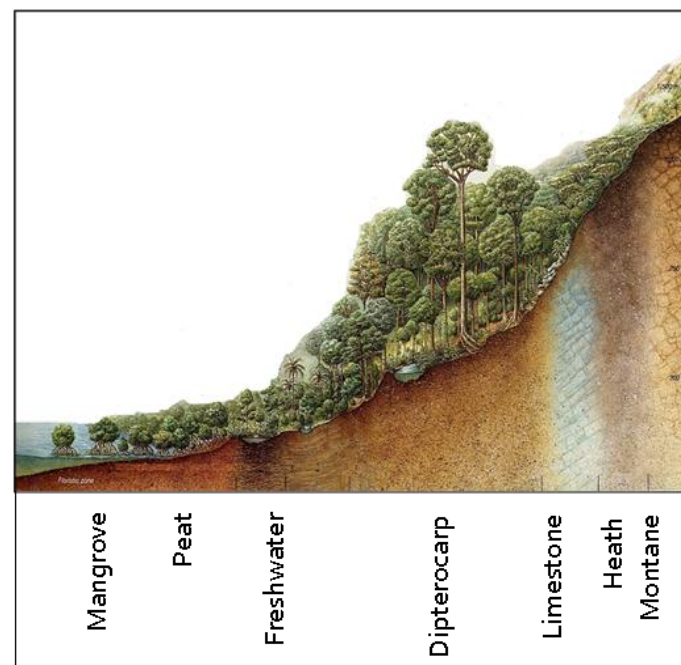


Figure 2.3: Ecological Forest Types in Peninsular Malaysia

² Stevens, W. E. 1968. Habitat Requirements of Malayan Mammals. *Malayan Nature Journal* 22: 3-9.

³ Ratnam, L., Nor Azman Hussein and Lim, B. L. 1991. Small Mammals in Peninsular Malaysia. Pp. 143-149. In: Kiew, R. (ed.), *The State of Nature Conservation in Malaysia*. Malayan Nature Society, Kuala Lumpur.

A full description of the fauna found in this type of habitat may not be possible for the present time because of its highly varied life forms and most of its components, apart from a few mammalian species, have not been well studied.

Despite the limitations stated above, there are some attempts made to come out with general figures reflecting the relative importance of different habitats for the mammalian fauna.

The main discussions below will focus on certain species of significant large mammals that are representative of the lowland dipterocarp forest and where current knowledge of their habitat range and requirements are relatively well surveyed and understood. The selection of the few species may be arbitrary and only forms a minor part of the overall fauna, this suite of “focal species” however do share a common feature, being primarily dwellers of lowland forests and all play a major role in ecological processes (seed dispersal and forest regeneration, and the control of prey species populations through predation). All are protected under the Protection of Wildlife Act No. 76, 1972 (Totally Protected Species: Malayan Tapir, Malayan Tiger, Sumatran Rhinoceros and Gaur; Protected Species: Asian Elephant)

2.6.2 Five Large Mammals within the Study Area

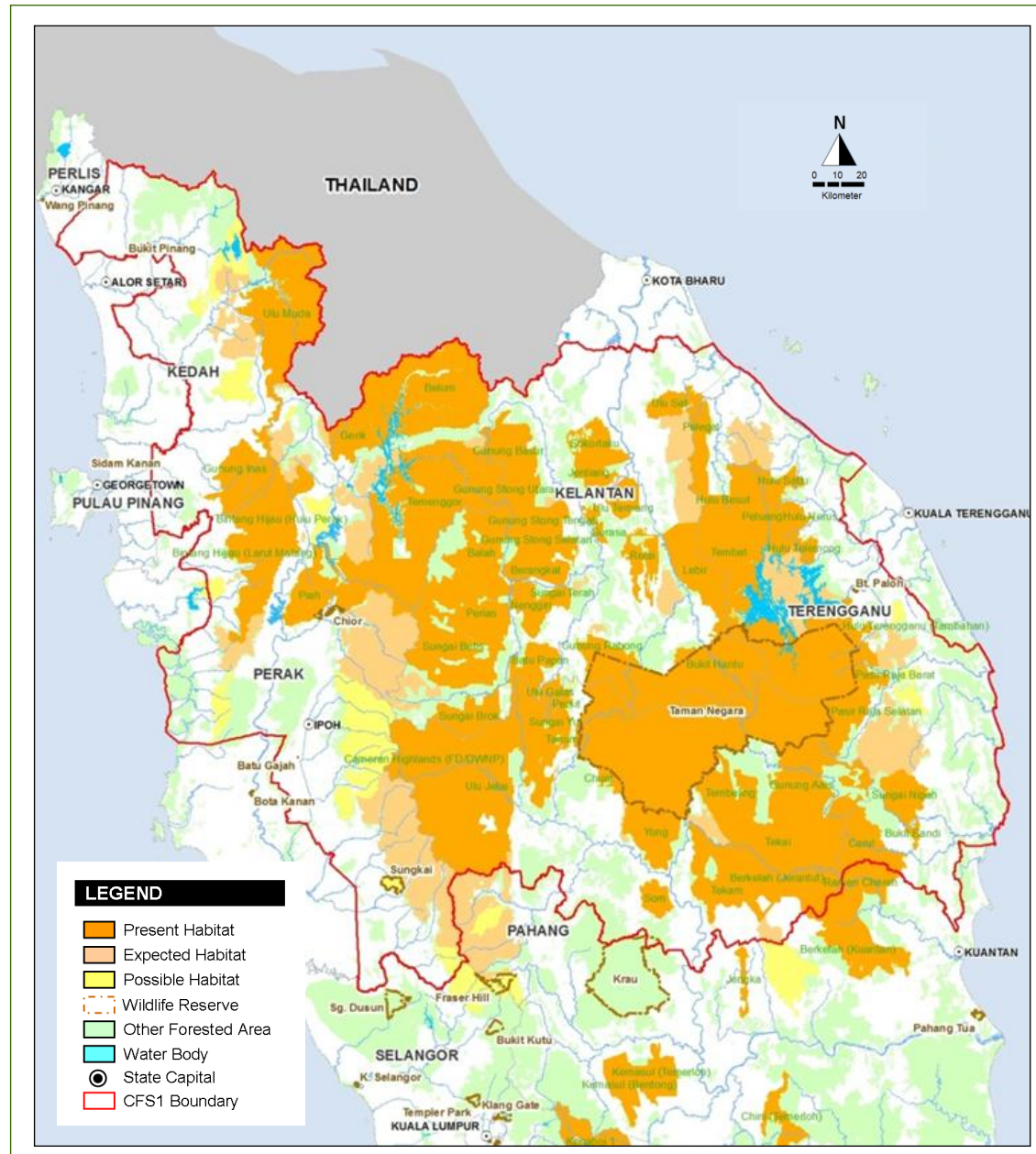
2.6.2.1 Asian Elephant (*Elephas maximus*)



Source: WWF library – Royal Belum State Park

Figure 2.4 shows the distribution of this mammal in Peninsular Malaysia. Currently, an estimate puts the Peninsular Malaysia elephant population at 1,220 - 1,460. This is based on data collected by the Department of Wildlife and National Parks (DWNP), Peninsular Malaysia through its inventory and monitoring programmes from 2000 to 2002. The Taman Negara National Park holds the largest population in Peninsular Malaysia at 290 – 350 elephants. This is mainly because it is the largest protected area and it has been the main release area for translocated elephants since 1983.

Figure 2.4: Distribution of Asian Elephant in CFS-1



Source: DWNP (2008)

2.6.2.2 Malayan Tapir (*Tapirus indicus*)

Malaysia is the centre of the Malayan Tapir's distribution range. Formerly on Borneo where it survived at least until 8,000 Before Present (BP), probably even later.⁴ It is considered a habitat generalist, found in every forest type including peat swamps up to lower montane forest. Similar to other large mammals, it is generally a lowland species, but DWNP wildlife inventories have found their signs near Gunung Tahan at 1,430m, Gunung Benom at 1,720m and Gunung Bintang Hijau at 1,730m. It may forage in oil palm and rubber plantations adjacent to forests. Several displaced animals have been recorded a few kilometres from cities such as Kuala Lumpur and Temerloh.

There are no density estimates of Tapir in Malaysia. The number of signs encountered by DWNP during wildlife inventories and enforcement activities throughout Peninsular Malaysia and the number of camera-trapping photographs in the past decade indicated that it is relatively abundant (**Figure 2.5**). It appears to be the third most abundant large ungulate species in Malaysia after wild pig and barking deer. The current minimum estimated Tapir population in Peninsular Malaysia is between 1,100 – 1,500.

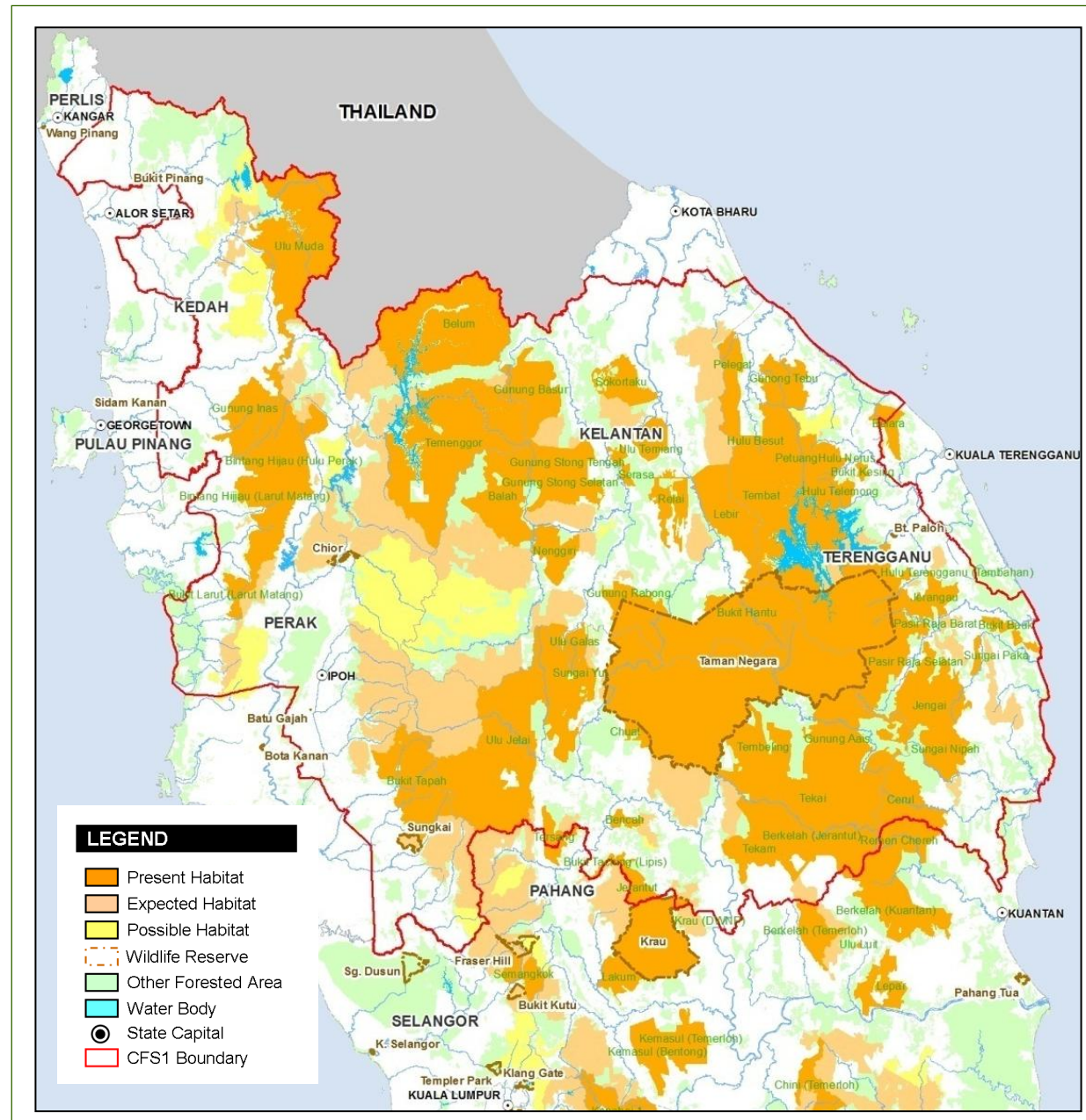
Tapirs are rarely hunted for consumption or trophies. The body parts are not used in traditional medicines. In addition, unlike other common large ungulates such as wild boar and barking deer, tapirs appear to be relatively safe from predation by large carnivores. Overall, among the five mega-herbivores (Elephant, Sumatran rhinoceros, Gaur, Tapir, and Sambar Deer) it appears to be the least threatened species by human activities.



Source: WWF library – Royal Belum State Park

Figure 2.5: Distribution of Malayan Tapir in CFS-1

⁴ Medway, Lord 1960. The Malay Tapir in Late Quaternary Borneo. *Sarawak Museum Journal* 9: 356-360.

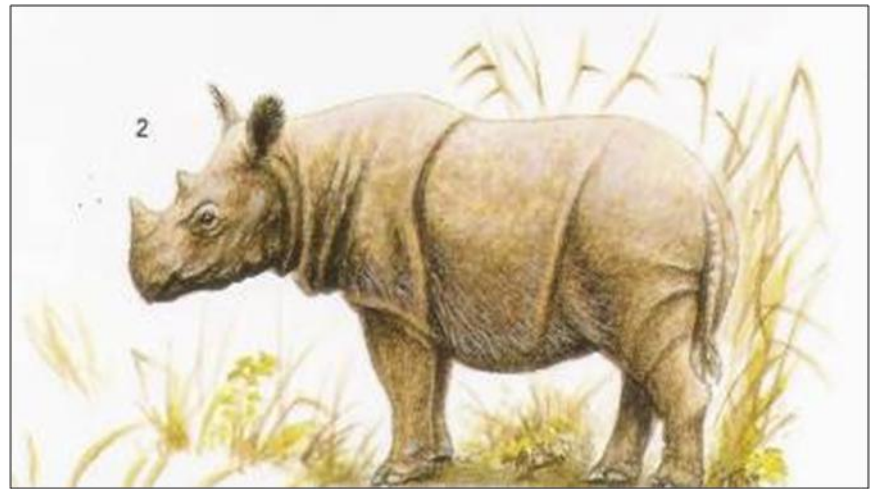


Source: DWNP (2008)

2.6.2.3 Sumatran Rhinoceros (*Dicerorhinus sumatrensis*)

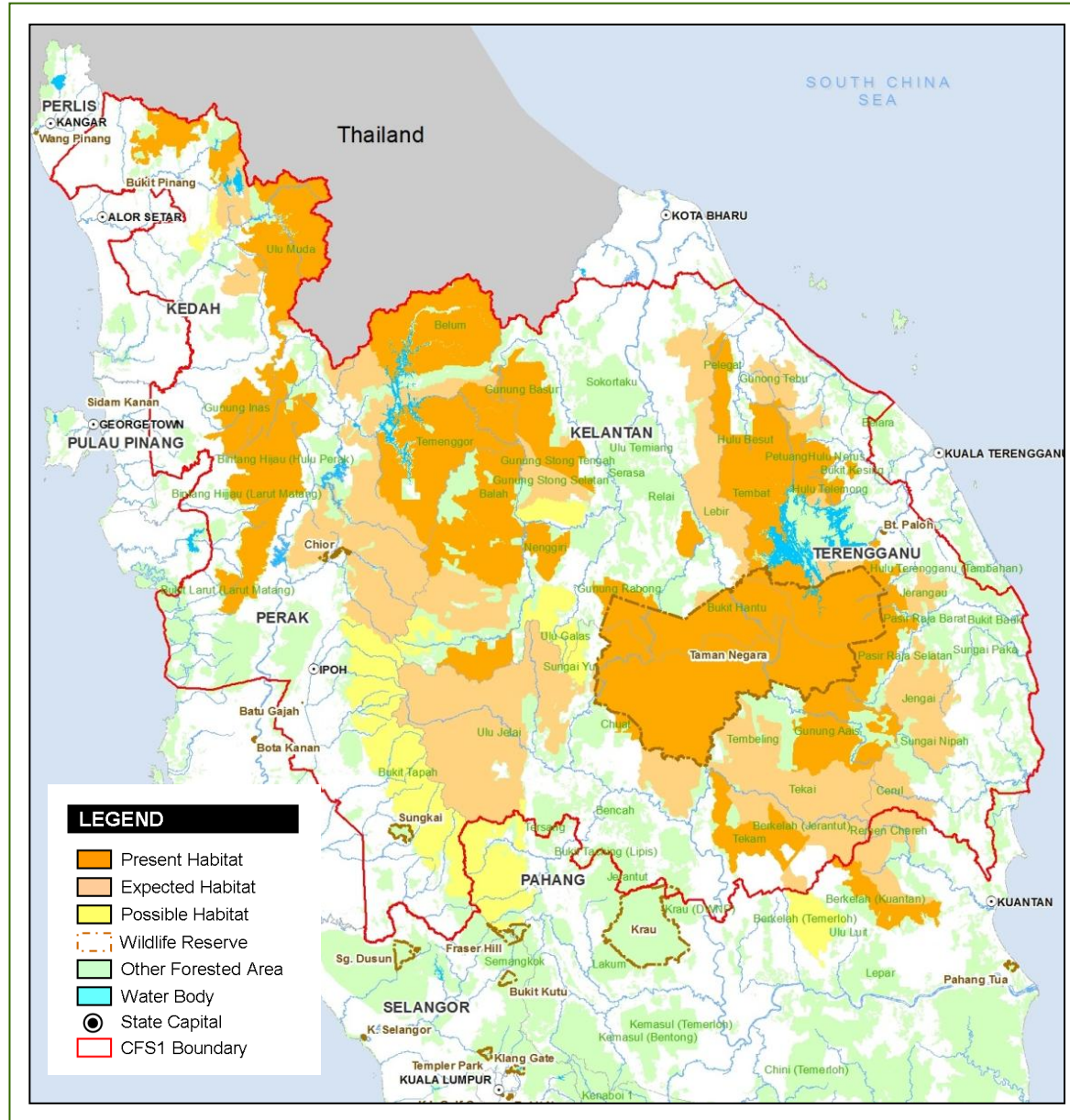
In Malaysia, its distribution is restricted to Kedah, Perak, Johor, Pahang, Terengganu and Kelantan. It can be found from lowland to montane forest, normally at elevations of 1,000 metres above sea level or higher. In the 1900's, the Sumatran rhinoceros was found throughout the peninsula, although exact numbers were not known. In 2005, the numbers were estimated to be less than 100 individuals. There are probably 4 to 5 individuals in Kedah, 16 to 18 animals in Perak, 1 to 2 animals in Johor, 13 to 15 in Pahang, 20 to 30 in Taman Negara National Park, 4 to 6 in Terengganu and 6 to 7 in Kelantan. A vast expanse of highland forests (Titiwangsa Range) covering some 12,000 km² is yet to be surveyed. **(Figure 2.6)**

The main threat affecting the Sumatran rhinoceros are habitat destruction and poaching. It is much sought-after for its horns, as well as its other body parts (hides and stomach contents) which are believed to have medicinal values. The monetary value of rhino products must be brought down to make poaching uneconomical, but the key to the conservation of this most endangered species in Malaysia is for people to stop using rhino products. Although specific numbers are unknown, records suggested that at least 30 individuals have been poached in Peninsular Malaysia since 1975 until 2006. Logging activity is also a threat, as this isolates populations in small fragmented forests. Apart from logging, land conversion for agriculture is also a threat, as it reduces available habitat for the Sumatran rhinoceros.



From Francis, C. M. 2008. A Field Guide to the Mammals of South-east Asia. New Holland Publishers (UK) Ltd.

Figure 2.6 : Distribution of Sumatran Rhinoceros in CFS-1



Source: DWNP (2008)

2.6.2.4 Gaur (*Bos gaurus*)

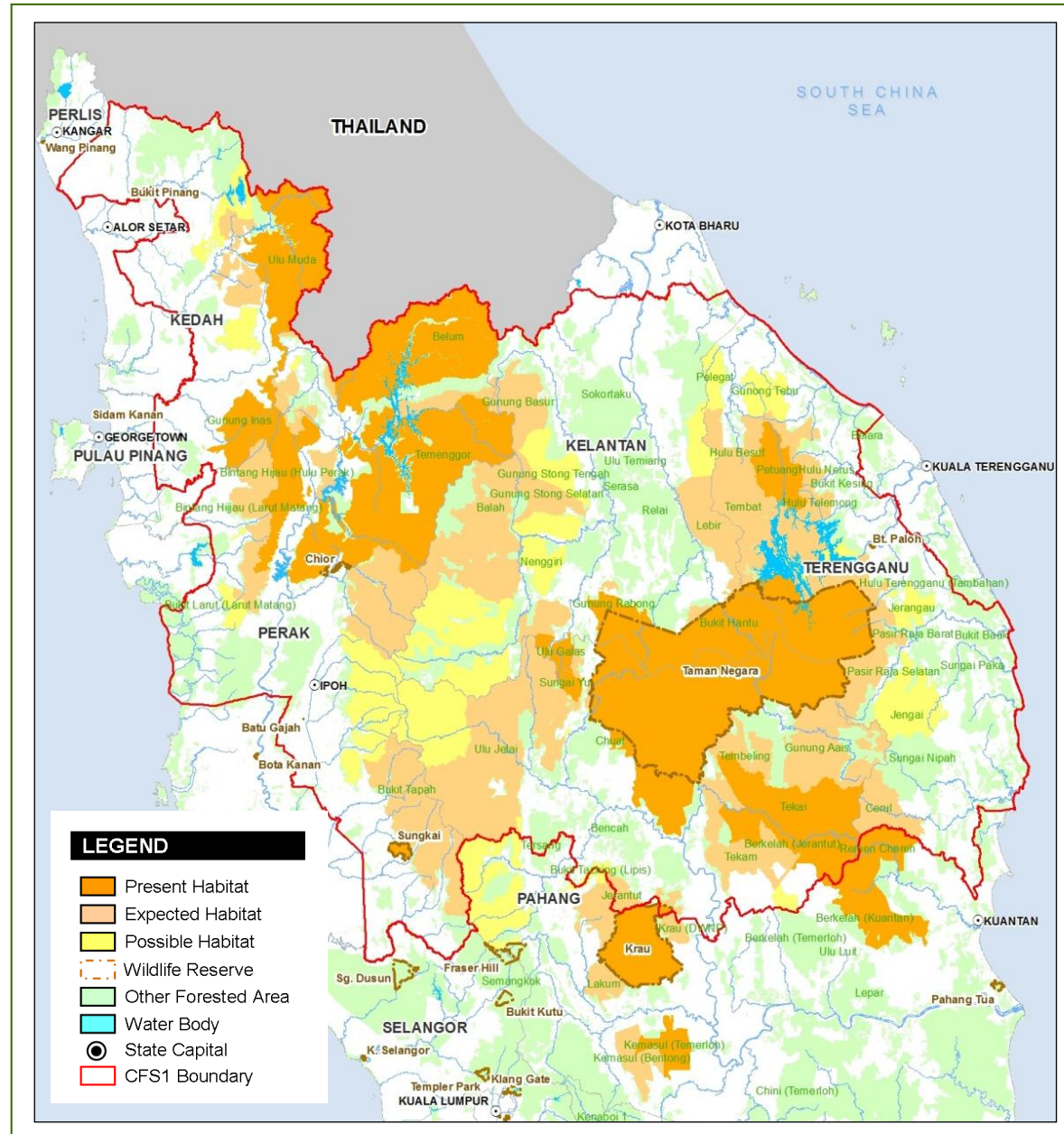
The subspecies *Bos gaurus hubbacki* is found only in Peninsular Malaysia and Thailand. The main states where it is found in Peninsular Malaysia are Pahang, Kelantan, Kedah, Perak and Terengganu. Since the 1980s, the Department of Wildlife and National Parks (DWNP) has conducted rapid biodiversity inventory to gain information on the populations and distribution of wildlife species including the gaur. The current estimated minimum gaur population in Peninsular Malaysia is 273 - 333 compared to 549 - 577 in 1991. **(Figure 2.7)**



Source: WWF library – Royal Belum State Park

Poaching, as well as loss and fragmentation of habitat due to rapid rural development are the most significant threats to this species. The gaur is hunted for its meat but other parts such as teeth, horn and skin are sought after as trophy and collectible items. Forest fragmentation increases the chance of extirpation of small isolated populations. Diseases transmitted by domestic cattle, such as Haemorrhagic Septicaemia, Malignant Catarrhal fever and foot-and-mouth disease are potentially fatal.

Figure 2.7: Distribution of Gaur in Peninsular Malaysia



Source: DWNP (2008)

2.6.2.5 Malayan Tiger (*Panthera tigris*)

Widely distributed throughout Peninsular Malaysia except for islands and small states such as Perlis, Pulau Pinang, Melaka, and the federal territories of Kuala Lumpur and Putrajaya. Although the preferred habitat is lowland forest, tigers are habitat generalists, inhabiting a variety of habitat types from peat swamp to small woodland inside plantations to lower montane forest, up to the Gunung Bintang Hijau at 1,730m in Perak. The four main tiger states, Pahang, Perak, Kelantan and Terengganu support nearly 90% of the tiger habitat in Malaysia.

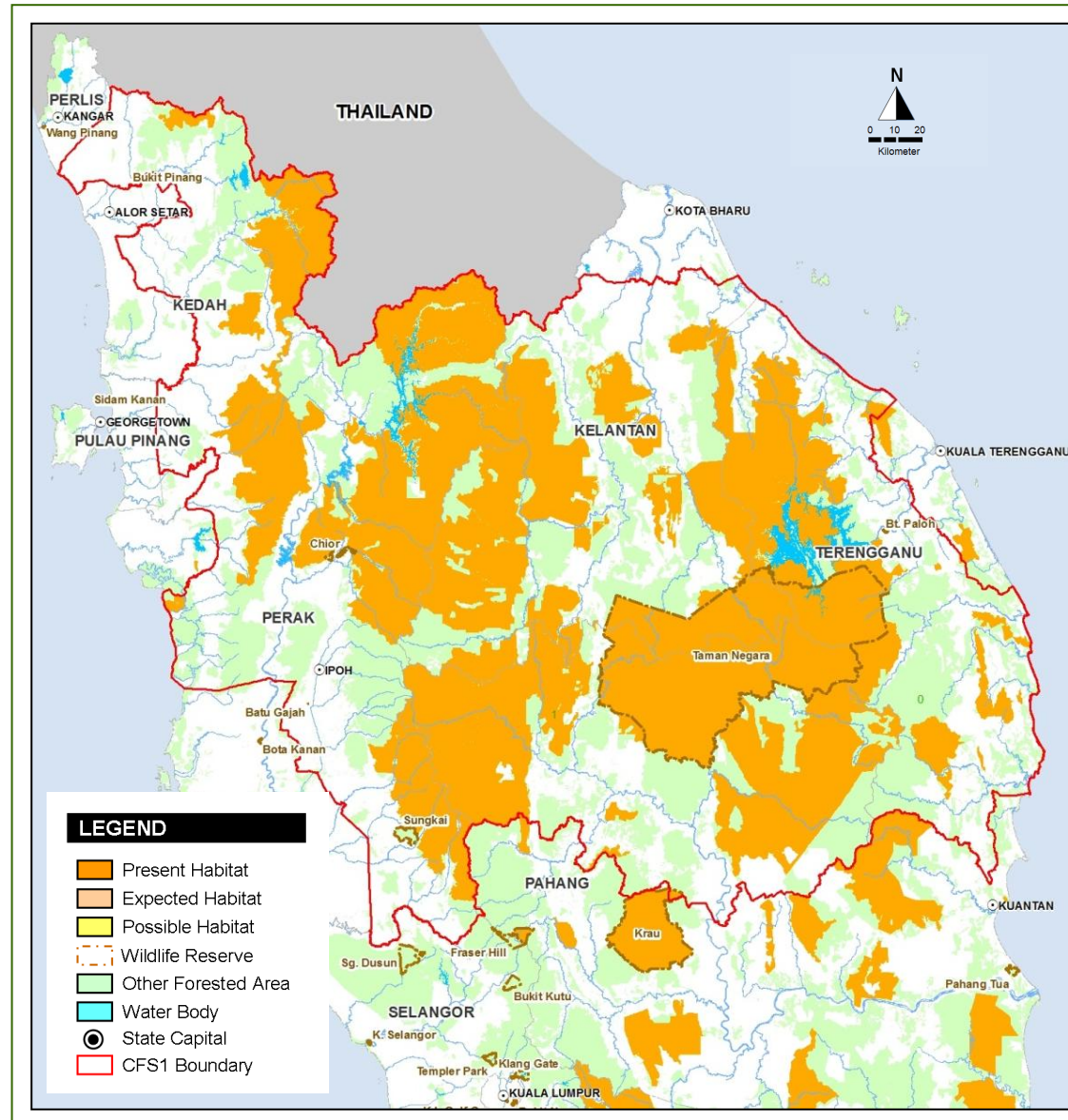


Tigers are rarely seen in the forests, therefore an accurate estimate of the number of tigers in the whole country is nearly impossible. Based on average carrying capacities of tropical forests, tigers' energetic needs, estimated tiger densities, and the land areas occupied by tigers between 1991 and 2003, it is roughly estimated that Malaysia has at least 490 tigers. This indicates that Malaysia currently supports the largest known tiger population in Southeast Asia. **(Figure 2.8)**

Source: WWF Library – Taman Negara

Almost every body part of the tiger is believed to have some curative powers in traditional medicines. Its meat is also served as a delicacy in exotic restaurants. Other body parts such as its teeth, claws and skin are sought after as trophy, magic and collectible items. The number of tigers killed is difficult to monitor and the extent of loss is largely unknown.

Figure 2.8: Distribution of Malayan Tiger in CFS-1



Source : DWNP (2008)



2.6.2.6 Habitat Requirement of Malaysian Mammals

Five large mammals are chosen for this study and these form the subjects of the discussion above. Ecological corridors, however, should not limit to the application for the large mammals. Other aspects of the fauna and flora need as much attention. In view of this, the following generalization on habitat requirements of Peninsular Malaysian mammals should be taken into consideration:-

- **Living Habits:** 51% live on the ground, 37% live in trees, 8% choose both, and 4% are aquatic.
- **Preferred Habitat:** 53% are confined to primary forest, 25% live in primary and tall secondary forest, 12% live in primary secondary forest or can subsist in cultivated areas, and 10% live in cultivated or urban areas only. Of the 22% that enter cultivated areas, most may be considered as agricultural pests, and it is possible that more species would invade cultivation if their usual habitats were reduced in size, fragmented or destroyed.
- **Elevation:** 52% do not live above 1,000 ft.; 81% do not live above 2,000 ft.; and only 10% live in higher locations. A few (9%) are found at any altitude.
- **Present Numbers:** 28% of Peninsular Malaysian mammals are abundant, 34% are common and 38% are rare at the present time. Of the larger mammals (carnivores and ungulates, including the elephant, with 39 species), many of which are subjected to hunting pressure, 21 species or 54% may be considered rare, with the Sumatran rhinoceros and the seladang (gaur) approaching critical state.

2.6.3 Existing Protected Areas/ Wildlife Reserves

There are a number of conservation areas within the CFS-1 study area that are important for biodiversity protection.

The largest of which is the Taman Negara National Park, a 434,000ha tract of protected primary forest that supports a rich flora and fauna. Many endangered or threaten species of Southeast Asia and some endemic species of Malaysia are found in Taman Negara. Charismatic megadiversities of Taman Negara undoubtedly draw many tourists to the park, and it is considered to be a stronghold of viable populations of many endangered species in Peninsular Malaysia.

Royal Belum State Park is another important conservation area recently gazetted by the Perak State Government. The area, next to the borders between Malaysia and Thailand, covers some 117,500 ha of the total 300,000 ha of the Belum and Temenggor Forest Reserves. The forested areas here are unique because it represents a mixture of the Thai-Burma and Malaysian types and it is found only in Myanmar and Thailand but not elsewhere in the Peninsular. The establishment of the Royal Belum State Park clearly opens up the opportunity to link this with other conservation areas in Thailand (Hala-Bala Wildlife Sanctuary /Bang Lang National Park) which, together with the remaining part of the Belum Forest Reserve and Temenggor Forest Reserve in the south, will create perhaps the largest single protected area on the Malay Peninsula.

2.6.4 Human-Wildlife Conflicts, Location and Causes

Human-wildlife conflict arises when both human and wildlife species have overlapping interests such as competing land utilization between human (living and agricultural development) and wildlife (ranging and predation grounds). In many cases, the conflicts are highest at the edge habitats between forested areas and human settlements or along linear infrastructure (e.g. roads). The conflicts are usually in the form of crop raiding by herbivores and omnivores or livestock depredation and human attacks by large predator species such as leopard and tiger.

Human-wildlife conflict refers to livestock and crops depredation, property damage or attacks on humans or causing human's fear of being injured or killed by wildlife.

Large, rare wildlife species (notably elephant and tiger) that need to range over wide areas for food are forced to enter plantations and farms. This stresses the wildlife populations and undermines the long-term viability of the rare species populations. It results in conflict as wild animals raid crops and, in the case of elephants, damage property. The map (**Figure 2.9**) shows the distribution of conflict spots for the year 2007. It represents cases of human-wildlife conflicts reported by the public, and then later followed up the Department of Wildlife and National Parks. There were more than 9,500 such cases reported for last year alone and these include 126 and 1,038 cases related to tiger and elephant respectively.

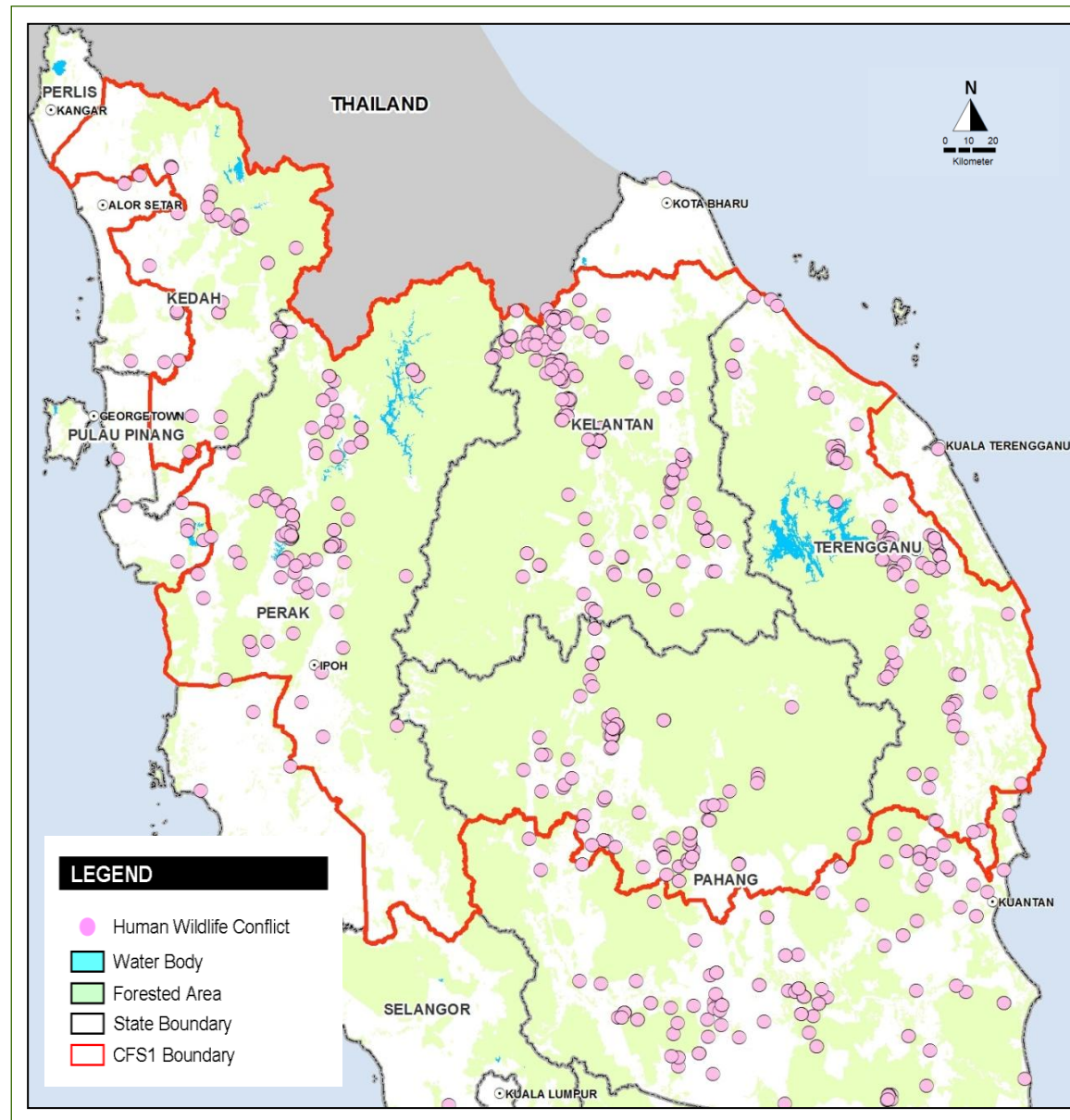
One of the underlying causes of Human-wildlife conflict is the loss of suitable natural habitat and the situation is aggravated by the lack of integrated land-use planning which leads to forest fragmentation.⁵ Large mammals tend to have large home ranges and territorial areas, and certain species may have well-established migration routes between different parts of their home range for different purposes (for example, between salt lick sites and foraging grounds). The conversion of even a small patch of forest to other land-uses not compatible with wildlife habitat requirement at critical conservation areas, such as near protected areas or dissecting the traditional migration routes, poses a serious threat to landscape species such as tigers and elephants. For herbivores and omnivores, such as elephant and wild pig, the movement patterns are disrupted, and with increasing degree of habitat fragmentation the sub-populations become isolated in an ever decreasing forest pocket and when the limited resources can no longer sustain the sub-population, it will need to depend on crop-raiding for survival.

A fragmented landscape has more peripheral area than prime habitat. It is known that once a territorial species like the tiger is forced to live in such an edge habitat which is not as rich as the prime habitat in terms of food it usually wanders over long distances in search of prey species and may occasionally come into direct conflict with nearby human settlements. Under the current trend of human population growth, land use patterns and policies, poverty in the rural areas, poor livestock management, and lack of proactive management strategies, Kawanishi⁶ noted that the conflicts between humans and tigers will not be resolved, but only intensify.

⁵ Chong, D. K. F. and Dayang Norwana, A. A. B. 2005. *Guidelines on the Better Management Practices for the Mitigation and Management of Human-Elephant Conflict in and around Oil-Palm Plantations in Indonesia and Malaysia*. Version 1. WWF-Malaysia, Petaling Jaya.

⁶ Kawanishi, K. 2002. Population Status of Tigers (*Panthera tigris*) in a Primary Rainforest of Peninsular Malaysia. PhD Dissertation. University of Florida, Gainesville, USA.

Figure 2.9: Human-wildlife conflict spots within CFS-1 study area



Source: DWNP (2008)

03

masterplan for ecological linkages

Overview
Primary And Secondary Linkages
Fact Sheet Primary Linkages (PL)
Fact Sheet Secondary Linkages (SL)
Trans-Boundary Linkages



CFS I



3.0 MASTERPLAN FOR ECOLOGICAL LINKAGES

OVERVIEW

The “Central Forest Spine” is envisaged to be a physically and functionally connected forest landscape, spanning across the eight forest complexes in Peninsular Malaysia, from Johor to the Thai border (and across the border to certain protected areas in southern Thailand). Once established, the CFS will serve as the backbone of the Environmentally Sensitive Area (ESA) network, reinforce the existing Protected Area network, and help maintain the health of forest ecosystems (including wildlife populations) by arresting the deleterious effects of fragmentation (**See Chapter 2.5**).

The CFS Masterplan for Primary and Secondary Linkages within CFS1 (**Figure 3.1.1**) and Masterplan Schematic diagram (**Figure 3.1.2**) show the overall layout of the CFS, across the eight forest complexes in Peninsula Malaysia.

Basically the criteria to identify the ecological linkages are:

- (1) Identified the forest islands within Peninsular Malaysia;
- (2) Using a scoring system to classify the importance of the forest islands, such as elevation, size of the forest complexes and type of the forest. Type of forest will be categorised under Type A (Protected Area, i.e. wildlife reserve, wildlife sanctuary, state park, national park, etc.), Type B (Permanent Reserved Forest) and Type C (state land forest and forest on alienated land). After the scoring analysis, eight forest complexes have been identified in Peninsular Malaysia. Out of these, five major forest complexes are within the CFS1 study area.
- (3) To connect all the forest complexes, the locations of suitable linkages have been identified using supporting information such as road kills, human-wildlife conflicts data and importance of forest biodiversity value. To identify the linkages, numerous meetings with biodiversity experts (MyCAT, FRIM and other biodiversity experts) have been held.
- (4) After the linkages were identified, the concept of Primary and Secondary Linkages was applied. A Primary Linkage is an application of the linear connection concept, and this linkage enables a connection between the highly ranked forest islands and forest complexes. It is also likely to be important for the movement of landscape species between forest islands / complexes. A Secondary Linkage follows the stepping stone concept which caters mostly for birds and small mammals, and is applicable when the forest island is highly isolated and is not a viable habitat for landscape species.

3.1 PRIMARY AND SECONDARY LINKAGES

In this study, Primary Linkages (PL) has been identified in areas where it is crucial to re-establish forest connectivity in order to achieve the main CFS link (**See Section 2.5**). Major interventions are required to establish these linkages. The establishment of all of the PLs will lead to the formation of the Central Forest Spine. Eleven (11) PLs have been defined in CFS1:-

- CFS1-PL1 : Tanum FR (Greater Taman Negara) – Sg Yu FR (Main Range)
- CFS1-PL2 : Temengor FR (Main Range) – Royal Belum State Park (Main Range)
- CFS1-PL3 : Lojing FR (Main Range) – Sg Brok FR (Main Range)



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- CFS1-PL4 : Padang Chong FR (Bintang Hijau) – Sg Kuak FR (Main Range)
- CFS1-PL 5 : Ulu Muda FR (Ulu Muda) – Gunung Inas FR (Bintang Hijau)
- CFS1-PL6 : Ulu Jelai FR (Main Range) – Hulu Lemoi FR (Main Range)
- CFS1-PL7 : Taman Negara – Tembat FR (Greater Taman Negara)
- CFS1-PL8 : Kenderong FR (Bintang Hijau) – Bintang Hijau (Hulu Perak) FR (Bintang Hijau)
- CFS1-PL9 : Bintang Hijau Larut Matang FR – Bintang Hijau Kuala Kangsar FR
- CFS1-PL10 : Bukit Larut FR – Bubu FR
- CFS1-PL11 : Jerangau FR – Jerangau FR

Note:

It is only to be expected that the existing forests in all other sections of the main CFS “chain” (both between and within the forest complexes) shall face the threat of fragmentation in the future (e.g. development of new highways, agriculture expansion etc.). Although it is not possible to identify these areas as PLs in this study, similar interventions as given here would be required in order to maintain connectivity at these areas.

Secondary Linkages (SL) are complementary to Primary Linkages. They are identified in areas where it is unfeasible to create a primary linkage (e.g. due to areas of non-forested land that cannot be reforested due usually to human land use), but it is still important to maintain some level of connectivity (albeit weaker) between forests. Thirteen (13) SLs have been identified in CFS1:-

- CFS1-SL1 : Lebir FR – Relai FR – Ulu Temiang FR – Jentiang FR - Serasa FR – Gunung Stong State Park
- CFS1-SL2 : Krau WR – Bencah FR – Som FR – Yong FR
- CFS1-SL3 : Bintang Hijau (Hulu Perak) FR – Papulut FR – Piah FR
- CFS1-SL4 : Taman Negara Forest Complex – Terengganu Coast
- CFS1-SL5 : Taman Negara Forest Complex – Terengganu Coast 2
- CFS1-SL6 : Taman Negara – Chiku FR
- CFS1-SL7 : Ulu Muda FR – Pedu FR – Chebar FR
- CFS1-SL8 : Ulu Muda FR – Rimba Telui FR
- CFS1-SL9 : Jeli FR- Sg. Sator FR- Sokortaku FR
- CFS1-SL10 : Chabang Tongkat FR- Ulu Sat FR- Temangan FR
- CFS1-SL11 : Bukit Kinta FR – Bujang Melaka FR
- CFS1-SL12 : Bubu FR – Matang mangroves
- CFS1-SL13 : Gunung Bongsu FR – Gunung Inas FR

The Primary and Secondary Linkages are described in the following pages.

Figure 3.1.1 : Primary and Secondary Linkages in The Central Forest Spine

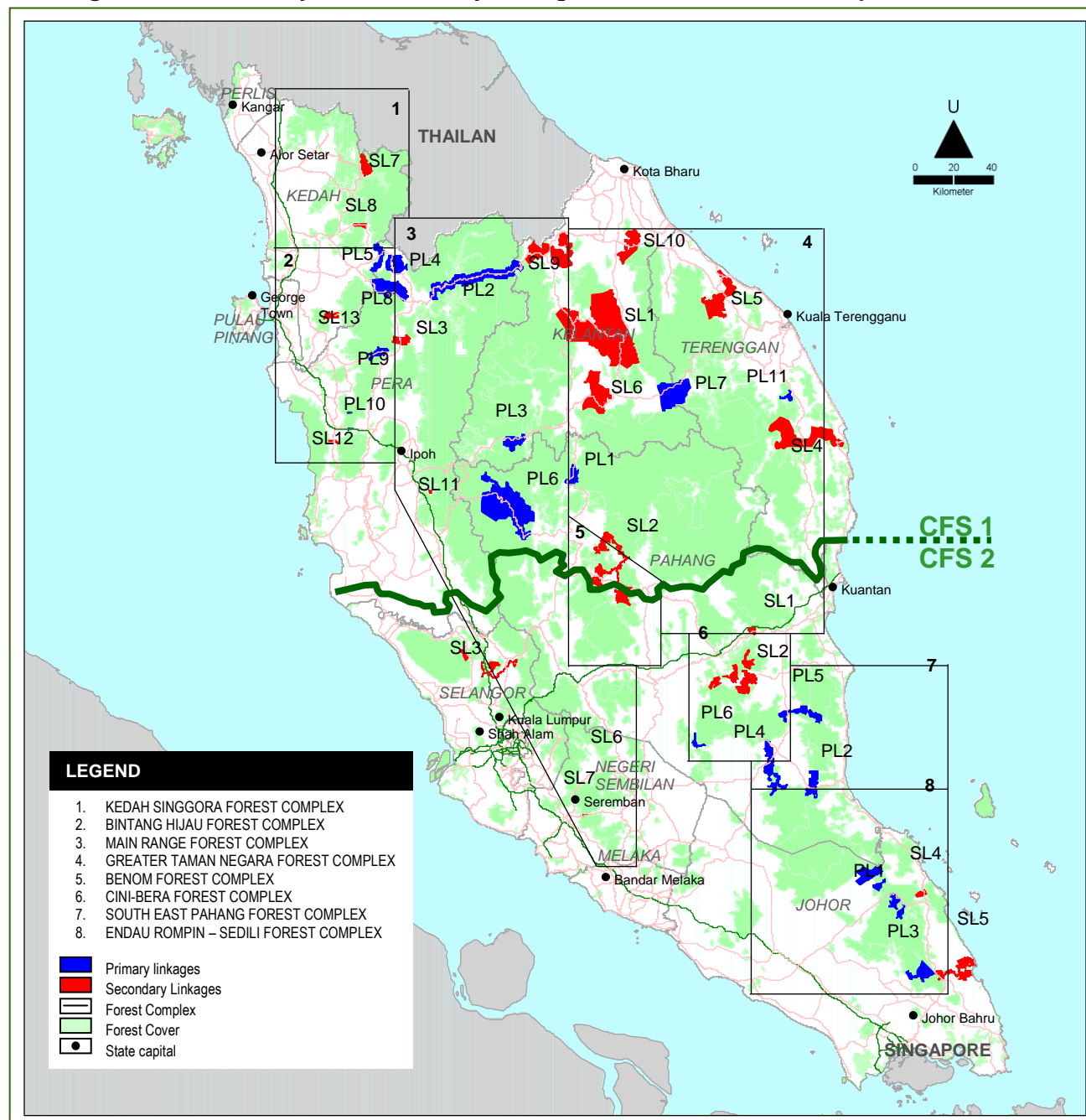
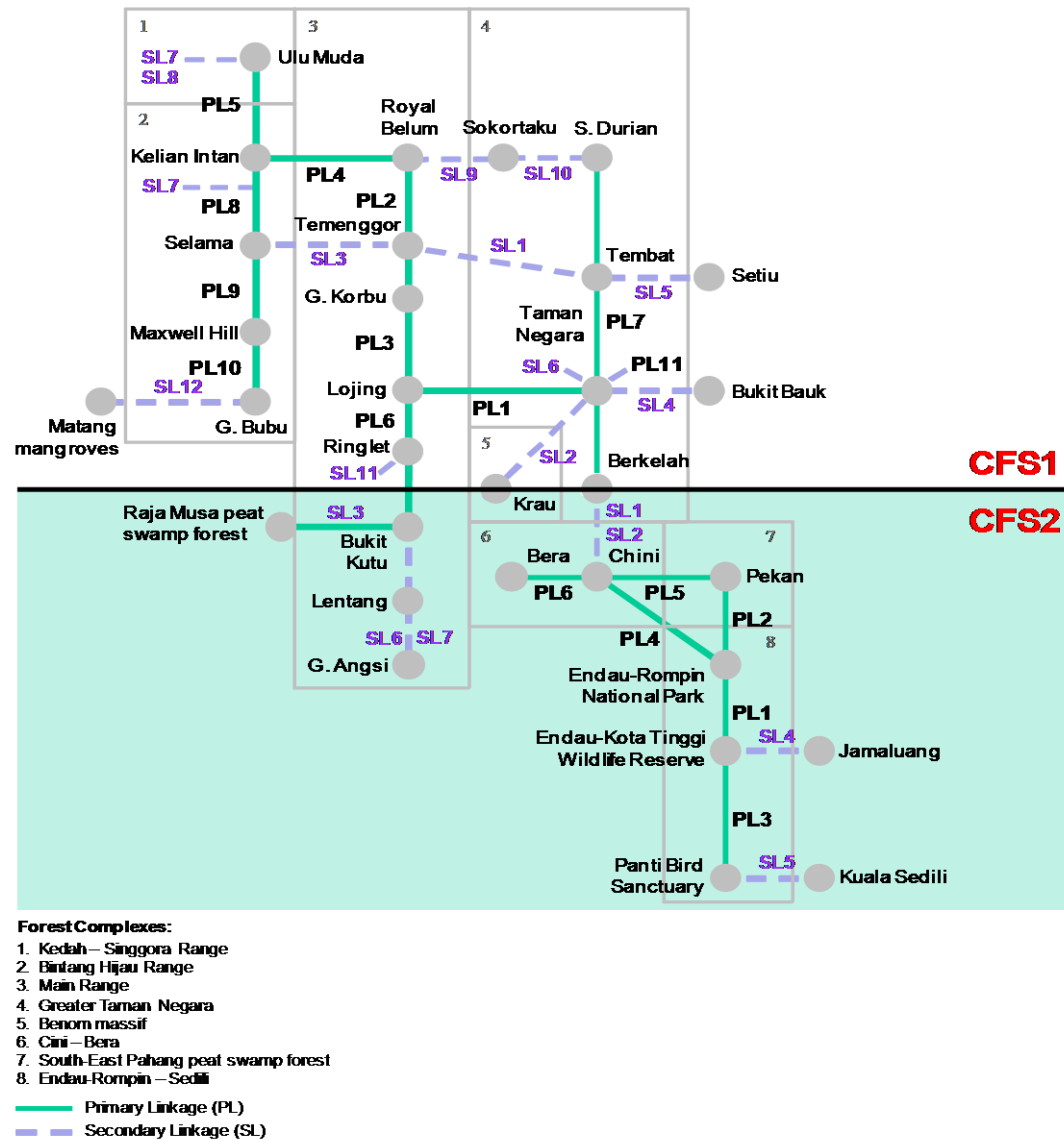
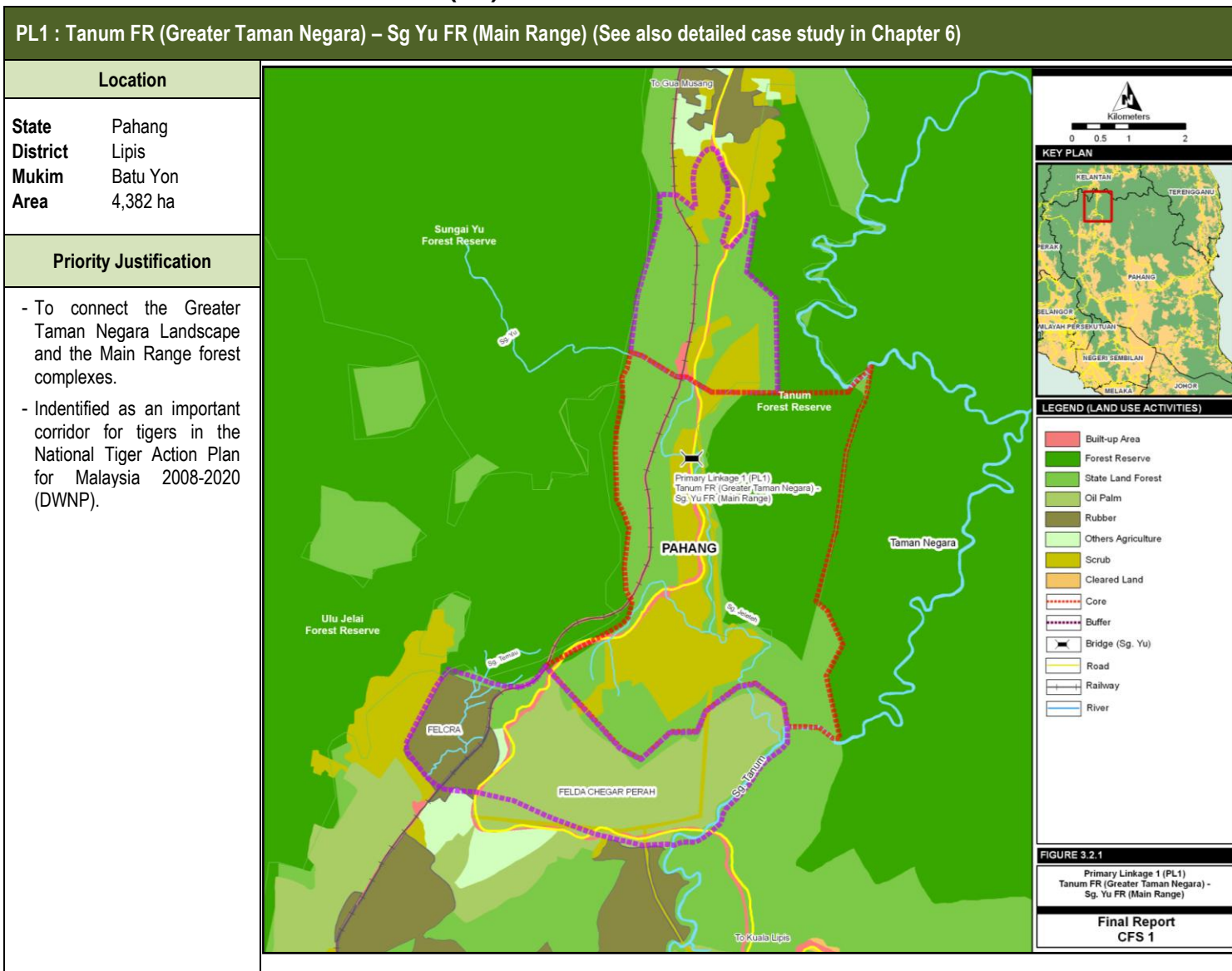


Figure 3.1.2 : CFS1 Masterplan Schematic Diagram



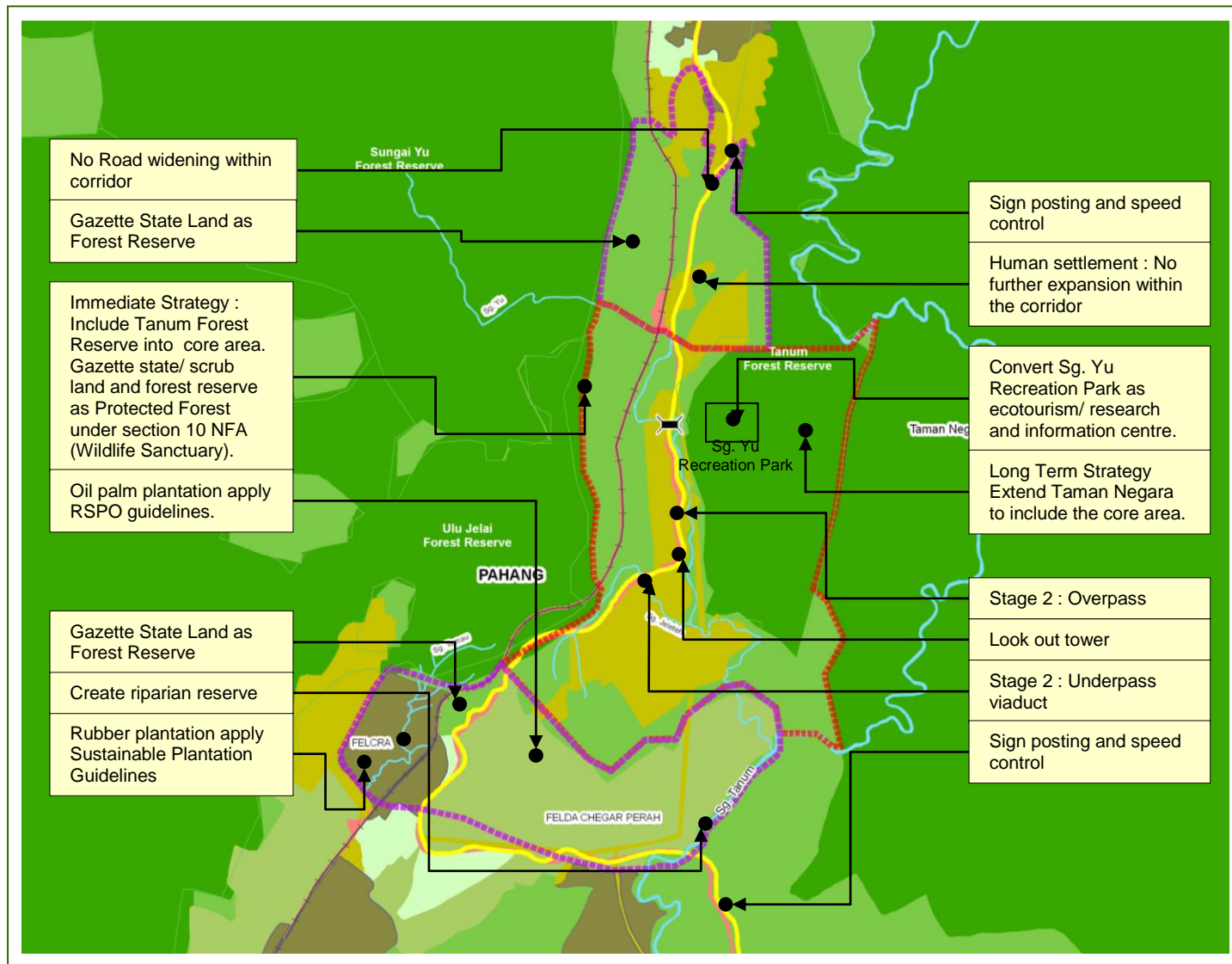
3.2 FACT SHEET PRIMARY LINKAGES (PL)

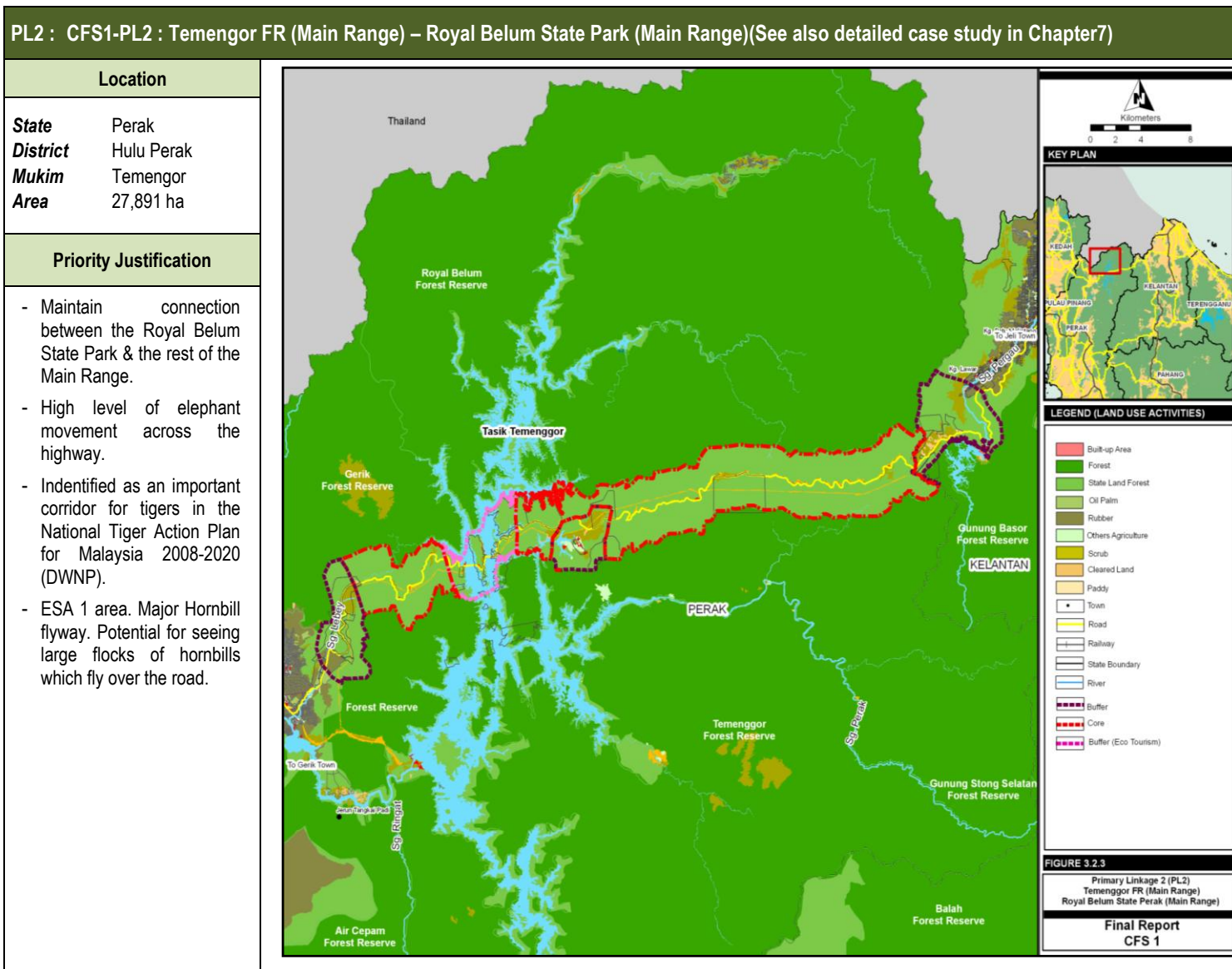


<p>Description</p>	<ul style="list-style-type: none"> • Sg Yu is located to the west of Taman Negara. The nearest towns are Merapoh at the north and Lipis at the south. This area is on the only road from Pahang to Kelantan which runs along the western side of Taman Negara. It is around 45 min drive from Lipis town. Along this road, there are some oil palm and rubber plantations. A railway track runs approximately along the same alignment as the road, and the train service here operates twice a day for passenger from Jerantut to Gua Musang and Jeli. There are 2 forest reserves beside the study area. There are also rivers (i.e. Sg. Yu and Sg Tanum) crossing the study area. • Tanum Forest Reserve (on the Taman Negara side) is bisected from the Ulu Jelai Forest Reserve & Sungai Yu Forest Reserve (on the Main Range side) by the Kuala Lipis – Gua Musang trunk road and railway. The forest reserves are separated by approximately 400 m of state land forest, scrub and grassland. • The least developed section of this road/railway is at the narrowest point (north and south of the bridge over Sungai Yu), where the forest is only separated by the road and the railway. • Sg Yu-Main Range Linkage is located within 10 kilometers of the national premier tourism destination Taman Negara, which has its main entry point at Merapoh.
<p>Threat/Constraints</p>	<ul style="list-style-type: none"> • Taman Negara is almost cut off from the rest of the forested landscape in the west, and increasingly becoming a “habitat island”. The clearing of forest cover along the north and west fringes of the park over the past 15 years has created an ecological bottleneck that hinders movement of wild animals, especially predators and their prey species between Taman Negara and the Main Range.
<p>Implementation Strategy</p>	<ol style="list-style-type: none"> 1) Gazettelement of Forest Reserve (protected) and Acquisition of Land <ol style="list-style-type: none"> i) Immediate freeze on land alienation and development in the corridor, plus any TOL land is not allowed to be renewed. ii) Gazette Tanum FR within the Core Area as protection forest under Section10(f) of the National Forestry Act 1984 (i.e. as a wildlife sanctuary) iii) Gazette all state land forests / scrub land within the Core Area as protection forest under Section10 of the National Forestry Act 1984 iv) Gazette state land forests within the Buffer Zone as Forest Reserve under NFA, 1984 v) Long term strategy: Extend the boundary of Taman Negara Pahang to include the Core Area. 2) Establish Wildlife Crossing <p><u>Components of Stage I</u></p> <ul style="list-style-type: none"> • Additional signage (gantry type) and advisory signs. • Speed control limited to 60km/hr over 5 km stretch. • Wildlife monitoring program.

<p style="text-align: center;">Implementation Strategy</p>	<p>Components of Stage 2</p> <ul style="list-style-type: none"> • Confirmation of wildlife crossing from monitoring program. • Underpass (viaduct) at 3.5 km south of Sg. Yu Bridge. • Overpass (vehicular box culvert) at 1.5 km south of Sg. Yu Bridge. • Remove 60km/hr speed limit. Road reverts to 90km/hr after crossing structures are in place. • Provide barriers and escape structures for wildlife crossing as necessary. <p>3) Create Riparian Corridor</p> <ol style="list-style-type: none"> i) Create a riparian corridor to allow elephants to continue to pass through the oil palm estate (FELCRA Sungai Temau) along the Tanum River. ii) For rivers located within the core area no riparian reserve required (Sg. Yu and Sg. Jeleteh). iii) For rivers within the buffer area riparian reserve is required for Sg. Temau and Sg. Tanum. iv) Riparian reserve is an additional 50 m to the river reserve. <p>4) Land Use Management Control</p> <ol style="list-style-type: none"> i) Carry out a monitoring programme. ii) FELCRA Sg Temau (942 ha), FELDA Chegar Perah 1(655 ha rubber) and FELDA Chegar Perah 1 (2,631 ha oil palm) encouraged to practice sustainable plantation management as outlined in 'Guidelines for Sustainable Agricultural Management of Plantations' and RSPO guidelines. iii) No further development of agricultural areas should be allowed in the core areas of the ecological corridor. iv) The wildlife corridor should be promoted as the most accessible part of the premier ecotourism destination of Taman Negara.
<p style="text-align: center;">Expected Benefits</p>	<ul style="list-style-type: none"> • Connect Taman Negara National Park, the largest protected area and an important stronghold of viable populations of many endangered species in Peninsular Malaysia, with the vast expanse of forest on and around the Main Range, and consequently to Royal Belum in the north. • Enhance the long-term viability of wildlife populations (tigers and elephants in particular) in the Peninsular. • Increased ecotourism awareness among travelers along the Federal Route 3 and the eastern region railway users.

Figure 3.2.2 : Implementation Strategy Plan - CFS1-PL1 : Tanum FR (Greater Taman Negara) – Sg Yu FR (Main Range)

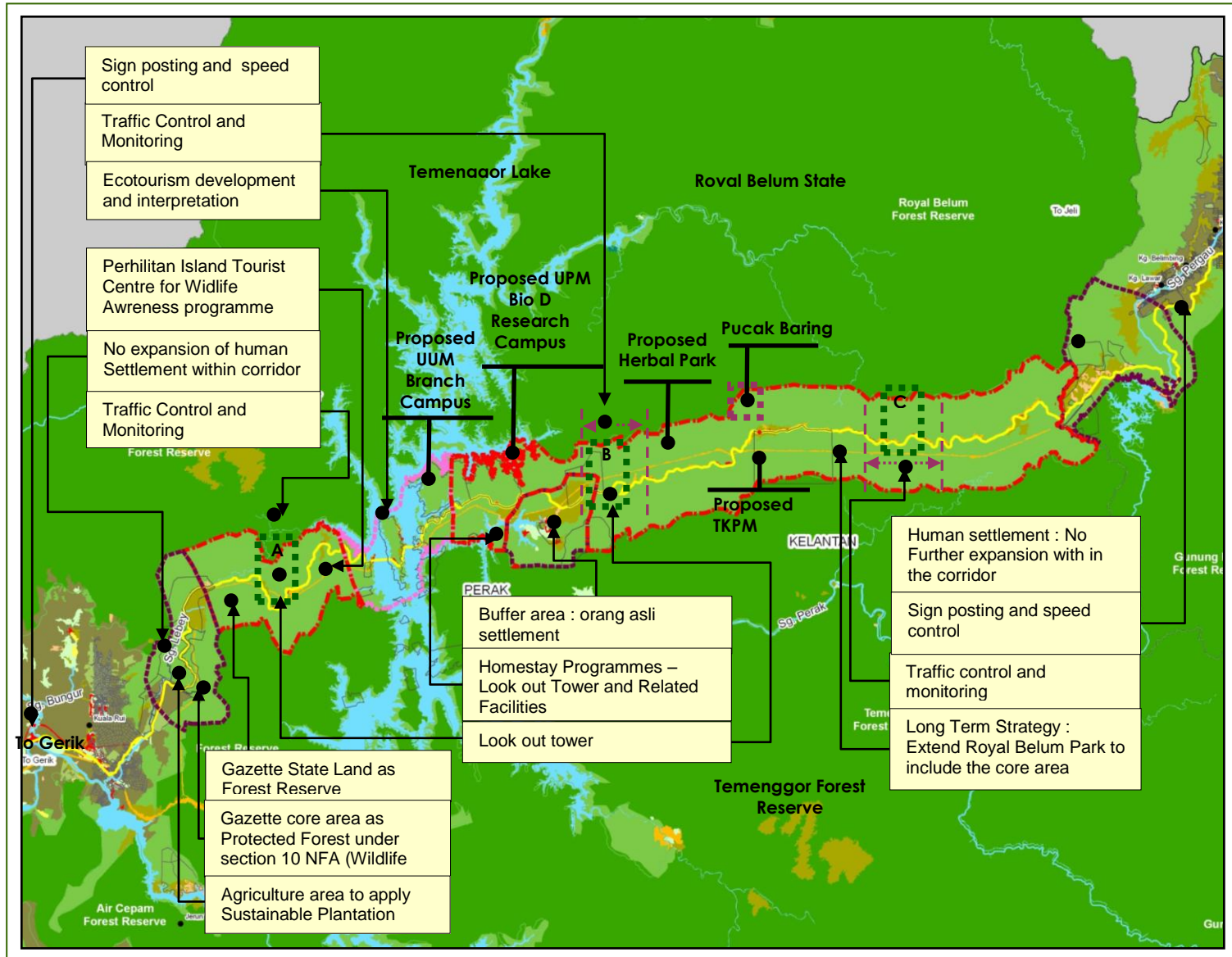


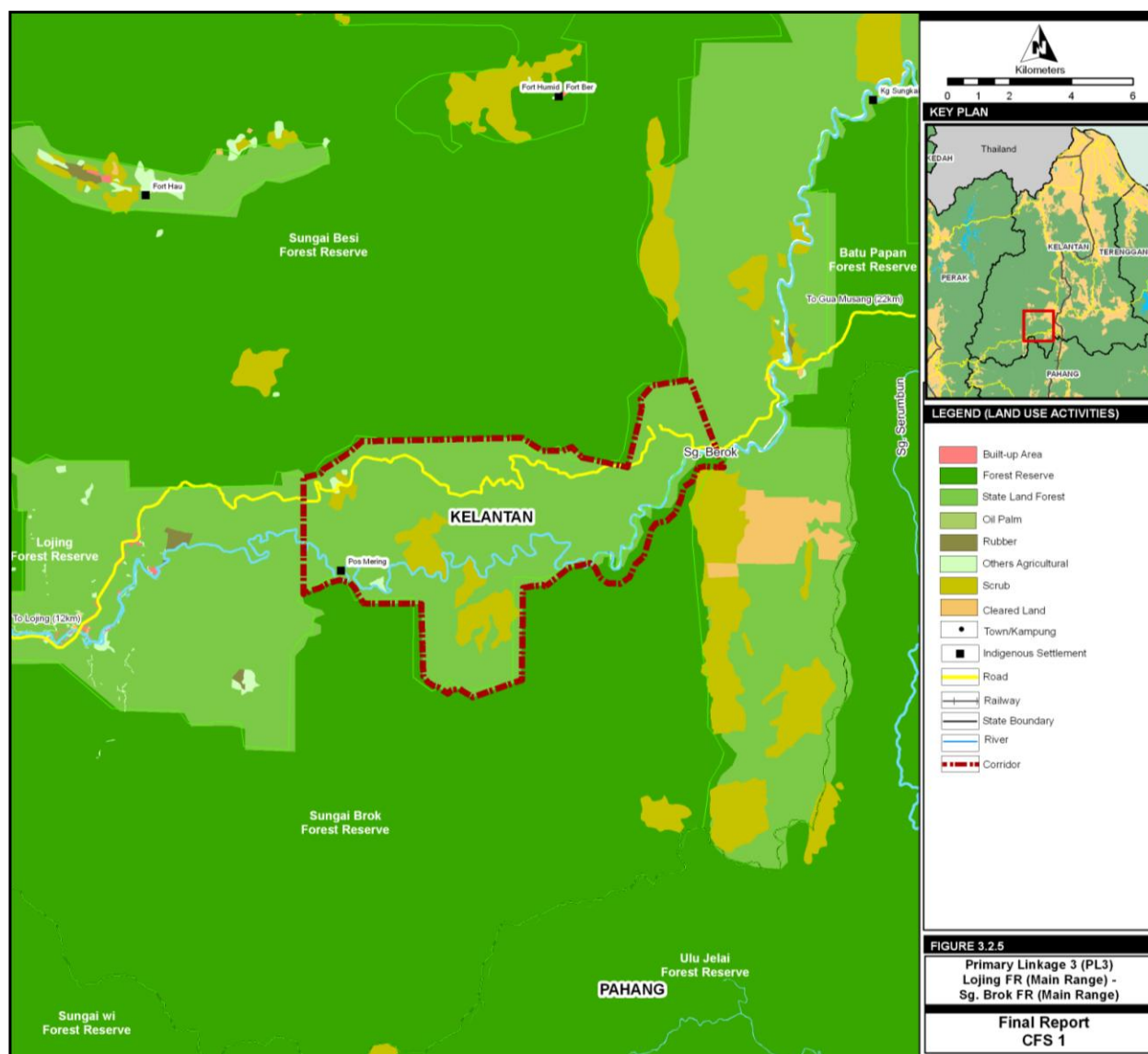
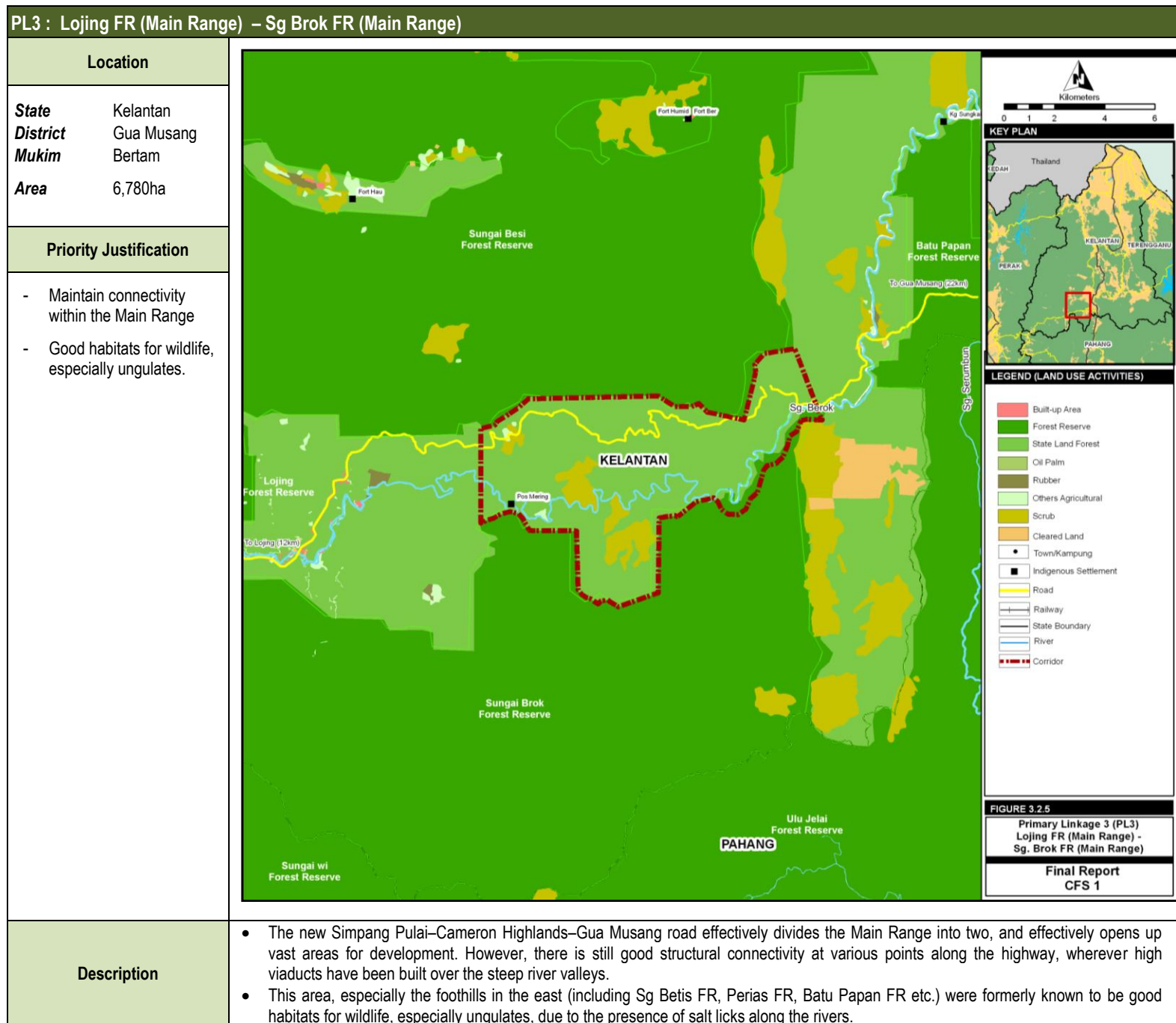


<p>Description</p>	<ul style="list-style-type: none"> • PL 2 is located on the federal road 4 which runs from Gerik town to Jeli in-Kelantan. Along this road, there are a famous eco-tourism destination (Pulau Banding), several orang asli settlements and oil palm plantations. • The Royal Belum State Park and the Belum and Temenggor Forest Reserves comprise an ecologically integrated landscape of great biological richness, extending across the Thai border. It is well known for its spectacular large mammals and birds. It is unique with a mixture of Thai-Burma and Malaysian forest types that is not found further south in the Peninsular. The Belum area is recognised internationally as an Important Bird Area (IBA). • Parts of the forest reserves and the state land forests have been and are being logged. In addition, development is spreading along the East-West Highway corridor.
<p>Issues</p>	<ul style="list-style-type: none"> • The entire stretch of the East-West Highway in Perak has been zoned as forest (Hutan Darat) under the Hulu Perak Local Plan (also ranked ESA1 in the National Physical Plan), with the exception of a proposal for a Herb Garden (Tanaman Herba) and Pulau Banding, which is zoned for tourism. • In 2007 the Perak State Exco approved plans for oil palm plantations on either side of the highway i.e. 962 acres under SADC and 1,000 acres under RPS Banun. Furthermore, highland agriculture has been proposed by the Agriculture Department near the designated Herb Garden in Puncak Baring (800 ha). These developments would be within the area designated as Hutan Darat in the Local Plan. • In addition, a number of development plans have been proposed along this road, such as the high speed train between Penang and Kota Bahru, the trans-peninsular pipeline from Bachok to Yan, and an <i>Acacia mangium</i> forest plantation. • Collectively, these plans are incompatible and would have a devastating impact on nature conservation and tourism. • In its present form, the highway is not a major barrier for large animals (e.g. elephants which regularly cross over). However, further development would create a more significant barrier and currently wildlife (especially elephants) presents a hazard to motorists. Nevertheless, the presence of wildlife is an important resource for tourism. • Joint surveys by Thai and Malaysian authorities found signs of organised poaching of large mammals and the sale of trophies in markets on both sides of the national border.
<p>Implementation Strategy</p>	<p><u>Gazettelement of Forest Reserve and Acquisition Of Land</u></p> <ol style="list-style-type: none"> 1. Immediate freeze on land alienation and development in the corridor (with the exception of tourism development on Pulau Banding) plus acquire alienated lands within the core area on a case-by-case basis as necessary. 2. Extend Royal Belum State Park to the south across the highway right up to the border of Temenggor Forest Reserve (this extension should stretch from the eastern shore of Temenggor Lake to the Kelantan border). (See detailed map under Case Study). 3. Likewise the sections of Gerik Forest Reserve north and south of the highway should also be reconnected by gazetting an extension to the forest reserve to cover the intervening land (including the forested land along the highway from Gerik to the western shores of Temenggor lake). 4. Include the state land strip along the East-West Highway within the core area (between the Royal Belum State Park and Temenggor Forest Reserve) as part of Royal Belum State Park. 5. Gazette the extension to the Gerik FR as protection forest under s10(f) NFA (i.e. as wildlife sanctuary).

PL2 : Belum – Temengor (See also detailed case study in Chapter7)	
Implementation Strategy	<p><u>Establish Wildlife Crossing</u></p> <ol style="list-style-type: none"> 6. Establish wildlife crossings at this area including the construction of viaducts to allow safe passage of animal and to minimize hazards to motorists. 7. Create signposting and speed limits to ensure that motorists drive appropriately and are aware that they are passing through a wildlife corridor. <p><u>Land Use Management Control</u></p> <ol style="list-style-type: none"> 8. The development approval for the Herb Garden and Highland Agriculture should be revoked since these developments are not sustainable due to the steep terrain and potential conflicts with wildlife. However, if the state decides to proceed with these developments, then it must comply with guidelines as outlined in 'Guidelines for Sustainable Agricultural Management of Plantations' especially in relation to the development of steep land. 9. Prohibit expansion of agriculture along the entire stretch of this highway in order to maintain the conservation and ecotourism benefits. Establish checkpoints at various parts of the highway to counter poaching. 10. Long-term monitoring to identify critical elephant crossing sites. 11. Establish proper wildlife viewing areas within the core area and associated tourism facilities at suitable locations 12. Promote the National Ecotourism "Jumbo Trail" site.
Expected Benefits	<ul style="list-style-type: none"> • Maintenance of large mammal populations such as the Asian Elephant, Sumatran Rhinoceros, Malayan Tiger, Gaur (Seladang), Leopard and Malayan Tapir, in addition to numerous other species of animals including spectacular flocks of hornbills. • Sustainable and profitable ecotourism. • Maintenance of the Temengor dam catchment. • Road safety. • Clear land use strategy for the area without conflicting proposals. • Improved enforcement against poaching and illegal wildlife trade.

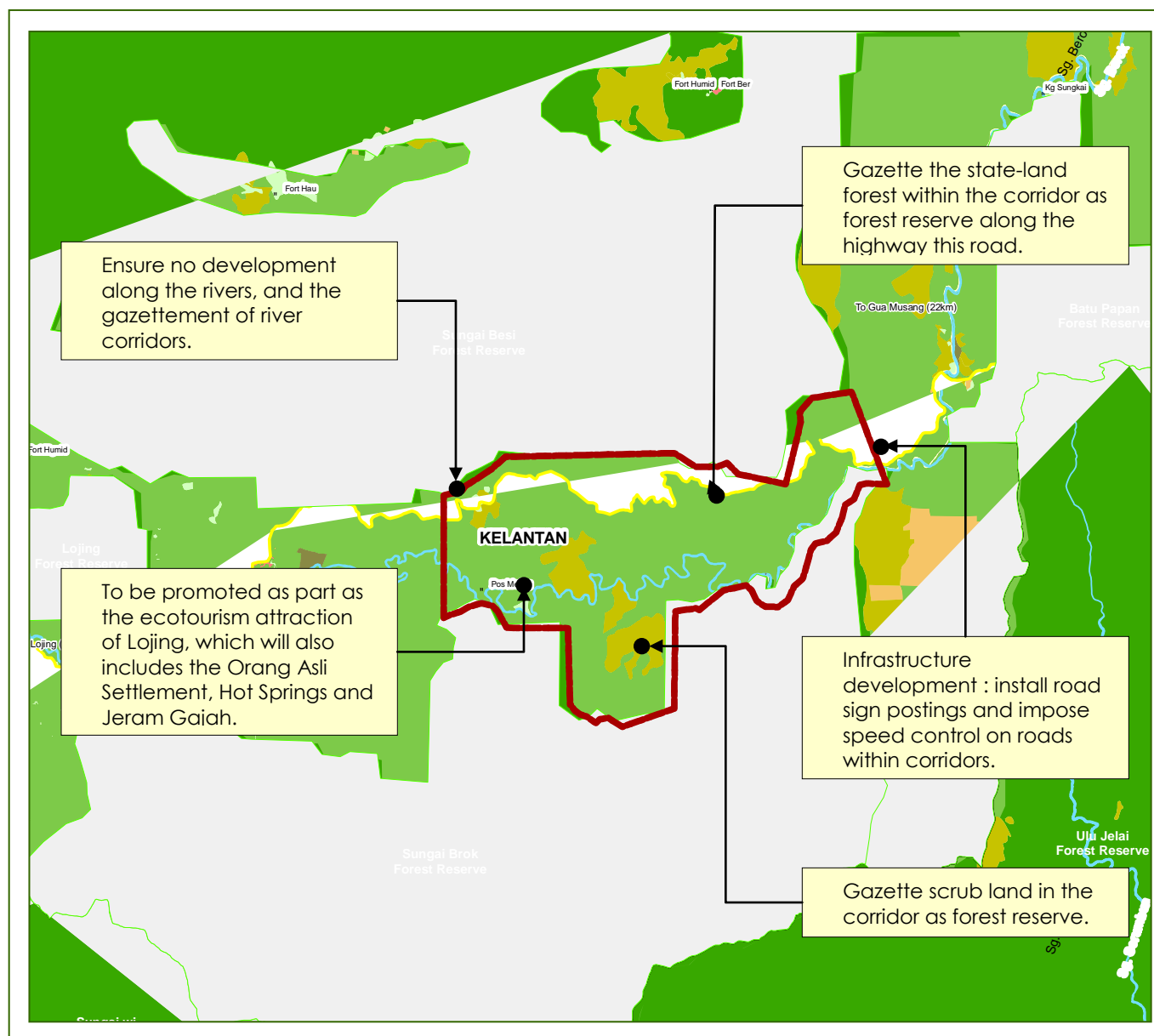
Figure 3.2.4 : Implementation Strategy Plan - CFS1-PL2 : Temenggor FR (Main Range) – Royal Belum State Park (Main Range)



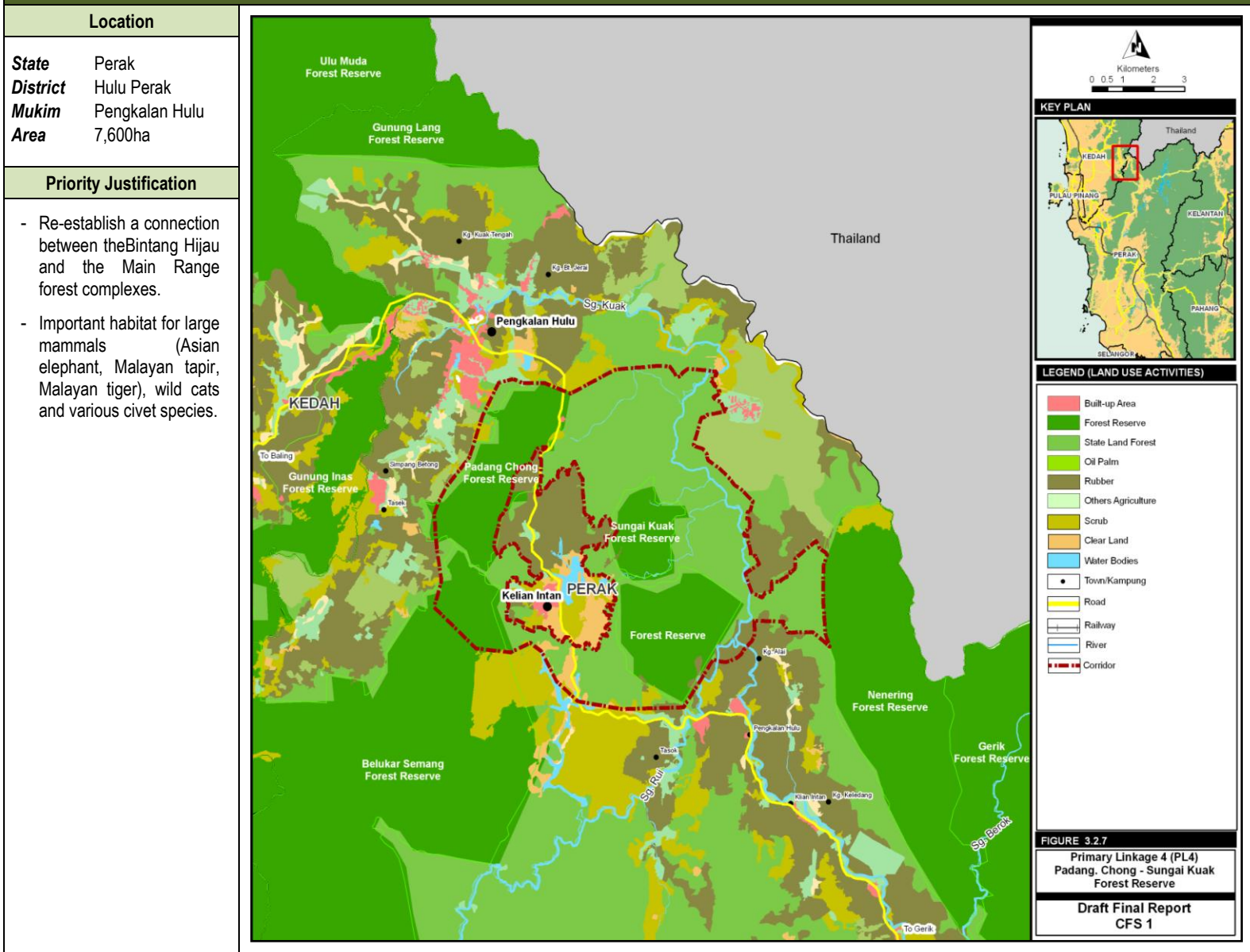


	<ul style="list-style-type: none"> At present the linkage seems to be free of any agricultural development. The soils in the area (Durian-Munchong- Bungur Series) are suitable for permanent crops such as oil palm, rubber and fruit trees. But since the linkage area is in the steep land zones, it should not be developed for agriculture.
Threat / Constraints	<ul style="list-style-type: none"> Forests have been cleared for agriculture on a large scale around Lojing area. There may also be plans to develop a township around the Sungai Brok area under the East Coast Economic Region Masterplan. The area may be targeted for future oil palm plantation and forest plantation. Thus the need to protect the area (corridor) from future development. Part of Bertam Mukim in the east has been earmarked for oil palm plantation.
Implementation Strategy	<p><u>Gazettelement of Forest Reserve</u></p> <ol style="list-style-type: none"> Gazette the state-land forests within the corridor as Forest Reserves along the highway. Gazette scrub land in the corridor as Forest Reserve and carry out forest rehabilitation. <p><u>Establish Wildlife Crossing</u></p> <ol style="list-style-type: none"> Install road sign postings and impose speed control on roads within corridors. <p><u>Create Riparian Corridor</u></p> <ol style="list-style-type: none"> Ensure existing viaducts across river valleys are suitable for wildlife movement.. Ensure no development along the rivers, and the gazettelement of river corridors. <p><u>Land Use Management Control</u></p> <ol style="list-style-type: none"> To be promoted as part as the ecotourism attraction of Lojing, which will also includes the Orang Asli Settlement, Bera Hotsprings and Jeram Gajah.
Expected Benefits	<ul style="list-style-type: none"> This link is vital to ensure connectivity between Taman Negara and Belum (Following PL1). The Simpang Pulai – Cameron Highland – Gua Musang road is getting popular as a regional route for tourists crossing the Peninsular from east to west and vice versa, via Lojing. Creation of such a linkage can assist to increase awareness among tourists about conservation efforts and the importance of biodiversity of the Main Range and its surrounding forest reserves.

**Figure 3.2.6 : Implementation Strategy Plan - CFS1-PL3 :
Lojing FR (Main Range) – Sg Brok FR (Main Range)**

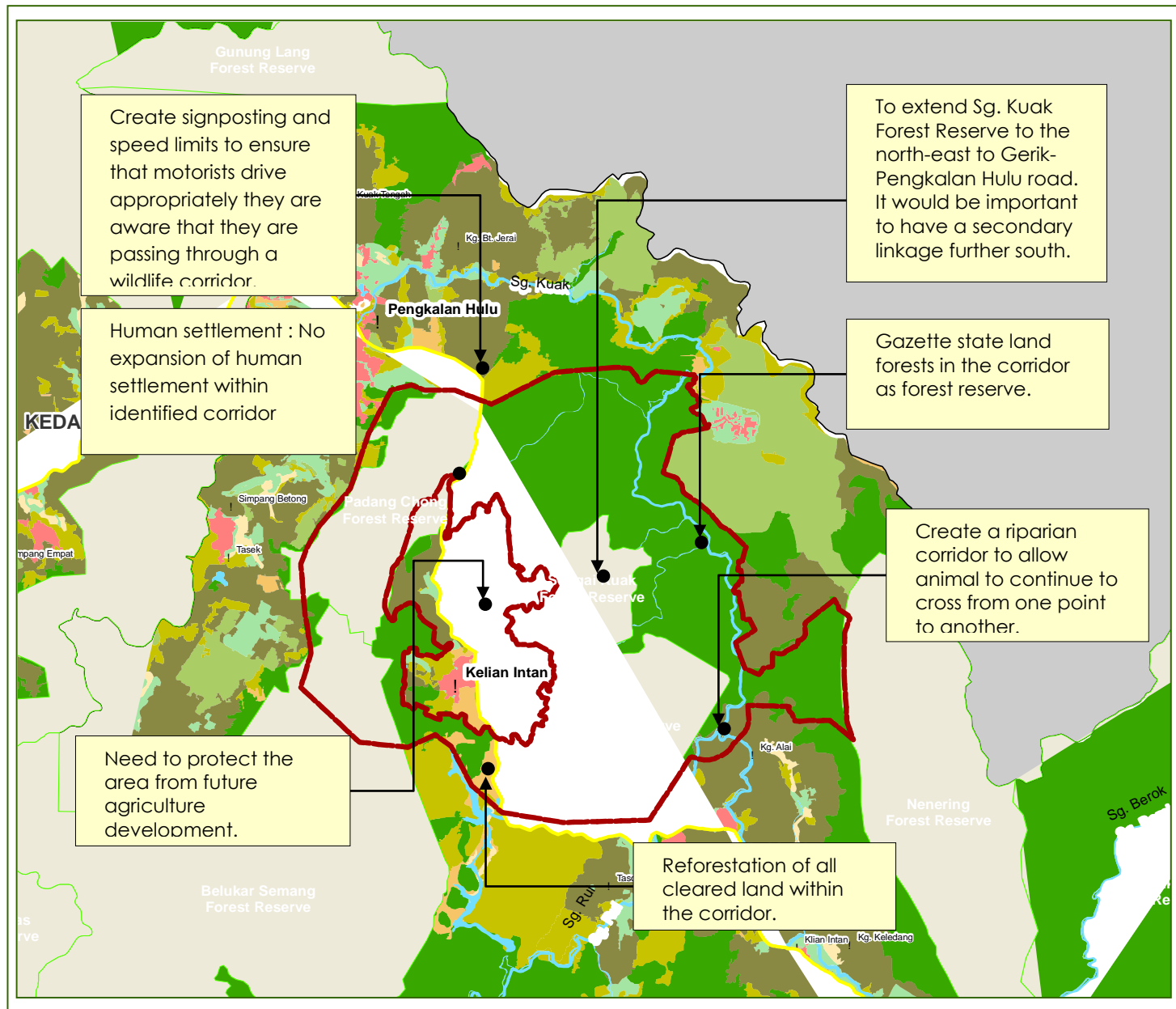


PL4: Padang Chong FR (Bintang Hijau) – Sg Kuak FR (Main Range)



<p>Description</p>	<ul style="list-style-type: none"> • The Bintang Hijau forest complex is almost entirely separated from the Main Range by the Kuala Kangsar – Gerik road, and a wide stretch of agriculture land (mostly rubber) and scattered human settlements, including Gerik and Lenggong towns along the road, except for a short stretch in the northern end of the complex. The nearer town from PL4 is Kelian Intan and Pengkalan Hulu. In addition, there are scrub land, cleared land and rubber plantations within this corridor. • Along a narrow stretch of the Gerik – Pengkalan Hulu road (particularly around Kelian Intan) the Padang Chong FR (Bintang Hijau range) extends all the way to the road. To the east of the road, there is still (logged over) state land forest remaining between the road and Sungai Kuak FR on the Main Range. • Most of the area consists of steep and unsuitable for agriculture. However it may be possible to plant rubber through terracing. • The Bintang Hijau complex is an important habitat for large mammals including the Asian elephant, Malayan tapir, Malayan tiger, as well as all of the wild cat and civet species. It is found to be a suitable habitat for Marbled cat which is rarest among the small cats in the Peninsular, and the type locality of Malayan Mountain spiny rat (<i>Maxomys Inas</i>).
<p>Threat / Constraints</p>	<ul style="list-style-type: none"> • Expansion of agriculture/settlements along the Stateland forests between Sungai Kuak and Padang Chong forest reserves. • Part of the linkage is now planted with rubber. • The area has been proposed under the State Structure Plan for the development of Ladang Mesra Rakyat Perak (LMRP) ie covering Lembang, Nenering, Tanjung Kala, Ulu Kenderong, Bersia Lama, Temenggong, Sumpitan and Temelong, possibly for the planting of rubber.
<p>Implementation Strategy</p>	<p><u>Gazettelement of Forest Reserve and Reforestation</u></p> <ol style="list-style-type: none"> 1. Extend Sg Kuak Forest Reserve to the north-east to the Gerik – Pengkalan Hulu road. It would be important to have a secondary linkage further south. (See SL3). 2. Gazette state land forests in the corridor as forest reserve 3. Reforest all cleared land within the corridor. <p><u>Create Riparian Corridor</u></p> <ol style="list-style-type: none"> 4. Create a riparian corridor to allow animal to continue to cross from one point to another. <p><u>Establish Wildlife Crossing</u></p> <ol style="list-style-type: none"> 5. Create signposting and speed limits to ensure that motorists drive appropriately and are aware that they are passing through a wildlife corridor. <p><u>Land Use Management Control</u></p> <ol style="list-style-type: none"> 6. Need to protect the area from future agriculture development. 7. If the proposed development of the Ladang Mesra Rakyat is implemented then its implementation should follow strictly the guidelines as outlined in 'Guidelines for Sustainable Agricultural Management of Plantations'. 8. Human settlement: No expansion of human settlement within identified corridor.
<p>Expected Benefits</p>	<ul style="list-style-type: none"> • Establish a link to enable movement of large mammals between this forest complex and the Main Range/Belum.

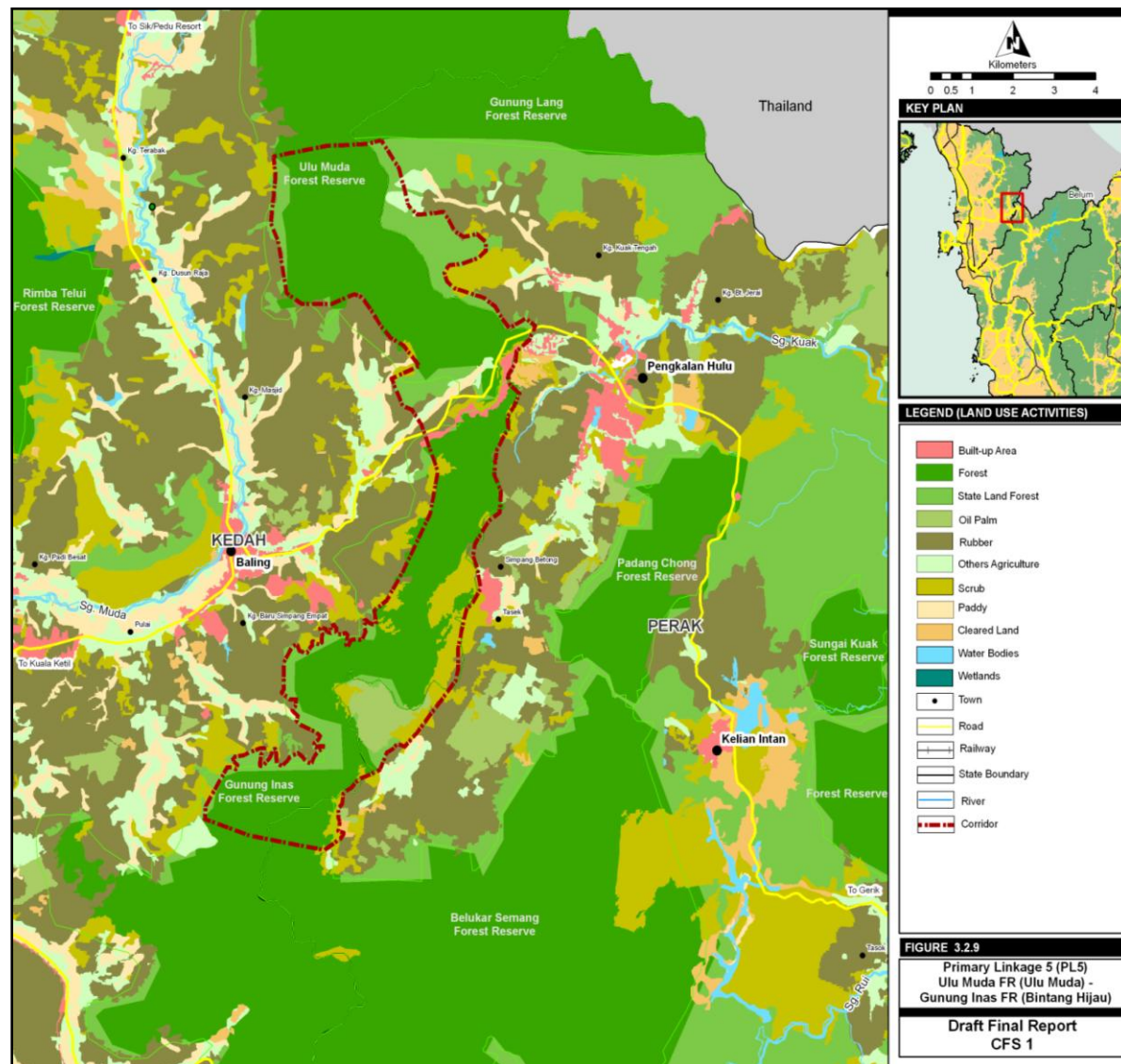
Figure 3.2.8: Implementation Strategy Plan - CFS1-PL4 : Padang Chong FR (Bintang Hijau) – Sg Kuak FR (Main Range)



PL5 : Ulu Muda FR (Ulu Muda) – Gunung Inas FR (Bintang Hijau)

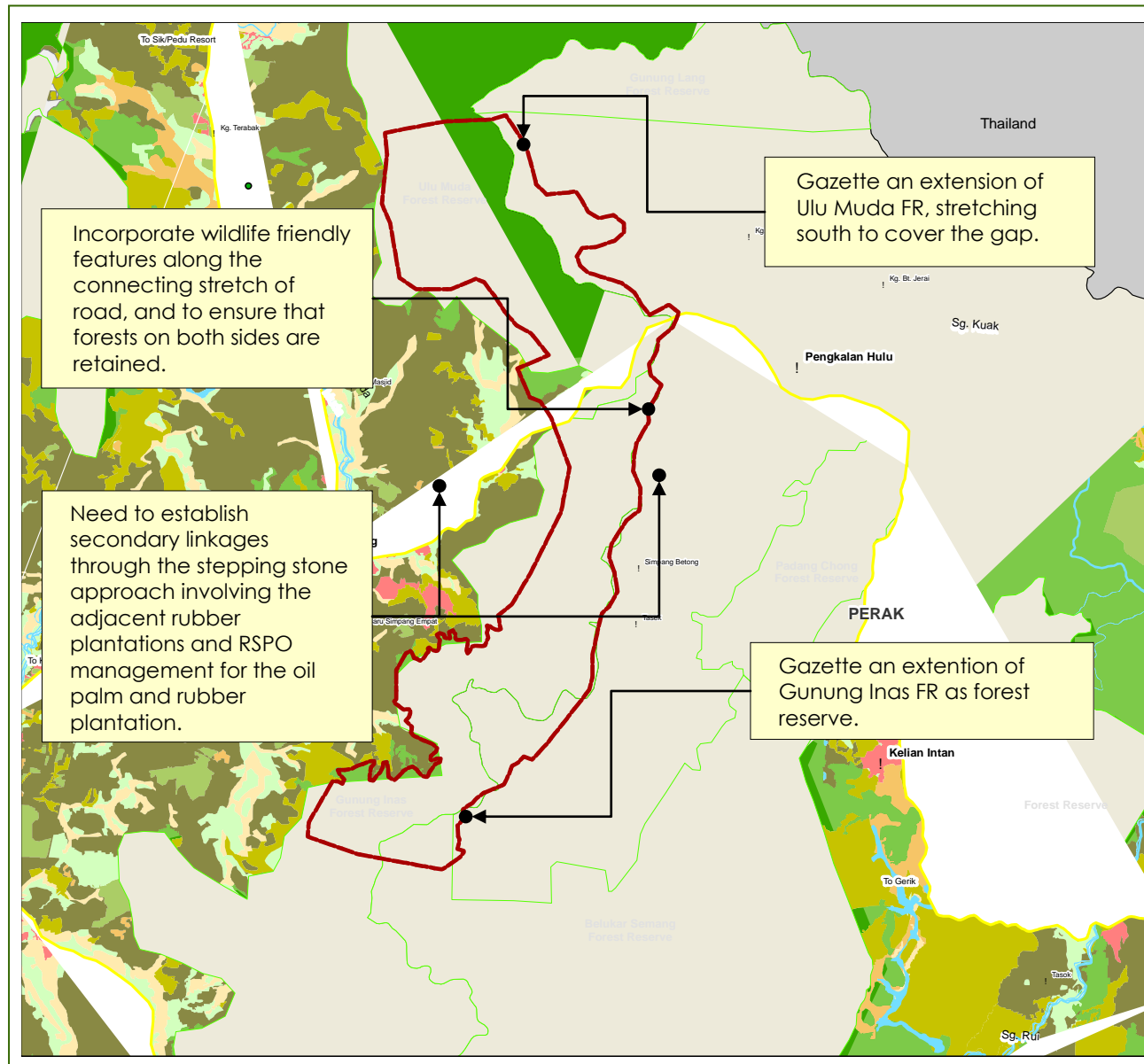
Location	
State	Kedah
District	Baling
Mukim	Baling
Area	4,635ha

Priority Justification	
-	Enable connection between Ulu Muda and Bintang Hijau forest complexes.
-	Water catchment area for Muda, Pedu and Ahning dams.
-	Important habitat for large mammals (Asian elephant, Malayan tiger, Seladang, Malayan tapir) and hornbills (especially Plain-pouched Hornbill).

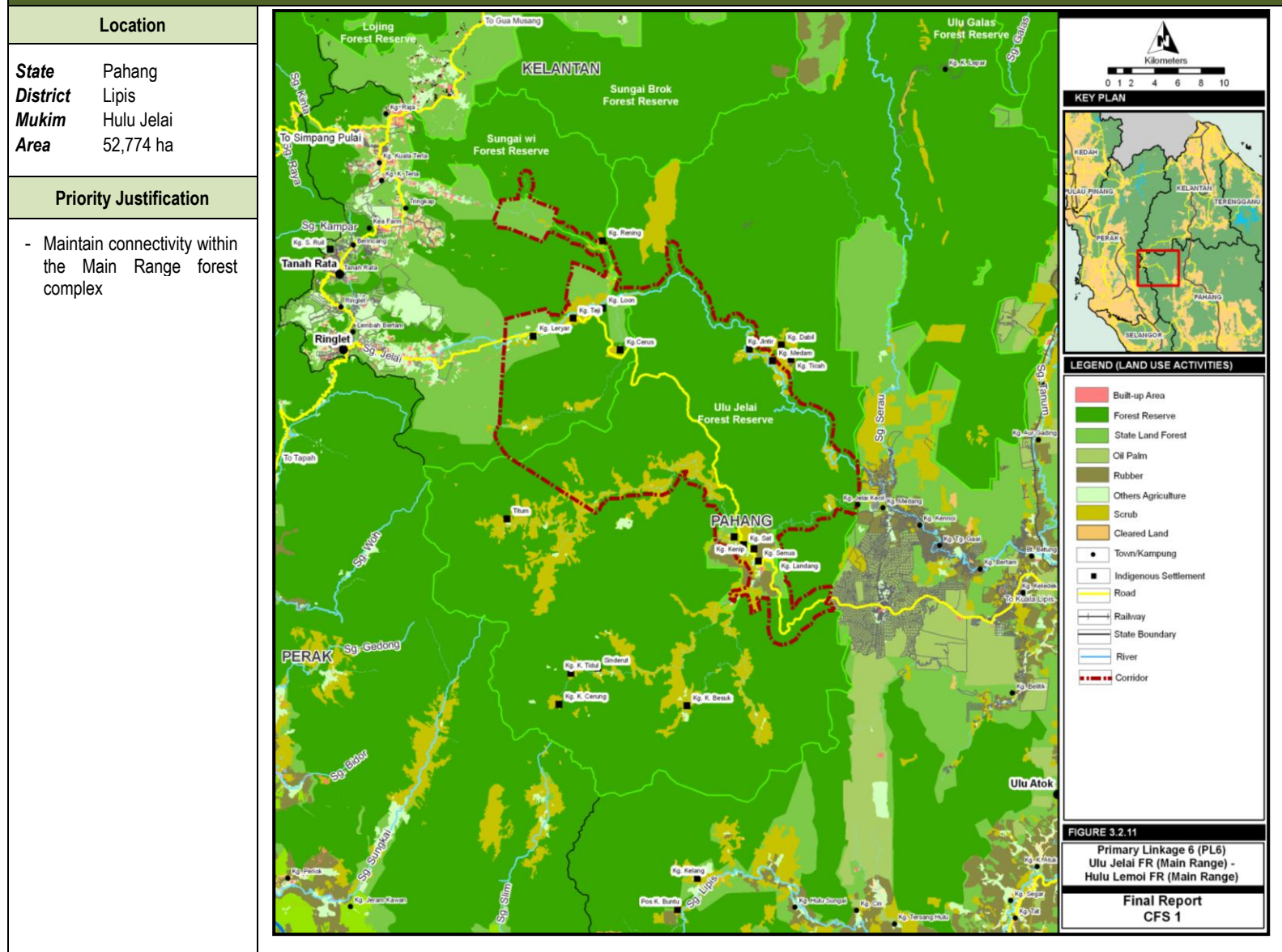


<p>Description</p>	<ul style="list-style-type: none"> • The Greater Ulu Muda Forest Complex is connected to the Bintang Range by a very narrow bottleneck less than 100m wide, which is situated along the R5/U5 road linking Baling in Kedah with Pengkalan Hulu in Perak. The forest is almost entirely on the Kedah side of the border with the Ulu Muda Forest Reserve to the north adjoining the Gunung Inas Forest Reserve to the south. • PL5 is on the west of PL4 and north of PL8. Around this corridor, there are paddy, oil palm and rubber plantations. • Six species of primates including two species of gibbons - White-handed gibbon and Agile gibbon can be found here. • There is also a large variety of birds, many of which can only be found in the north of the Peninsular. Ulu Muda is the second location in Malaysia where the Plain-pouched Hornbill (listed as 'Vulnerable' by IUCN) is found. It is reported recently that this population is the first breeding population found in Malaysia.
<p>Threat / Constraints</p>	<ul style="list-style-type: none"> • The location where the two forest reserves meet is only 100m wide at the top of a ridge and is bisected by the Baling - Pengkalan Hulu road. The actual forest cover at this point has been heavily disturbed by activities and land clearing along the road reserve. Furthermore, there are several sections of Gunung Inas FR that are also very narrow (<300 m at one point). These sections have the potential to become severe bottlenecks in future if the adjoining state-land forest is cleared. • A major constraint is the settlement areas which seem to stretch all along the corridor.
<p>Implementation Strategy</p>	<p><u>Gazettelement of Forest Reserve</u></p> <ol style="list-style-type: none"> 1. Gazette an extension of Ulu Muda FR, stretching south to cover the gap. 2. Gazette an extension of Gunung Inas FR as protected forest. <p><u>Establish Wildlife Crossing</u></p> <ol style="list-style-type: none"> 3. Incorporate wildlife friendly features along the connecting stretch of road, and to ensure that forest cover on both sides is retained. <p><u>Land Use Management Control</u></p> <ol style="list-style-type: none"> 4. Establish secondary linkages through the stepping stone approach involving the adjacent rubber plantations and implement best management practices (RSPO) for the oil palm and rubber plantations.
<p>Expected Benefits</p>	<ul style="list-style-type: none"> • Facilitate wildlife crossings • Improved biodiversity protection • Enable exchange of genetic material between flora and fauna population within the Greater Ulu Muda Forest Complex and the Main Range Forest Complex.

Figure 3.2.10 : Implementation Strategy Plan - CFS1-PL 5 : Ulu Muda FR (Ulu Muda) – Gunung Inas FR (Bintang Hijau)

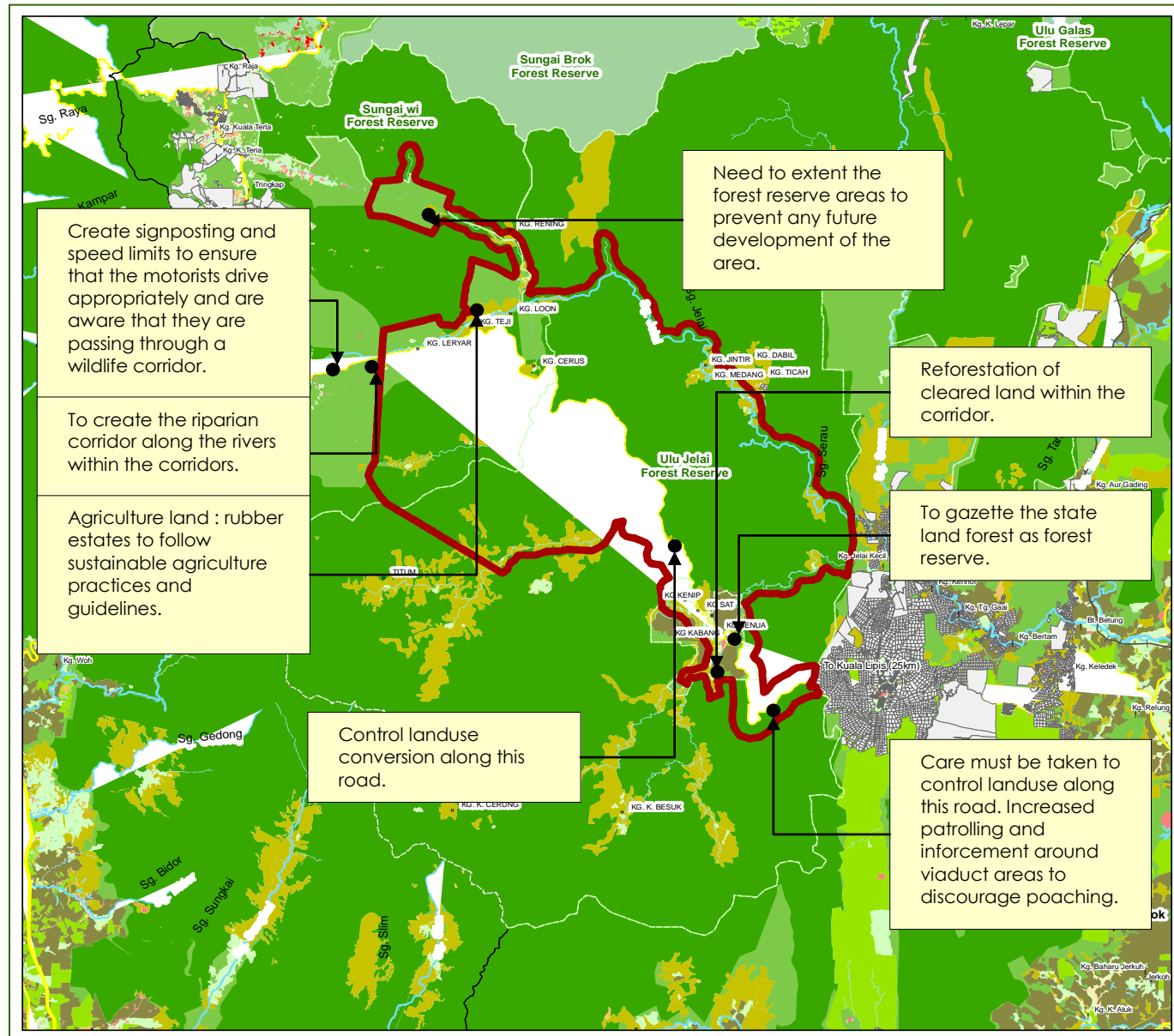


PL6 : Ulu Jelai FR (Main Range) – Hulu Lemoi FR (Main Range)



<p>Description</p>	<ul style="list-style-type: none"> • The Tapah – Ringlet road, and the newly constructed Ringlet – Kuala Lipis road are the main linear barriers within this section of the Main Range. However, a number of viaducts were incorporated in the design of the new road, and these may also be useful for wildlife. • The area is a highland area east of Cameron Highlands. • Area consists of forest land that has been partially logged over (productive forest). Thus presence of scrubs (semak/ belukar) and regenerated forest. • So far no agricultural development is present due to the inaccessibility of the area. • Sg. Medang Homestay, a popular homestay destination is located within the vicinity. Telom River, which traverses from Cameron Highland to Kuala Lipis is also popular among white water rafters for its existing rapids. Many Orang Asli settlements are located along the river.
<p>Threat / Constraints</p>	<ul style="list-style-type: none"> • Agriculture development along the road in the corridor. • There is poaching activity within the forest reserve. • Threats to water quality of Telom River, an eco-tourism resource within the Kuala Lipis District • Future encroachment of agricultural development into the area due to the recently completed road joining Cameron Highlands to Sg. Koyan in Kuala Lipis.
<p>Implementation Strategy</p>	<p><u>Gazettelement of Forest Reserve and Reforestation</u></p> <ol style="list-style-type: none"> 1. Need to extent the forest reserve areas to prevent any future development of the area. 2. Reforestation of cleared land within the corridor. 3. Gazette the state land forest as Forest Reserve. <p><u>Establish Wildlife Crossing</u></p> <ol style="list-style-type: none"> 4. Care must be taken to control land use along this road. Increase patrolling and enforcement around viaduct areas to discourage poaching. 5. Create signposting and speed limits to ensure that motorists drive appropriately and are aware that they are passing through a wildlife corridor. <p><u>Create Riparian Corridor</u></p> <ol style="list-style-type: none"> 6. Create the riparian corridor along the rivers within the area. <p><u>Land Use Management Control</u></p> <ol style="list-style-type: none"> 7. Agriculture land: rubber estates to follow sustainable agricultural practices and guidelines. 8. Control land use conversion along this road.
<p>Expected Benefits</p>	<ul style="list-style-type: none"> • Facilitate wildlife crossings. • Improved biodiversity. • Prevent land degradation. • Enhanced ecotourism attraction of Kuala Lipis District.

Figure 3.2.12 : Implementation Strategy Plan - CFS1-PL6 : Ulu Jelai FR (Main Range) –
Hulu Lemoi FR (Main Range)

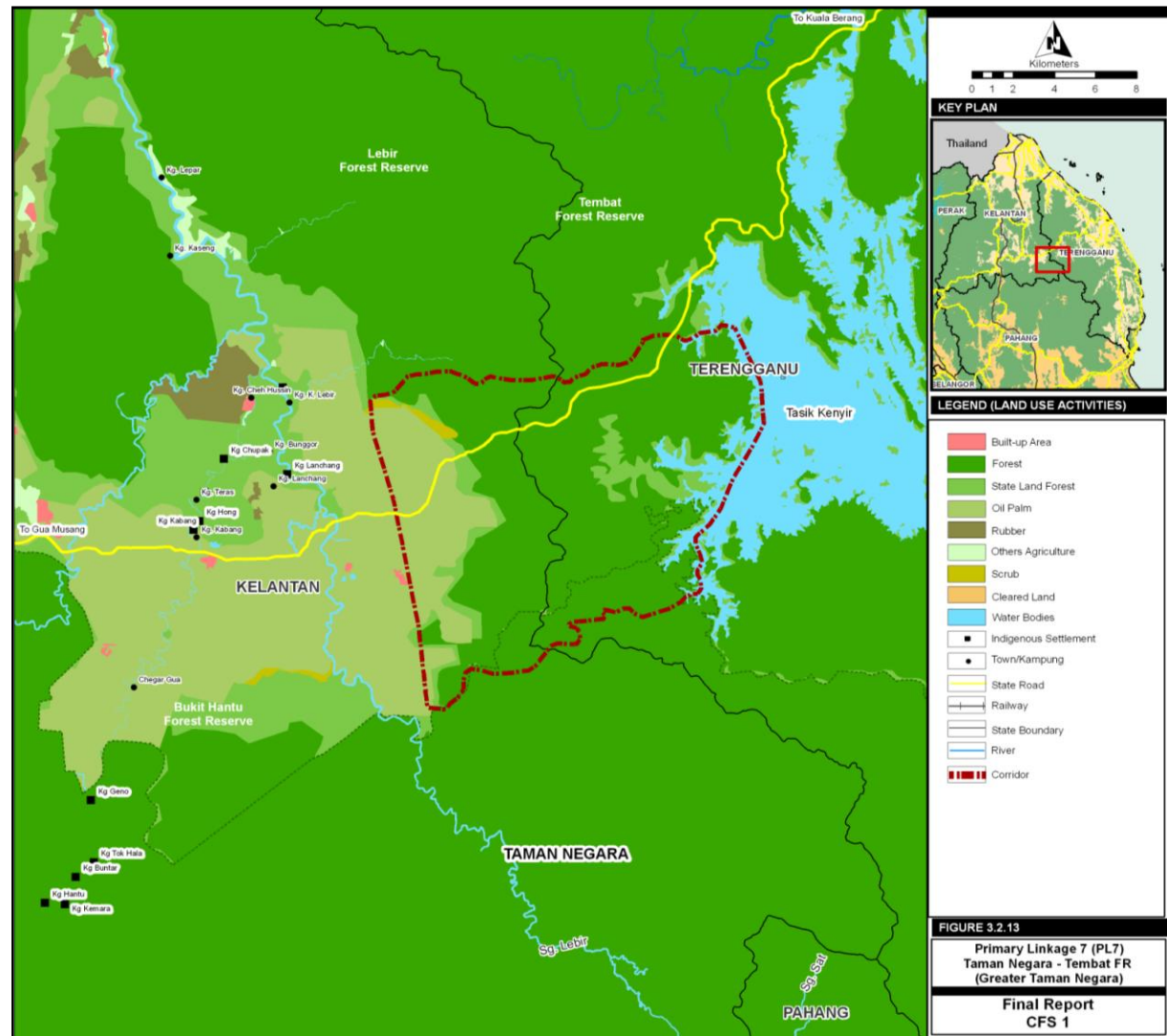


PL7 : Taman Negara – Tembat FR (Greater Taman Negara)

Location	
State	Terengganu / Kelantan
District	Hulu Terengganu / Gua Musang
Mukim	Hulu Terengganu / Chiku
Area	29,411ha

Priority Justification

-Maintain connection between Taman Negara and Tembat Forest Reserve.



<p>Description</p>	<ul style="list-style-type: none"> The Taman Negara – Tembat FR linkage is important, as Tembat and the adjoining forest reserves represent a large habitat to the north of Taman Negara. The second East-West highway presently divides the Greater Taman Negara landscape separating the core Taman Negara area from the extensive forests along the Terengganu-Kelantan border. While the impact of this highway has been somewhat mitigated by the construction of three viaducts along the new Gua Musang - Kuala Berang road to allow animals to pass underneath, it is essential that the forested landscape at this location remains contiguous. Thus far, no encroachment of agriculture has been detected in the area in Terengganu portion of the area. In the Kelantan side, however, due to the development of the Gua Musang-Kuala Berang Highway, vast areas of land are now opened for oil palm plantations. Located near to Taman Negara Kuala Koh and Tasik Kenyir. The Sg. Ketiar Elephant Sanctuary has been developed along the road as an ecotourism destination. It is also noted that a major portion of the PL within Terengganu is proposed to be a wildlife reserve (Refer figure 3.2.1)
<p>Threat / Constraints</p>	<ul style="list-style-type: none"> There is a high possibility that the integrity of the Tembat forest island may be affected in the future, as there is a proposal for a hydroelectric dam at Tembat FR (the DEIA is open for public review at the time of study), and a water resource dam was proposed at Lebir FR under the National Water Resources Plan 2000-2050. The forests in Lebir FR on the Kelantan side of the border have recently been cleared, the purpose of which is not known. On the Terengganu side, a narrow bottleneck has been created by Tasik Kenyir which leaves a relatively narrow (2-5 km) stretch of dry land forest between the waters' edge and the Kelantan border. Further threat of oil palm plantation development in the Terengganu side and the development in Kelantan.
<p>Implementation Strategy</p>	<p><u>Gazette and Maintenance of Forest Reserve</u></p> <ol style="list-style-type: none"> It is particularly important that the Lebir Forest Reserve remains protected and is not excised further for oil palm plantations or other development. Gazette state land near the Lebir FR to be as Forest Reserve. <p><u>Establish Wildlife Crossing</u></p> <ol style="list-style-type: none"> Create signposting and speed limits to ensure that motorists drive appropriately and are aware that they are passing through a wildlife corridor. <p><u>Land Use Management Control</u></p> <ol style="list-style-type: none"> No development activity should be permitted along the dry land forest between the Tasik Kenyir waters' edge and the Kelantan border stretch. Promote the corridor as part of the ecotourism destination of Taman Negara Kuala Koh and Kenyir Lake. Follow sustainable agricultural practices and guidelines (RSPO) for oil palm estates and rubber smallholdings.

<p>Expected Benefits</p>	<ul style="list-style-type: none"> • Enhance connectivity between Taman Negara and the Tempat Forest Reserves within the Greater Taman Negara Forest Complex allowing the movement of elephants and other large mammals. • Enhance the attractions of the national ecotourism destination of Kenyir Lake and Taman Negara National Park (Kuala Koh) through the provision of tourism facilities and increased awareness about the importance of biodiversity conservation in the area.
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Figure 3.2.14: Terengganu Wildlife Reserve

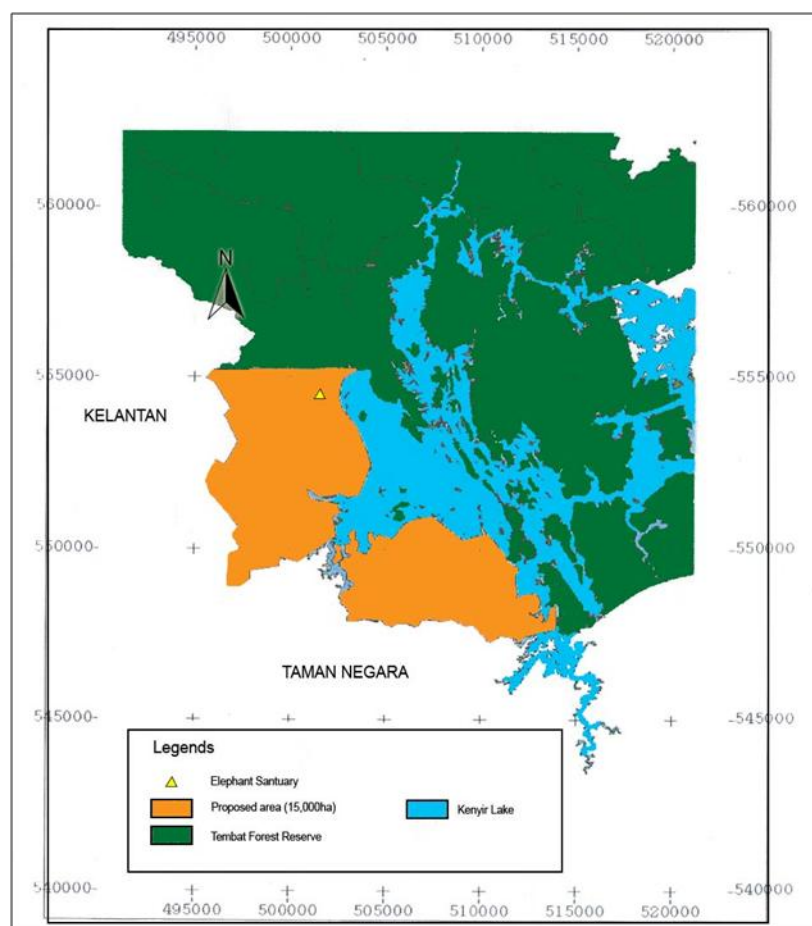
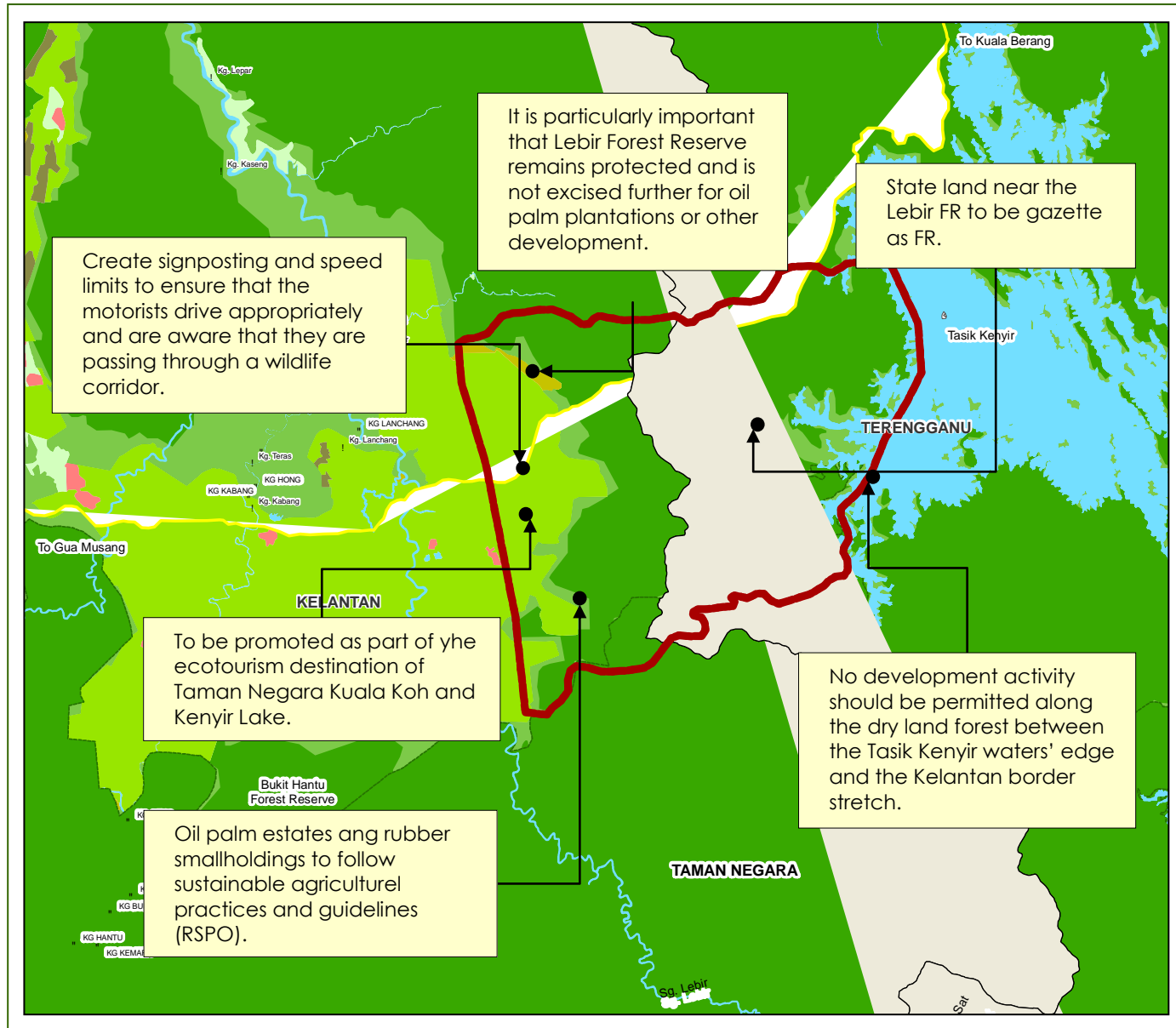
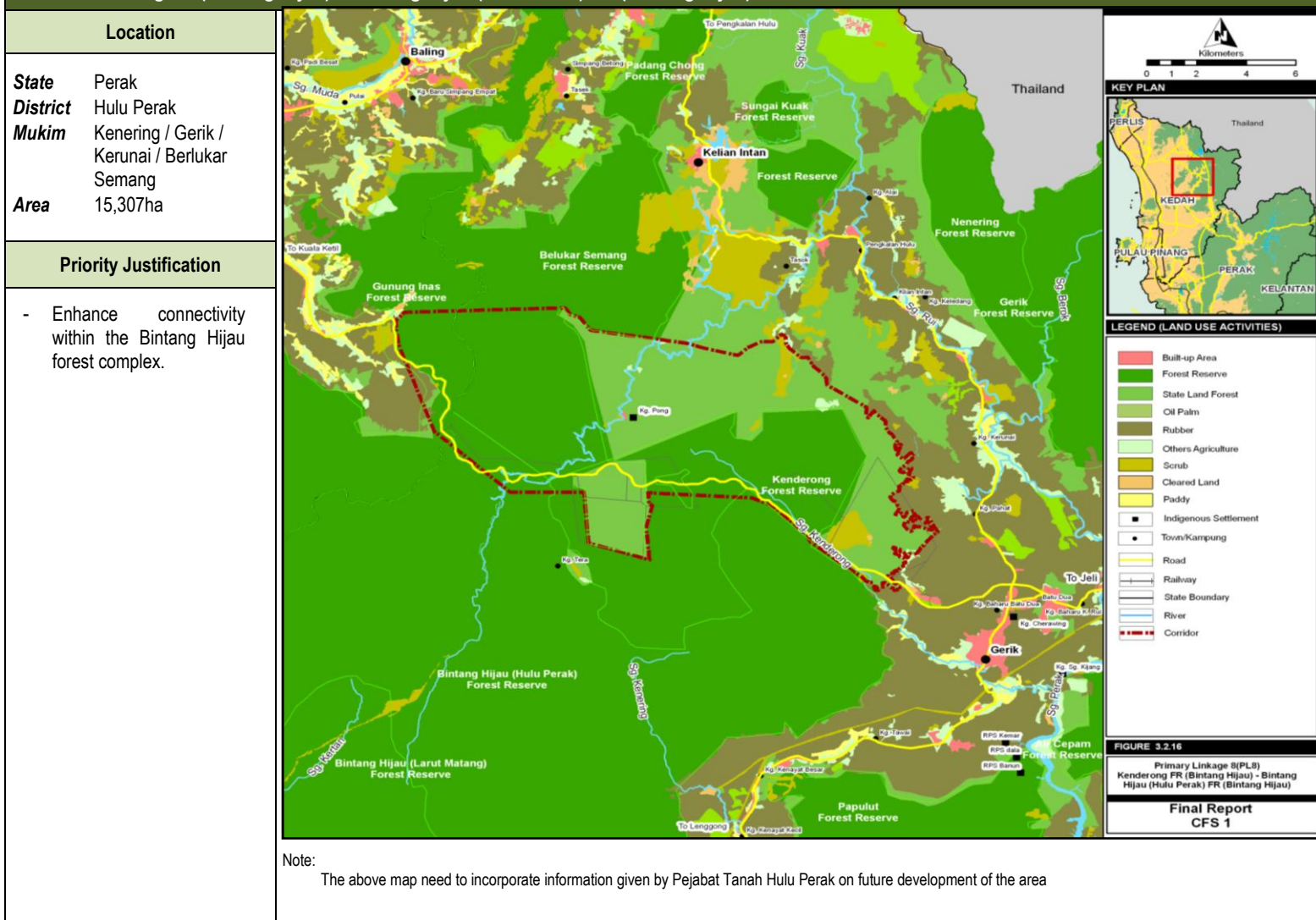


Figure 3.2.15 : Implementation Strategy Plan - CFS1-PL7: Taman Negara – Tembat FR (Greater Taman Negara)

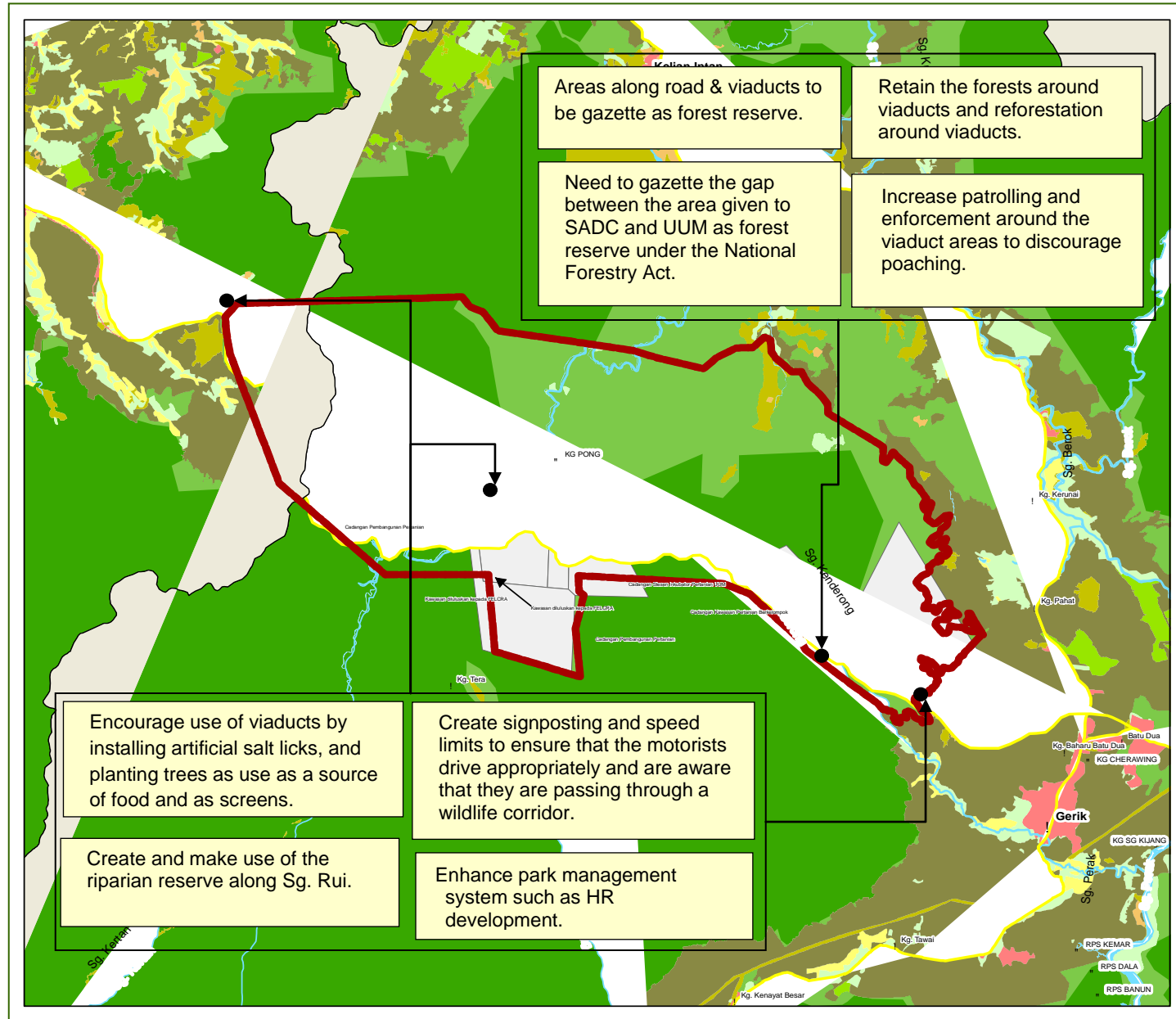


PL8 : Kenderong FR (Bintang Hijau) – Bintang Hijau (Hulu Perak) FR (Bintang Hijau)



<p>Description</p>	<ul style="list-style-type: none"> • The northern end of the Bintang Hijau is separated from the rest of the forest complex by a new highway connecting Gerik to Titi Karangan. Five viaducts were incorporated in the construction of this highway to allow for wildlife movement, and there is evidence (from the presence of elephant dung found during a site visit) to indicate that wildlife are in fact using these crossings. • Connectivity of the forests has been lost on the Larut-Matang side of the Bintang Range at this point due to encroachment up the river valley along the road inside the forest reserve. Forest at the Hulu Perak side is reasonably well connected. • At present not much agriculture activity except in the north where some rubber is planted. • Linkage is separated by a new road linking Gerik to Kuala Pegang, Kedah.
<p>Threat / Constraints</p>	<ul style="list-style-type: none"> • Alienation of forest reserves for agriculture. • A number of areas has been proposed for development along the highway linking Gerik to Kuala Pegang, Kedah between Kenderong Forest Reserve and Belukar Semang Forest Reserve. These include: <ol style="list-style-type: none"> i) SADC: 1,500 acres for rubber or oil palm plantation. ii) FELCRA: 1,500 acres for rubber or oil palm plantation iii) Universiti Utara Malaysia (UUM): 1,000 acres for Agricultural Incubator station. iv) Group Farming Projects. v) Agricultural schemes for Orang Asli.
<p>Implementation Strategy</p>	<p><u>Gazettement of Forest Reserve and Reforestation</u></p> <ol style="list-style-type: none"> 1. Gazette areas along road & viaducts as forest reserve under the NFA 1984 . 2. Gazette the gap between the area given to SADC and UUM as forest reserves under the NFA 1984. 3. Retain existing forests and carry out reforestation, where necessary, around viaducts. <p><u>Establish Wildlife Crossing</u></p> <ol style="list-style-type: none"> 4. Increase patrolling and enforcement around the viaduct areas to discourage poaching. 5. Encourage use of viaducts by installing artificial salt licks, and planting trees as a source of food and screens for wildlife. 6. Create signposting and speed limits to ensure that motorists drive appropriately and are aware that they are passing through a wildlife corridor. <p><u>Create Riparian Corridor</u></p> <ol style="list-style-type: none"> 7. Create and make use of the riparian reserve along Sg. Rui. <p><u>Land Use Management Control</u></p> <ol style="list-style-type: none"> 8. No expansion of human settlements within the corridor.
<p>Expected Benefits</p>	<ol style="list-style-type: none"> 1. Enable the connection between the Kenderong and Belukar Semang Forest Reserves within the Bintang Hijau forest complex. 2. Improved biodiversity.

Figure 3.2.17 : Implementation Strategy Plan - CFS1-PL8 : Kenderong FR (Bintang Hijau) – Bintang Hijau (Hulu Perak) FR (Bintang Hijau)

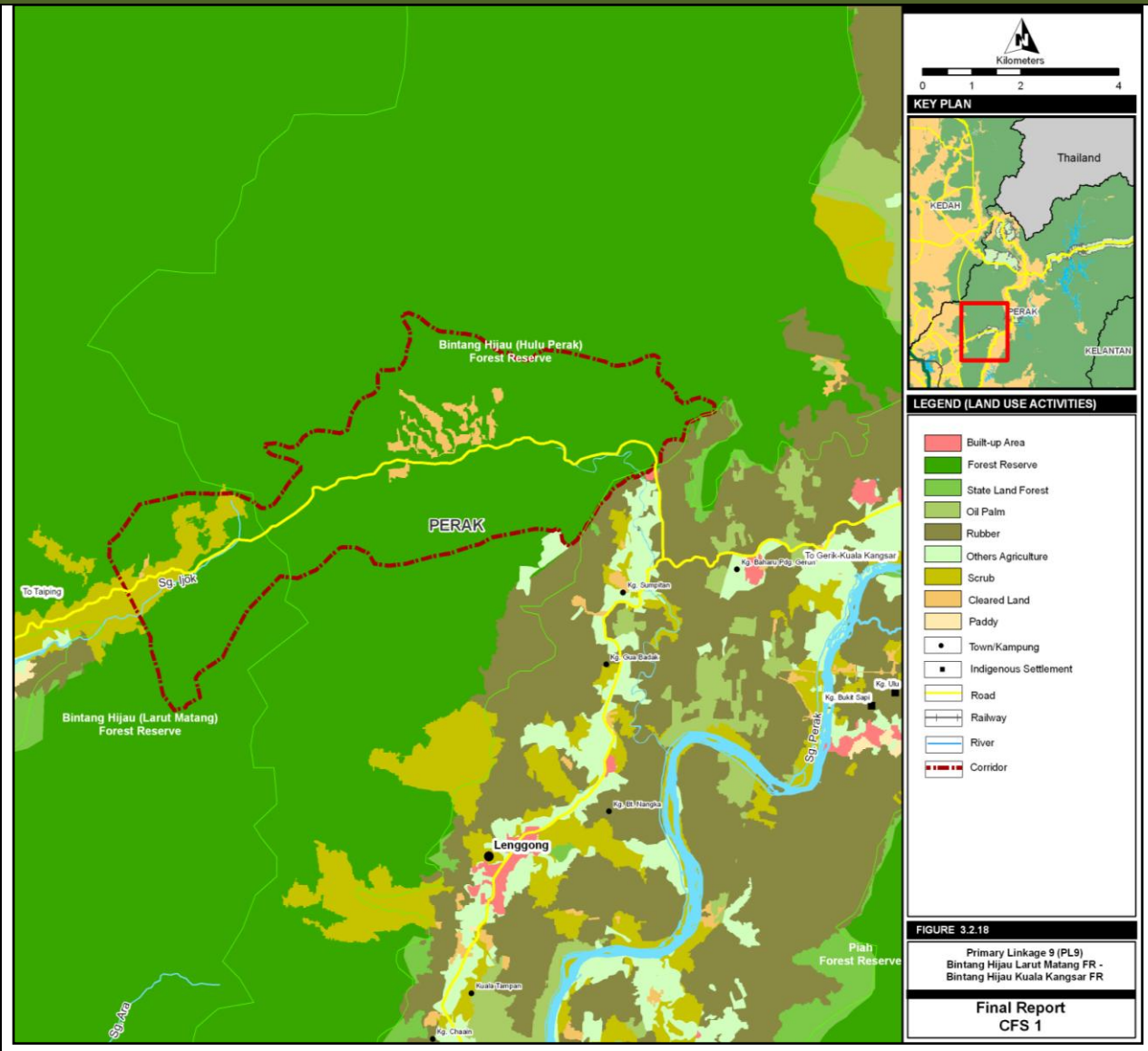


PL9 : Bintang Hijau Larut Matang FR – Bintang Hijau Kuala Kangsar FR

Location	
State	Perak
District	Hulu Perak
Mukim	Lenggong
Area	3,684 ha

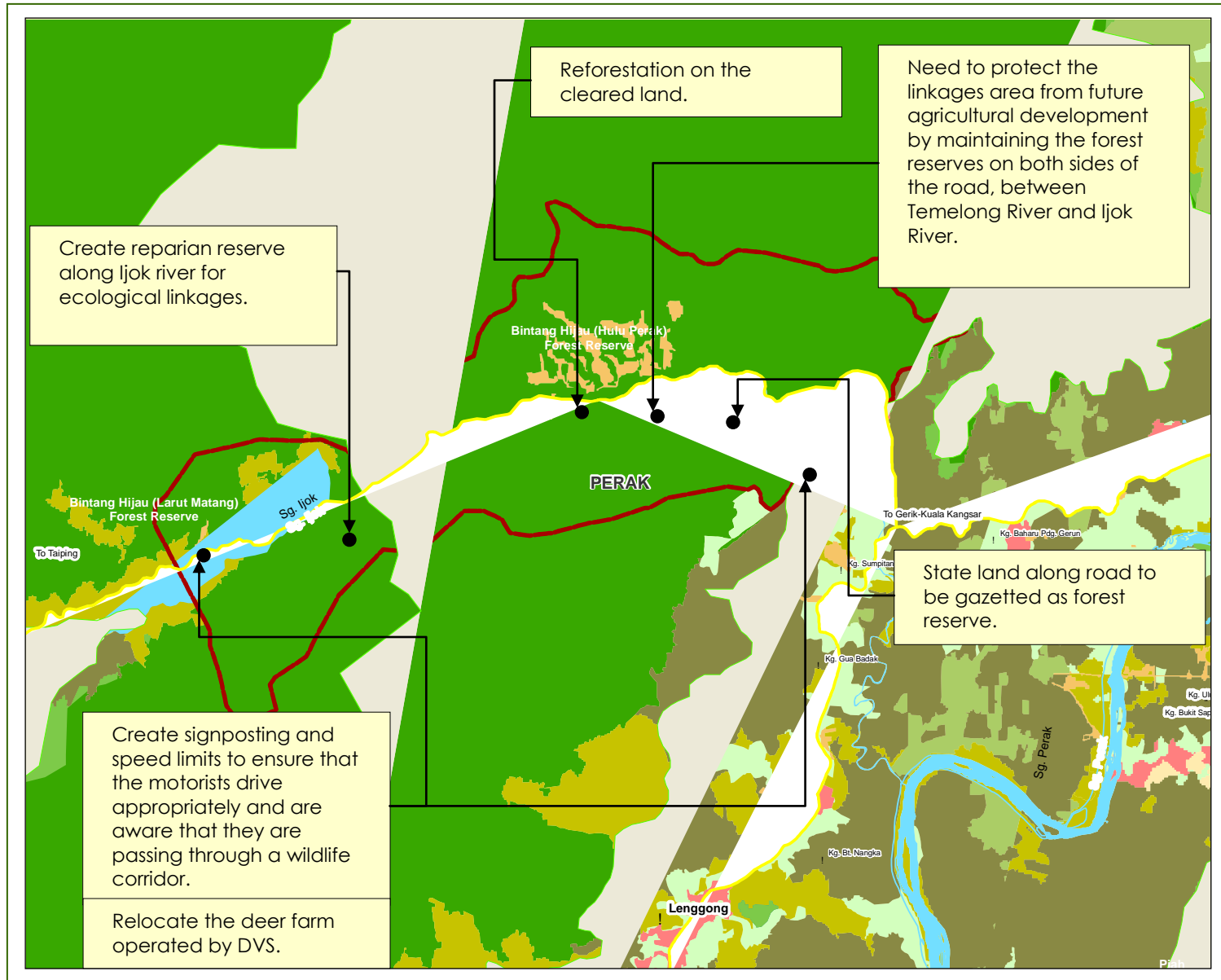
Priority Justification

- Maintain connection within the Bintang Hijau forest complex.

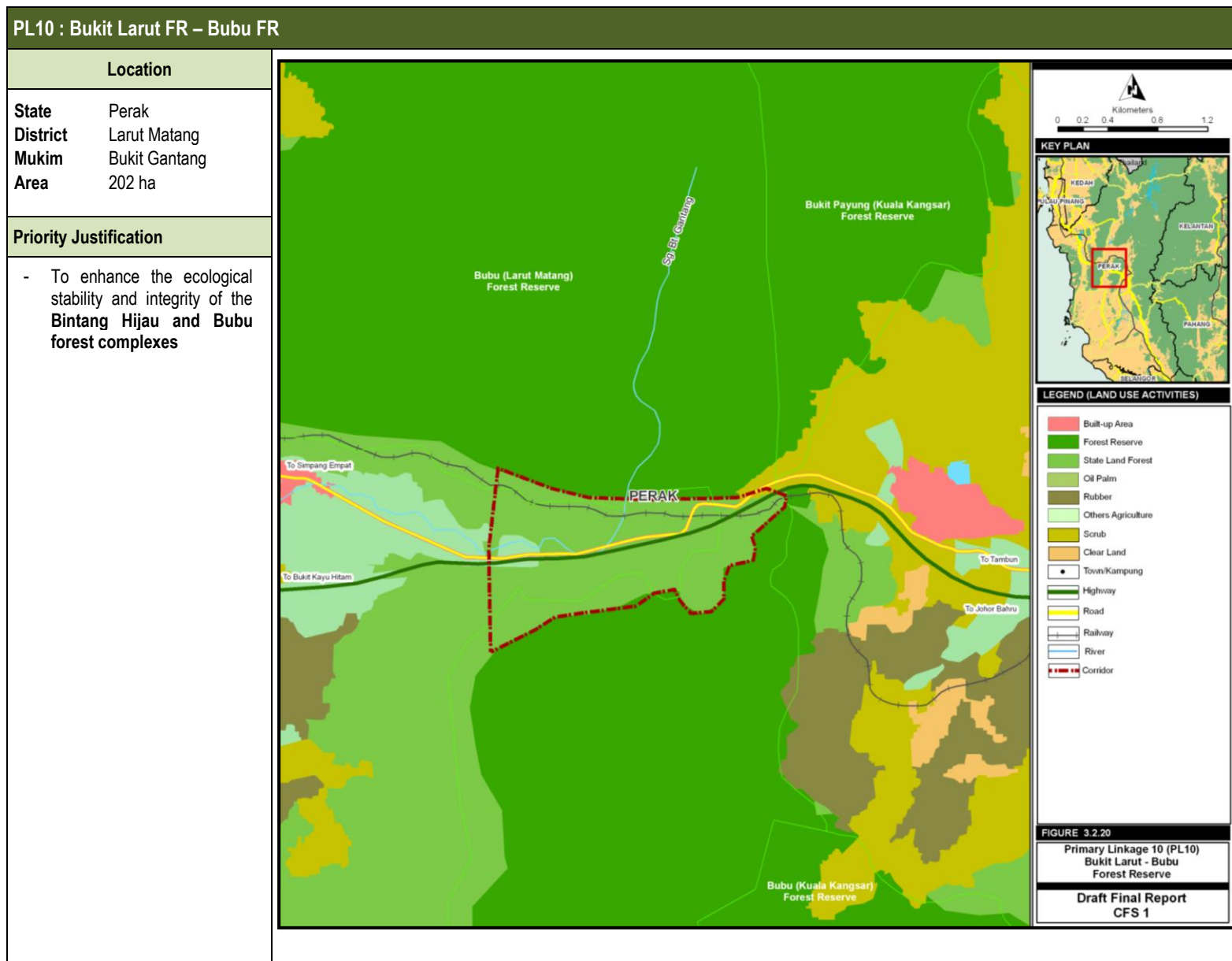


<p>Description</p>	<ul style="list-style-type: none"> The middle section of the Bintang Hijau Range is dissected by a road cutting across from Selama to Lenggong. There is still good forest cover and connection along the road between Sungai Temelong and Sungai Ijok. The only major land use (besides forest) within this stretch is the deer farm operated by Jabatan Haiwan Negeri Perak which is situated close to Sungai Temelong. The road currently only has two lanes, with the tree canopy on both sides coming close together at many points. Telephone lines that cross over the road also provide means for small arboreal mammals to cross. This is a highland area with no agricultural development within the immediate area of the linkage. PL9 is located within 50 kilometer of Chenderoh Lake (also known as Tasik Raban) which are the ecotourism attractions of Perak State.
<p>Threat / Constraints</p>	<ul style="list-style-type: none"> Expansion of agriculture development (oil palm and rubber) from the Pondok Tanjong Forest Reserve eastwards.
<p>Implementation Strategy</p>	<p><u>Gazettement of Forest Reserve and Reforestation</u></p> <ol style="list-style-type: none"> Reforest the cleared land within the area. Gazette State Land along road to be as forest reserve under the NFA 1984. Protect the linkage area from future agricultural development by maintaining the forest reserves on both sides of the road, between Sungai Temelong and Sungai Ijok. <p><u>Create Riparian Corridor</u></p> <ol style="list-style-type: none"> Create riparian reserve along Sg. Ijok for ecological linkages. <p><u>Establish Wildlife Crossing</u></p> <ol style="list-style-type: none"> Create signposting and speed limits to ensure that motorists drive appropriately and are aware that they are passing through a wildlife corridor. <p><u>Land use Management Control</u></p> <ol style="list-style-type: none"> Relocate the deer farm operated by Jabatan Haiwan Negeri Perak.
<p>Expected Benefits</p>	<ul style="list-style-type: none"> Maintained ecological connection within the Bintang Hijau forest complex. Improved biodiversity. Enhance the attraction of Chenderoh Lake ecotourism region including the proposed Chenderoh Lake Water Sports Centre of Perak State (State Structure Plan).

Figure 3.2.19 : Implementation Strategy Plan - CFS1-PL9 : Bintang Hijau Larut Matang FR – Bintang Hijau Kuala Kangsar FR



(ADDITIONAL POTENTIAL PRIMARY LINKAGES WITHIN CFS1 AREA)



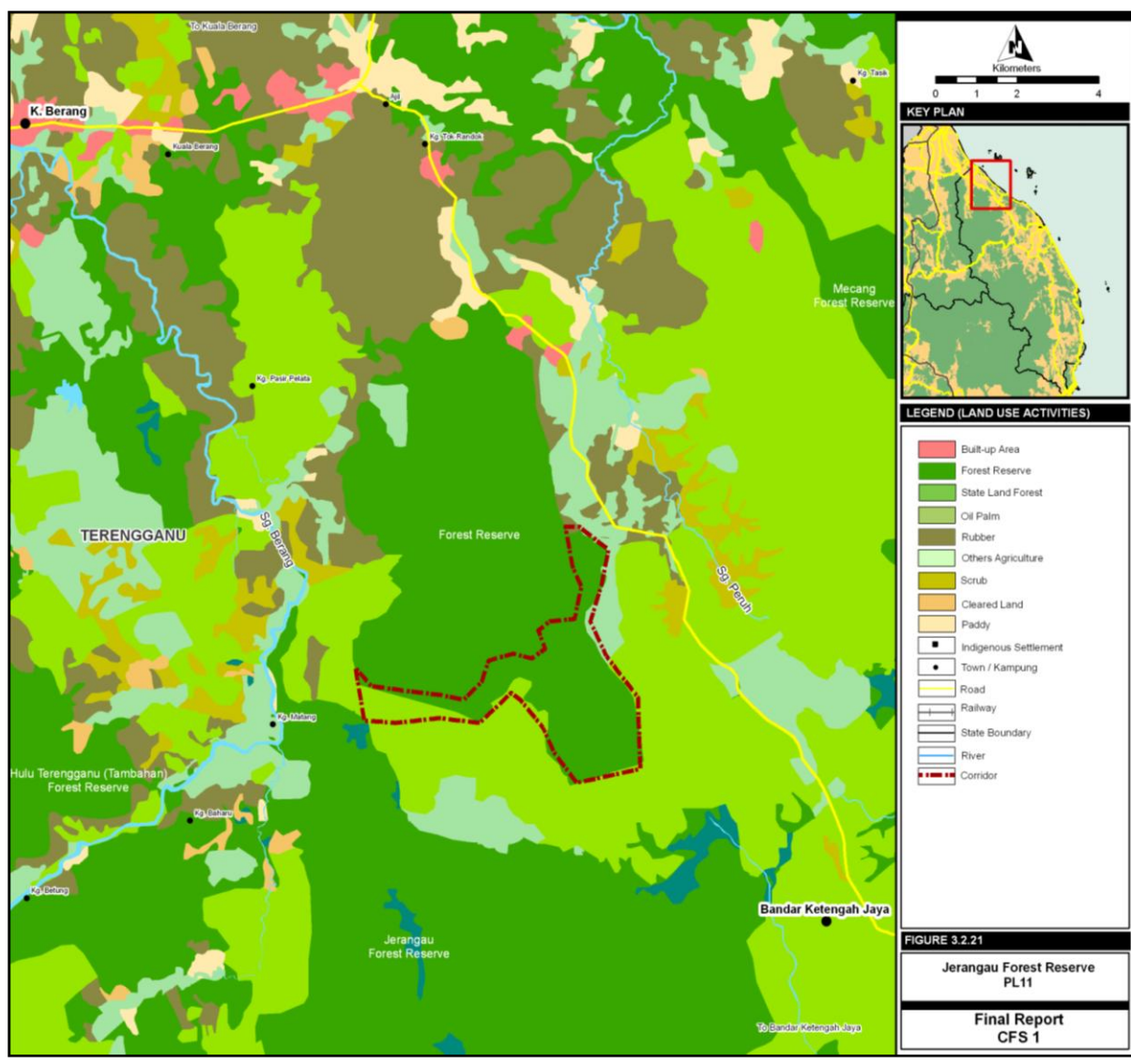
PL10 : Bukit Larut FR – Bubu FR	
Description	<ul style="list-style-type: none"> The Bubu range is a minor forest complex in Perak, south of the Bintang Range and Larut (or Taiping) Hills. The complex is almost totally isolated, except for a weak connection within a narrow valley where the Bubu Forest Reserve meets the Bukit Larut Forest Reserve. This connection consists of a narrow forested bottleneck approximately 2.5km wide where the North-South Expressway cuts between the spurs of the two the ranges, west of Sungai Perak, between Changkat Jering and Padang Rengas.
Threat/Constraints	<ul style="list-style-type: none"> Agriculture expansion is an issue, although the reason why there has not been any agriculture activity in this area is likely because of the steep slopes here.
Implementation Strategy	<p>Gazzettment and Maintenance of Forest Reserve</p> <ol style="list-style-type: none"> The existing forest reserves and stateland forests in the area should be not be converted for other land use. The Bukit Payung and Bubu Forest Reserves should be extended to both sides of the North-South Expressway. <p>Establish Wildlife Crossing</p> <ol style="list-style-type: none"> Carry out wildlife survey in the Bubu range to determine if there is a need to establish crossings for large mammals (It should be noted however that previous studies have found no signs of tigers here). When upgrading the North-South Expressway, consider incorporating a viaduct or other forms of wildllife crossing structures along this 2.5 km stretch. If the survey finds that this corridor is not important for elephants, then wildlife crossing structures could take the form of bridges or expanded culverts beneath the expressway where the many small rivers cross from the Bubu and Bintang Hijau ranges. These include the tributaries of Sg. Larah, Sg. Kg. Patut, Sg. Betong and Sg. Keledang.
Expected Benefits	<ul style="list-style-type: none"> Enable movement of large mammals, if present, in particular elephants and tapirs between possible habitats in the south and present habitats the north. Enhance the ecological stability and integrity of the Bintang Hijau and Bubu forest complexes.

PL11 : Jerangau FR – Jerangau FR

Location	
State	Terengganu
District	Dungun, Hulu Terengganu
Mukim	Penghulu Diman, Hulu Berang, Jerangau
Area	1,250 ha

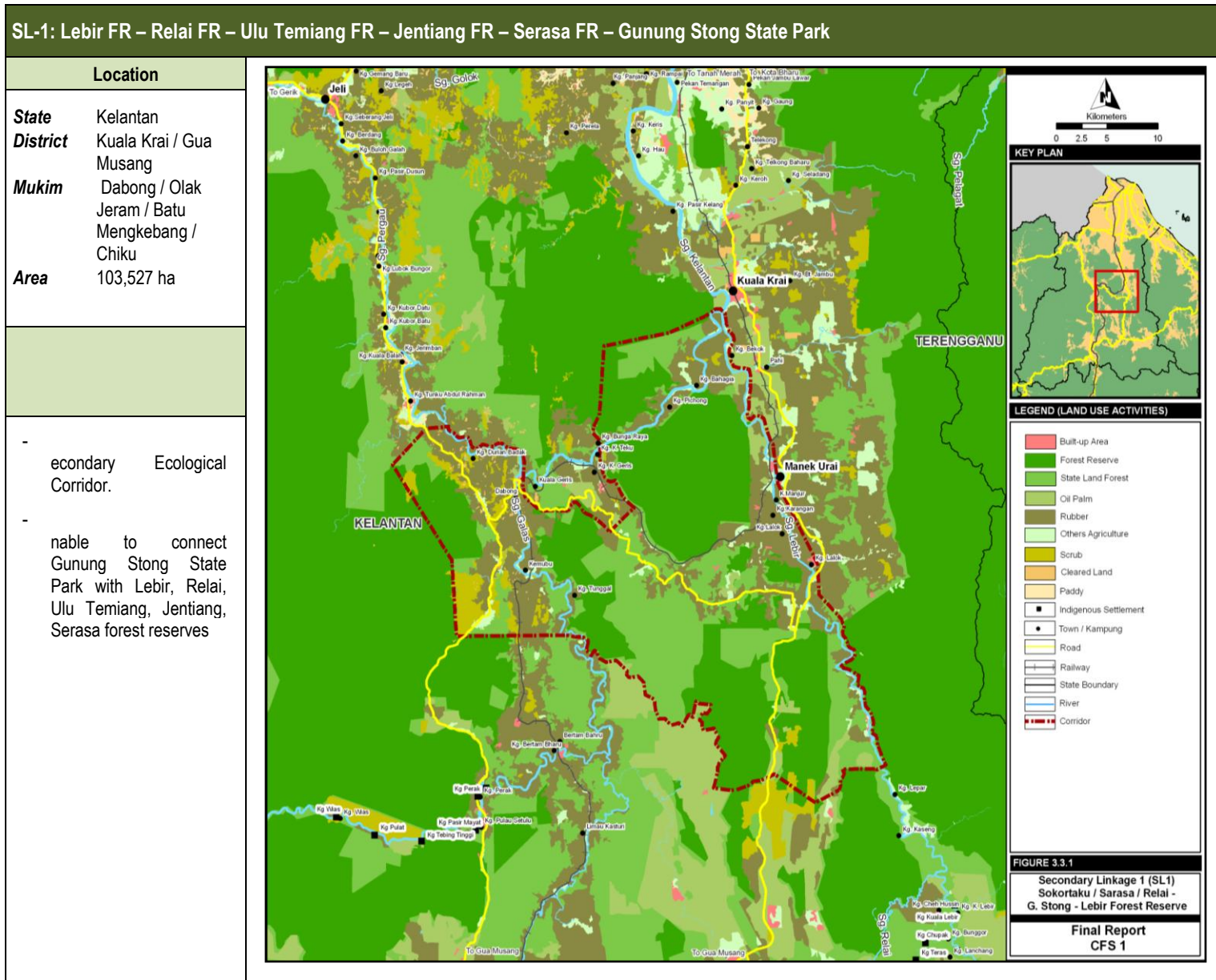
Priority Justification

- To maintain the ecological integrity of Jerangau Forest Reserve.



PL11 : Jerangau FR – Jerangau FR	
Description	<ul style="list-style-type: none"> • The northern portion of the Jerangau Forest Reserve has been cut off from the rest of the forest reserve and consequently the Greater Taman Negara forest complex. • At present, the closest distance between the isolated northern patch and the rest of the forest reserve is only around half a kilometer. • It is quite feasible and justifiable to re-establish this connection, as the distance is not too great, plus the fact that Jerangau is a known tiger habitat.
Threat/Constraints	<ul style="list-style-type: none"> • Expansion of oil palm plantation. • Opposition by locals due to previous occurrences of human-tiger conflict in the area.
Implementation Strategy	<p>Gazettment of Forest Reserve and Reforestation</p> <ol style="list-style-type: none"> 1. Gazette corridor as forest reserve. 2. Retain existing forests and carry out reforestation in the corridor. <p>Land Use Management Control</p> <ol style="list-style-type: none"> 3. No expansion of settlements or oil palm within the corridor.
Expected Benefits	<ul style="list-style-type: none"> • Maintain the size of the Greater Taman Negara forest complex. • Maintain the ecological integrity of Jerangau Forest Reserve. • Maintain the viability of Jerangau Forest Reserve as a tiger habitat.

3.3 FACT SHEET SECONDARY LINKAGES (SL)

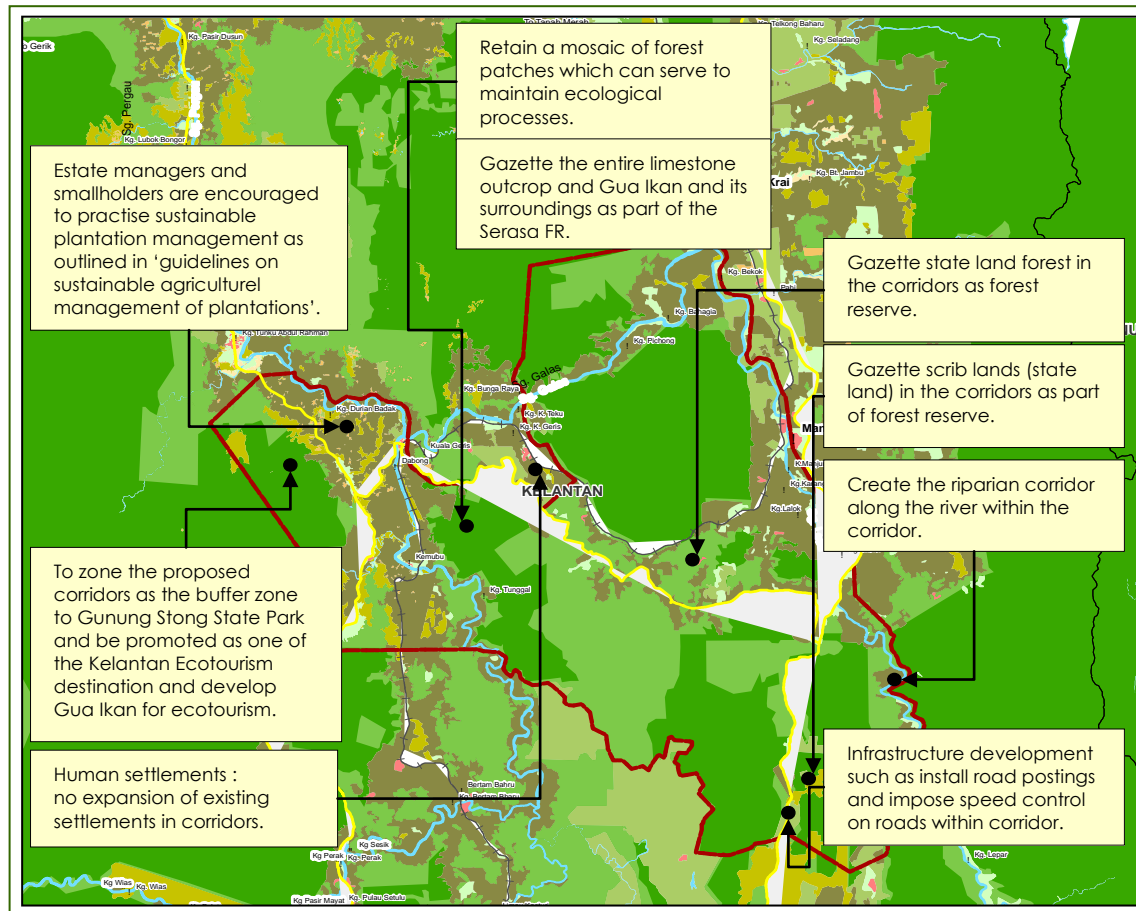


SL-1: Lebir FR – Relai FR – Ulu Temiang FR – Jentiang FR – Serasa FR – Gunung Stong State Park	
Description	<ul style="list-style-type: none"> • A sizeable part of the forests in the middle of Kelantan have been (and are being) converted to rubber and oil palm plantations. The resulting group of forest islands is thus sandwiched and isolated from the forest reserve complexes on both sides. • The linkage is located less than 10 kilometer from the Gunung Stong State Park of Kelantan with Stong Hill, Stong Waterfall and Ikan Cave as major attractions. • The two towns within the corridor are Kuala Krai Town and Dabong. All the settlement areas are along the Federal Roads 8 and 66. The settlements here are mainly villages. Railway passes through this area from Kg. Limau Kasturi- Dabong-Manek Urai- Kuala Krai. • The non-forest land use within this corridor is mainly agriculture (oil palm and rubber plantations). There are also state land forests and scrub lands. • According to DWNP, this corridor is one of the human-wildlife conflict zones in Kelantan and wildlife crossing is needed to solve this problem.
Threat / Constraints	<ul style="list-style-type: none"> • The remaining patches of forest may no longer be viable habitats for landscape species (species that require large area of natural forest to survive) in the long term, as they have been reduced significantly in size, are increasingly fragmented, and isolated among themselves and from the Greater Taman Negara and Main Range forest complexes. • There is also a development of rubber timber plantation in Mukim Telekong/Enggong in Mengkebang and Kuala Krai.
Implementation Strategy	<p><u>Gazettelement and Maintenance of Forest Reserve</u></p> <ol style="list-style-type: none"> 1. Retain a mosaic of forest patches which can serve to maintain ecological processes (energy flow and nutrient cycles), and provide viable habitats for birds and small mammals. Forest mosaic which need to be retained are Ulu Temiang FR, Jentiang FR, the forests south of the Chiku – Dabong road, from Relai FR to Serasa FR and finally across the Pergau river to Gunung Stong State Park in the west. 2. Gazette the entire limestone outcrop and the Dabong Caves, including Gua Ikan, and its surroundings as part of the Serasa FR. 3. Gazette state land forests in the corridor as forest reserve. 4. Gazette scrub lands (state land) in the corridor as part of forest reserve. <p><u>Establish Wildlife Crossing</u></p> <ol style="list-style-type: none"> 5. Install road sign postings and impose speed control on roads within corridor. <p><u>Create Riparian Corridor</u></p> <ol style="list-style-type: none"> 6. Create the riparian corridor along the river within the corridor. <p><u>Land Use Management Control</u></p> <ol style="list-style-type: none"> 7. Estate managers and smallholders are encouraged to practice sustainable plantation management as outlined in 'Guidelines on Sustainable Agricultural Management of Plantations' to ensure plantations provide suitable micro-climate for wild-life especially small mammals. 8. Zone the proposed corridor as the buffer zone to Gunung Stong State Park and promoted it as one of the Kelantan's ecotourism destinations and capitalise the potential of the Dabong Caves for eco tourism. 9. Adopt a landscape-level planning approach whereby a matrix of forest and agriculture land-use coexists to maintain landscape heterogeneity as stepping stones for wildlife and bio-diversity. 10. No expansion of existing human settlements in the corridor.

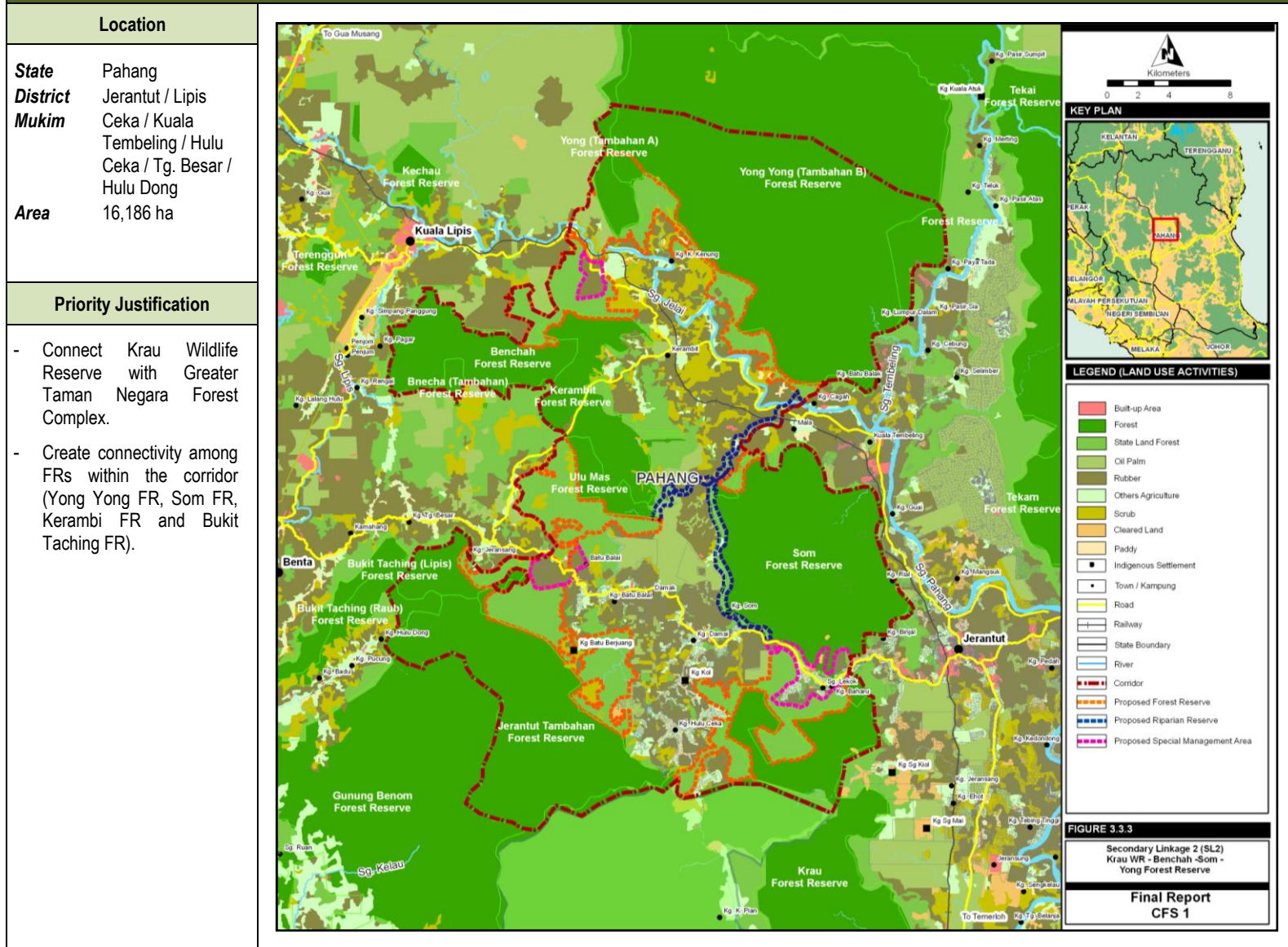
SL-1: Lebir FR – Relai FR – Ulu Temiang FR – Jentiang FR – Serasa FR – Gunung Stong State Park

<p>Expected Benefits</p>	<ul style="list-style-type: none"> • Ensure the viability and integrity of Gunung Stong State Park, and ecological linkages between Main Range and Greater Taman Negara Landscape. • Enhanced ecotourism attraction within the Dabong area and ecotourism participation among locals. • Reduce human-wildlife conflicts within the corridor.
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Figure 3.3.2: Implementation Strategy Plan - CFS1-SL1 : Lebir FR – Relai FR – Ulu Temiang FR – Jentiang FR – Serasa FR – Gunung Stong State Par



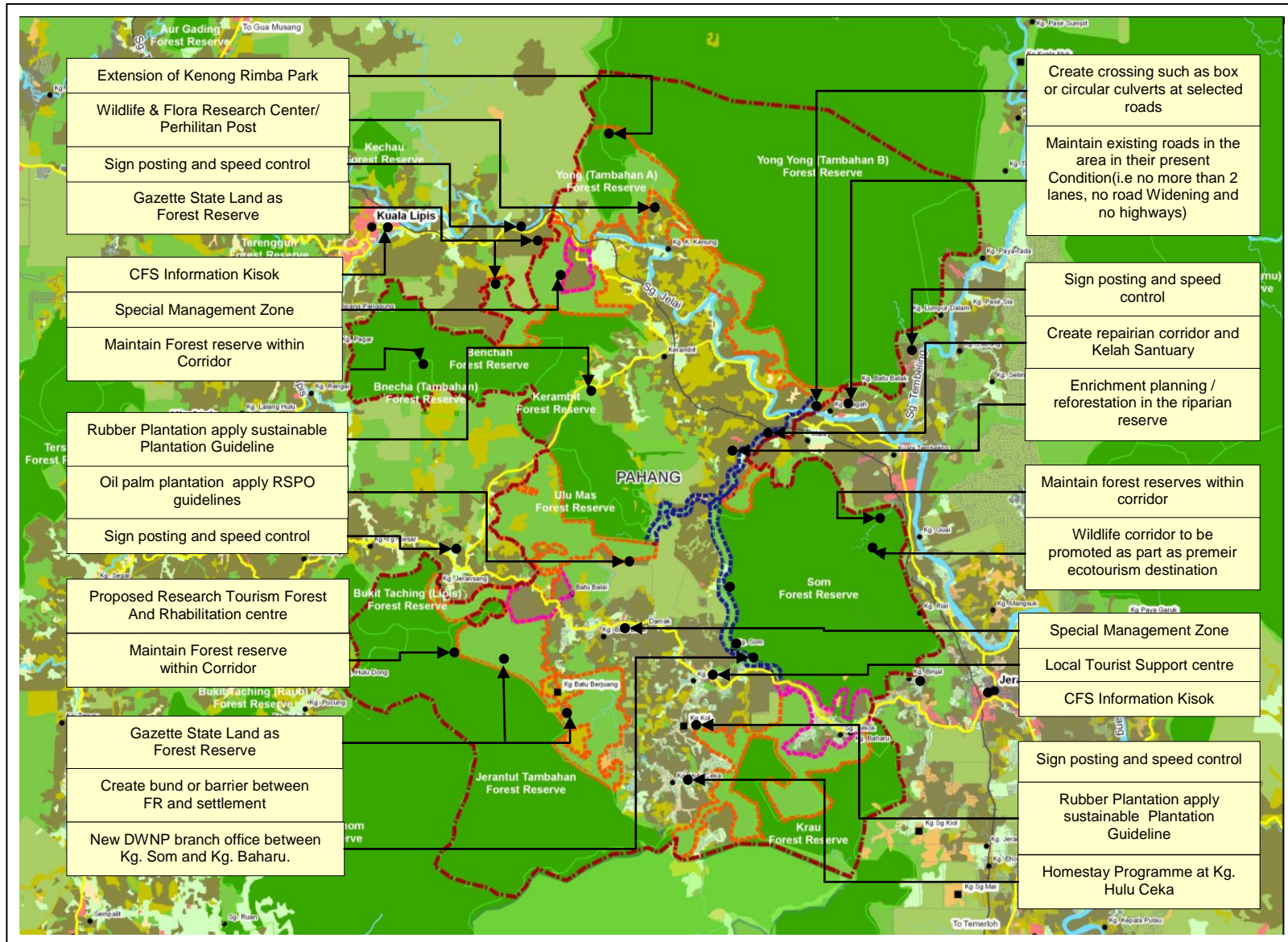
SL2: Krau WR – Benchah FR – Som FR – Yong FR (See also detailed case study in Chapter8)

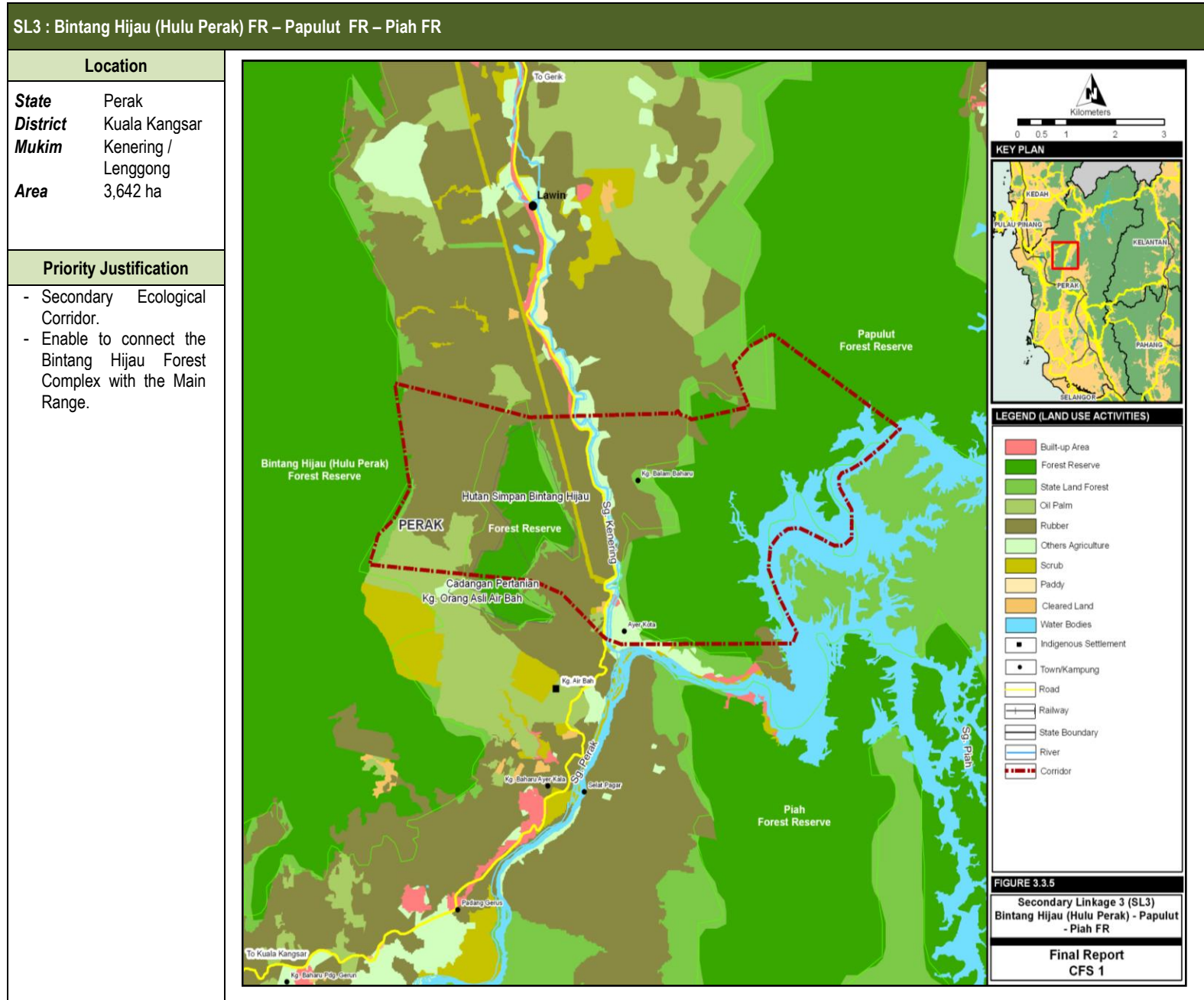


<p>Description</p>	<ul style="list-style-type: none"> • There are 2 main towns within the corridor, Kuala Lipis town and Jerantut town. Jerantut town is the gateway town to Taman Negara while Kuala Lipis town is a heritage town in Pahang. Railway passes through this corridor along the Jerantut town-Kg. Mala-Kg. Kerambit-Lipis town alignment. There are 2 roads connecting Kuala Lipis and Jerantut town which are the Jerantut- Kg. Mamak- Kg. Jeransang- Lipis road and Jerantut- K. Tembeling- Kg. Mala- Kg. Kerambit- Lipis road. All the settlements are along the roads. Sg. Jelai, Sg. Ceka, Sg. Som and Sg. Kerambit are within the corridor. The Kenong recreational forest is located about 10 km from Kuala Lipis town above the Sg. Jelai. • The Krau Wildlife Reserve is one of the most important conservation areas of lowland forest type in Peninsular Malaysia. Many important scientific studies have been carried out here over the past 50 years. The National Biodiversity Centre is located here at Bukit Lanchang. • Together with the Gunung Benom Forest Reserve, this area comprises the Greater Krau complex, with a diverse forest types from lowland to highland habitats. The complex has isolated from other forests on all sides by agriculture, plantations, settlements and linear infrastructure (roads and railway). • Major agriculture land-uses in the area are rubber, oil palm, short-term crops. Soils consist of Telemong-Akop_Inar Tempatan (Riverine alluvium) and Durian-Munchong-Bungur(mineral soils derived from steep slope). These soils are generally suitable for agriculture. Report from DWNP confirms that this is one of the Human-Wildlife conflict areas.
<p>Threat/Constraints</p>	<ul style="list-style-type: none"> • High development pressure from the large human population in the surrounding area, and encroachment of vegetable farms. It is also increasingly separated from the Greater Taman Negara and Main Range complexes by settlements, agricultural developments, railway and roads. • The complex is no longer a viable habitat for most large mammals; the Asian elephant and the Sumatran rhinoceros are locally extinct, and the gaur population is dwindling. It is thought that only 2-3 tigers left in the complex, and they are unlikely to persist for long. <p>However, there are viable populations of many other, smaller species in the complex (i.e., birds, small mammals, reptiles, invertebrates etc.), and they would benefit from some form of connectivity with the Greater Taman Negara Forest Complex.</p>
<p>Implementation Strategy</p>	<p>As the extent of human settlements and other artificial barriers in areas surrounding the forest complex is too great to allow for establishment of linear corridors, the stepping stone approach shall be taken to allow movement of birds and other small animals between Krau and Greater Taman Negara complex. The following key steps should be taken:</p> <p><u>Gazettement of Forest Reserve</u></p> <ol style="list-style-type: none"> 1. Gazette state land forests in the identified corridors as forest reserve. 2. Gazette all scrub land in the corridor as part of the forest reserve. 3. Establish a link to the Krau Wildlife reserve. <p><u>Establish Wildlife Crossing</u></p> <ol style="list-style-type: none"> 1. Establishment of wildlife crossing over roads within the corridor. <ul style="list-style-type: none"> • Maintain existing roads in the area in their present condition (i.e. no more than 2 lanes, no road widening, and no highways). • Put up sign posts and impose speed controls on road.

<p style="text-align: center;">Implementation Strategy</p>	<ol style="list-style-type: none"> 2. Although elephants have been sighted along this secondary link, generally the target wildlife are small mammals. 3. The existing roads or railways do not appear to pose a major obstacle to wildlife crossings. 4. Route 64 is undergoing upgrading works and it may be necessary to incorporate elements of wildlife crossings in the upgrading works. 5. For small mammals and reptiles, appropriate forms of crossings would be culverts, either box or circular. Both types of culverts may be used and if properly designed could also serve as drainage structures as well as for wildlife crossings. <p><u>Create Riparian Corridor</u></p> <ol style="list-style-type: none"> 1. Rivers play an important role to create continuous corridor which can connect the isolated forest islands. 2. Acquire land on a case-by-case basis as riparian reserve. 3. Gazette a riparian reserve as a wildlife corridor (50m wide on both sides) in order to link Krau complex to Sungai Jelai. 4. Immediate freeze on land alienation and development in the riparian reserves. 5. Within SL2, Sg. Ceka, Sg. Som and Sg. Sepan have been identified to establish a riparian reserve to become a natural corridor for the animals. 6. Planting of selected tree species that attract animals and birds. <p><u>Forest Management</u></p> <ol style="list-style-type: none"> 1. Carry out enrichment planting / reforestation in the riparian reserves. 2. Maintain the Som, Hulu Mas, Bukit Taching, Jerantut Tambahan, Krau, Kerambit forest reserves (i.e., no further degazettment). 3. Utilise principles 3 (Maintain structural complexity of habitat stand) and 4 (Maintain landscape heterogeneity), for managing biodiversity in the landscape (refer to the Common Vision, NRE) for all future land use planning in the buffer areas. 4. Unprotected state land forest should be incorporated into the forest reserve network. Low-impact, selective logging can be carried out as long as the impacts on connectivity are carefully monitored. <p><u>Land Use Management Control</u></p> <ol style="list-style-type: none"> 1. Practise sustainable agriculture as provided in the guidelines 'Guidelines for Sustainable Agricultural Management of Plantations' and RSPO criteria and indicators. 2. Promote the wildlife corridor as part as premier ecotourism destination of the Taman Negara National Park (Jerantut) and the Pahang ecotourism destination of the Kenong Rimba Park. 3. Establish special management zones to reduce wildlife-human conflicts. No further expansion of human settlements within these SMAs such as Kg. Baharu and Kg. Batu Balai. 4. Promote the wildlife corridor as a premier ecotourism destination.
<p style="text-align: center;">Expected Benefits</p>	<ul style="list-style-type: none"> • Maintenance of biodiversity of the Greater Krau forest complex. • Clear land use strategy for the area without conflicting proposals. • Maintenance of river water quality. • Increased awareness among domestic tourists of tourist attractions around Jerantut and Kuala Lipis Districts. • In close vicinity to existing traditional villages, therefore involvement of rural communities in the development of the wild life corridor as a tourism attraction is feasible. • Development and promotion of the wildlife corridor as part of Kenong Rimba Park tourism package can assist its promotion as state park. • Reduce human-wildlife conflicts.

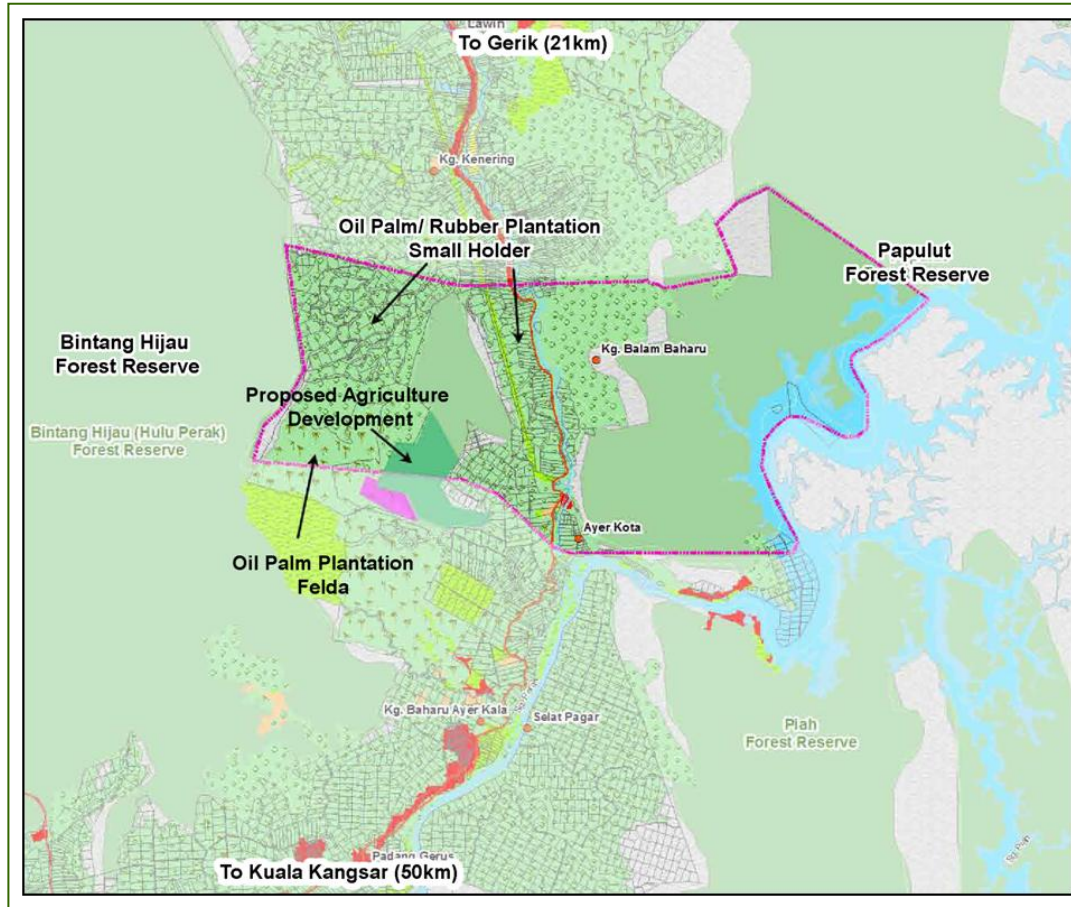
Figure 3.3.4: Implementation Strategy Plan - CFS1-SL2:
Krau WR – Benchah FR – Som FR – Yong FR



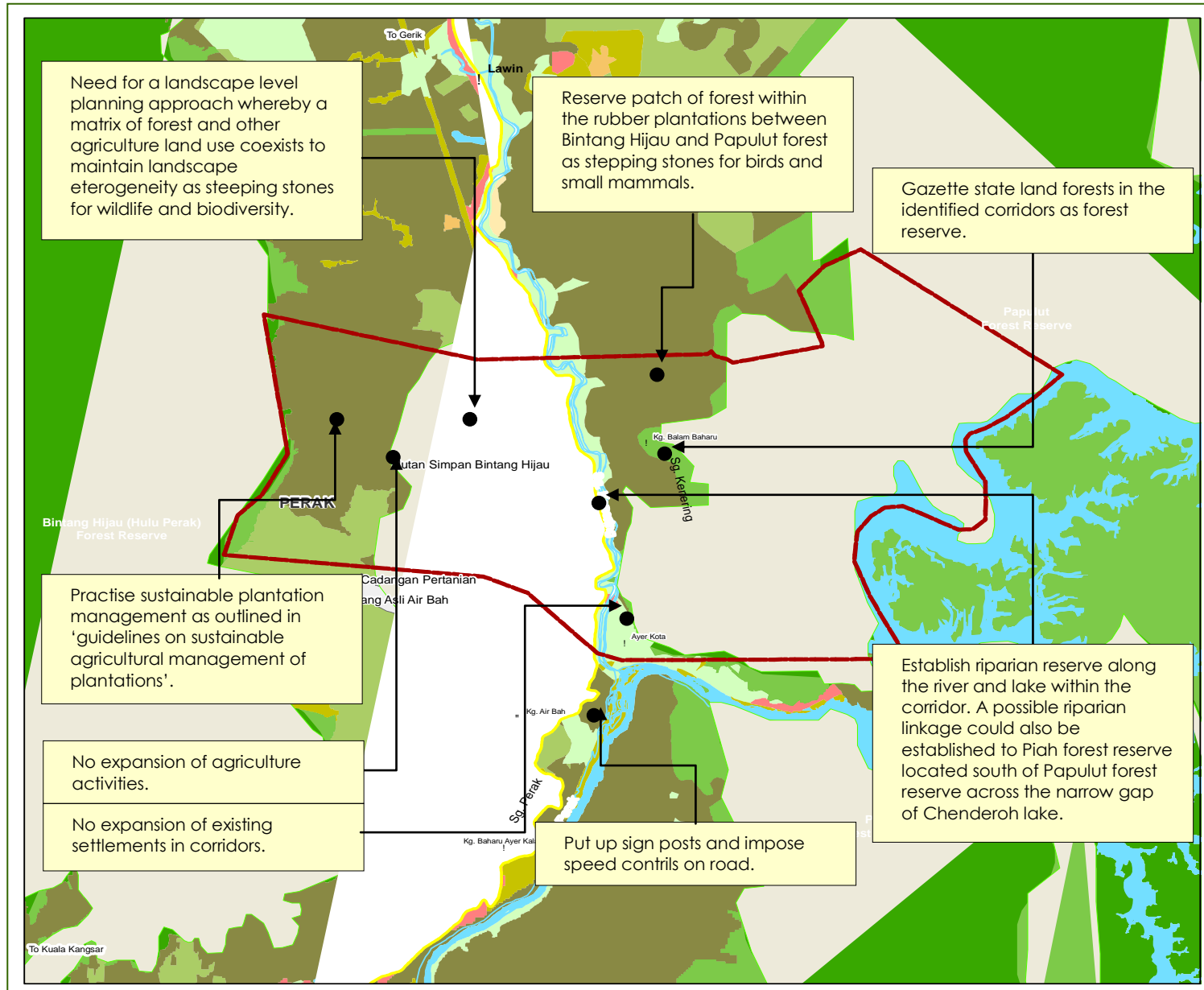


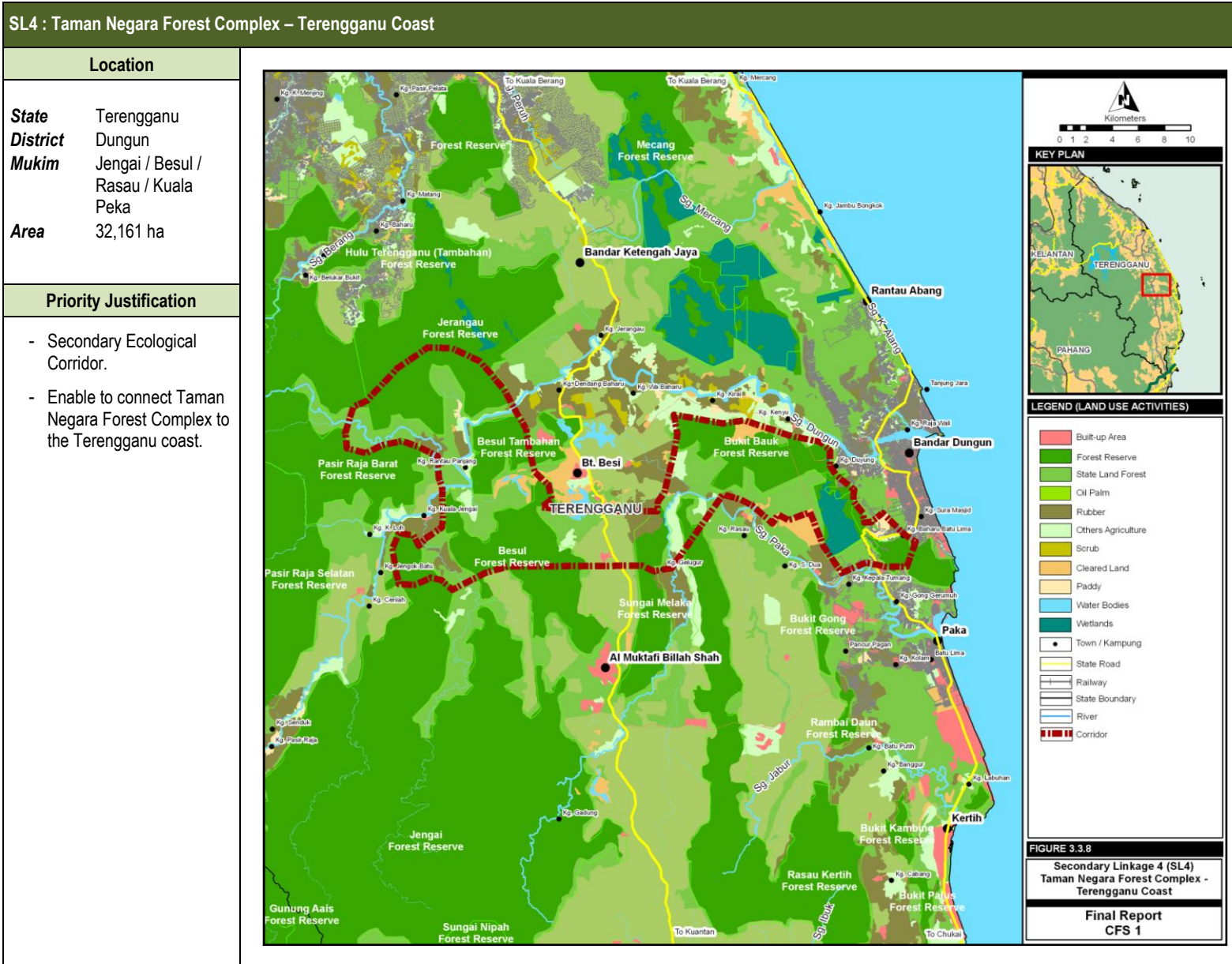
<p>Description</p>	<ul style="list-style-type: none"> To complement CFS1-PL4, a secondary linkage is proposed between Bintang Hijau (Hulu Perak) FR and Papulut FR in the Main Range. Major agriculture land use is rubber and oil palm plantations. Rubber plantations fringe the edge of the forest along the road south from Lawin to Lenggong. (see figure 3.3.1) Soil consists of Rengam-Bukit Temiang and Chenian series suitable for agricultural development Ecotourism attractions have been promoted by the tourism players within the area with some ecolodge operators offering ecotourism activities. Located within Raban-Chenderoh ecotourism destination of Perak. There is a Bt. Ulu Labu at the middle of Bintang Hijau FR and Papulut FR. Federal Road 76 is the road which joins Kuala Kangsar to Gerik through the corridor. Kg. Air Bah is the only orang asli village within the corridor, while the other villages are Kg. Balam Baharu and Ayer Kota.
<p>Threat / Constraints</p>	<ul style="list-style-type: none"> Small and isolated forest islands within rubber plantations between Bintang Hijau and Papulut forest reserves are constantly under pressure to be converted into non-forest land use. Strip of agriculture development for rubber and settlements along the K. Kangsar-Grik highway near Lenggong/Lawin.
<p>Implementation Strategy</p>	<p><u>Gazettement and Maintenance of Forest Reserve</u></p> <ol style="list-style-type: none"> Reserve patches of forest within the rubber plantations between Bintang Hijau and Papulut forest as stepping stones for birds and small mammals. Gazette state land forests in the identified corridors as forest reserve under NFA 1984. It is imperative to establish and protect the forest connectivity between Bintang Hijau and Papulut forest reserve. Bintang Hijau forest complex is a vital habitat for large animals and the Chederoh Lake acts as a meeting point and not necessarily as a barrier between the Bintang Range on the west and the Main Range on the east. <p><u>Create Riparian Corridor</u></p> <ol style="list-style-type: none"> Establish riparian reserve along the river and lake within the corridor. A possible riparian linkage could also be established to Piah forest reserve located south of Papulut forest reserve across the narrow gap of Chederoh Lake. <p><u>Establish Wildlife Crossing</u></p> <ol style="list-style-type: none"> Put up sign posts and impose speed controls on road. <p><u>Forest Management</u></p> <ol style="list-style-type: none"> Need for a landscape-level planning approach whereby a matrix of forest and other agriculture land-use coexists to maintain landscape heterogeneity as stepping stones for wild life and bio-diversity. <p><u>Land Use Management Control</u></p> <ol style="list-style-type: none"> Practise sustainable agriculture as provided in the guidelines 'Guidelines for Sustainable Agricultural Management of Plantations'. No expansion of agriculture activities. No expansion of human settlements within identified corridor.
<p>Expected Benefits</p>	<ul style="list-style-type: none"> Ecological connectivity between the Bintang Hijau Forest Complex with the Main Range. Enhances the attraction of Chenderoh – Raban ecotourism region and proposed Chenderoh Lake Water Sports Centre of Perak State.

Figure 3.3.6: Land Status and Land Use on SL3



**Figure 3.3.7: Implementation Strategy Plan - CFS1-SL3 :
Bintang Hijau (Hulu Perak) FR – Papulut FR – Piah FR**





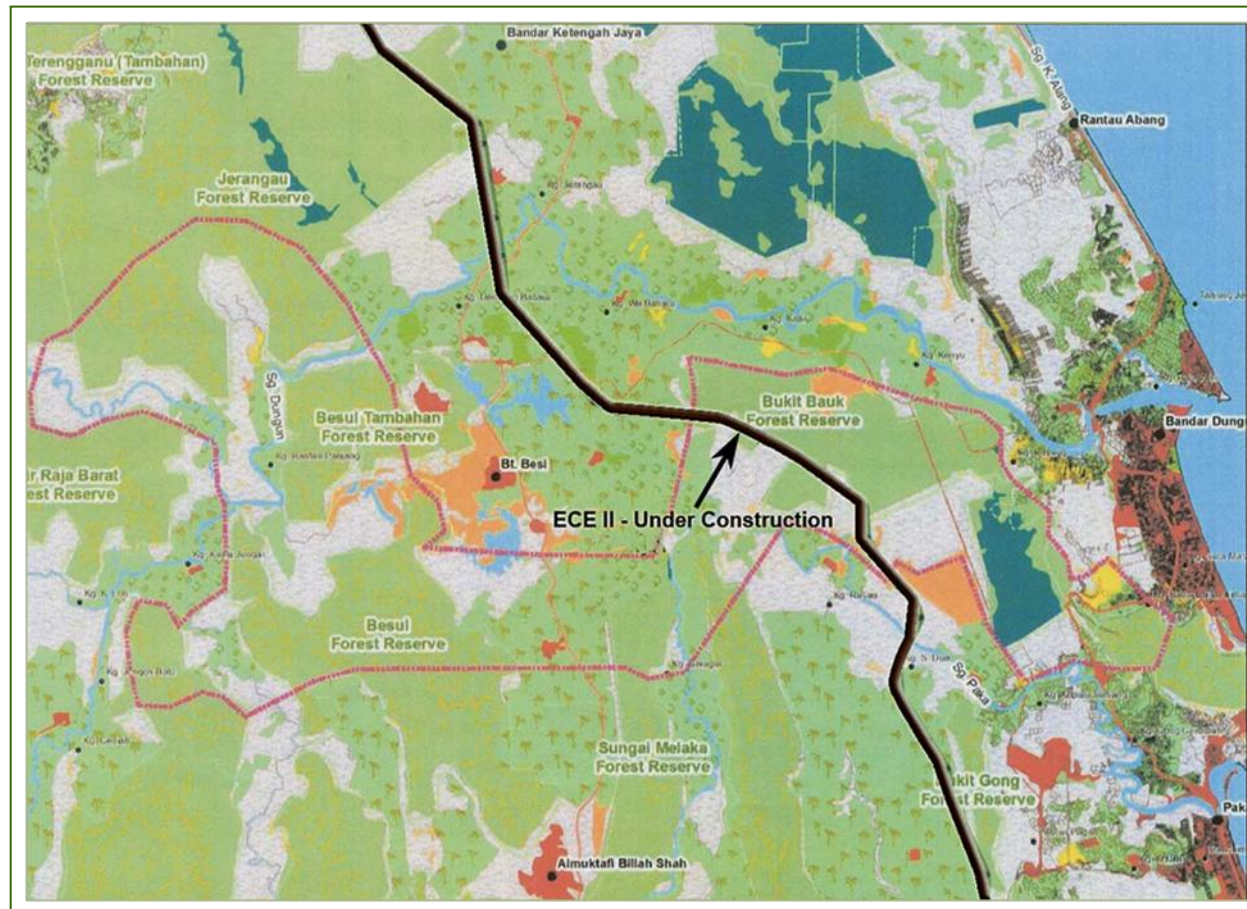
SL4 : Taman Negara Forest Complex – Terengganu Coast	
Description	<ul style="list-style-type: none"> • This corridor is in the middle of Bukit Besi, Al-Muktafi Billah Shah, Paka and Dungun Town. Sg. Paka, Sg. Besul are within the corridor. The landuse within the corridor mostly is agriculture such as oil palm and rubber areas. There are peat swamp forests within the corridor which is near to the Sg. Paka. Federal Road 14 crosses the corridor and connects the Al-Muktafi Billah Shah town to Bukit Besi town. • This 'mountains to the coast' linkage can be maintained in Terengganu, particularly along riparian corridors. There are still excellent patches of forest remaining in Bukit Bauk FR and Besul FR located along the Dungun river. • FELDA Jerangau Barat was previously a hotspot for human-tiger conflict whereby tigers from Jerangau FR had attacked cattle reared by FELDA settlers. • Setiu Wetlands has been designated as one of the ten special places for ecotourism by the National Ecotourism Plan and has also been proposed as a state park. • Located less than 10 kilometre from Merang, the international tourists' gateway to Redang and Perhentian Island (Terengganu Marine Park).
Threat / Constraints	<ul style="list-style-type: none"> • Development of oil palm plantations under KETENGAH • The proposed east coast expressway (ECE II) will pass through the corridor.
Implementation Strategy	<p><u>Gazettement of Forest Reserve</u></p> <ol style="list-style-type: none"> 1. Linking these forests along the Dungun river to Jerangau FR and Pasir Raja Barat FR through a stepping stone approach would facilitate the movement of small mammals and birds, and maintain the natural environment of the area. 2. Gazette state land forests in the identified corridors as forest reserve under NFA 1984. <p><u>Create Riparian Corridor</u></p> <ol style="list-style-type: none"> 3. Establish riparian reserve along the rivers within the corridor. <p><u>Establish Wildlife Crossing</u></p> <ol style="list-style-type: none"> 4. Put up sign posts and impose speed controls on existing road. 5. Establish wildlife crossing viaducts at ECE within the corridor. <p><u>Forest Management</u></p> <ol style="list-style-type: none"> 6. Need for a landscape-level planning approach whereby a matrix of forest and other agriculture land-use coexists to maintain landscape heterogeneity as stepping stones for wild life and bio-diversity. 7. Conserve wetlands within the corridor. <p><u>Land Use Management Control</u></p> <ol style="list-style-type: none"> 8. Practise sustainable agriculture as provided in the 'Guidelines for Sustainable Agricultural Management of Plantations'. 9. Implement sustainable agricultural practices for paddy lands. 10. No expansion of agricultural activities in the identified corridors. 11. No expansion of human settlements within identified corridors.

SL4 : Taman Negara Forest Complex – Terengganu Coast

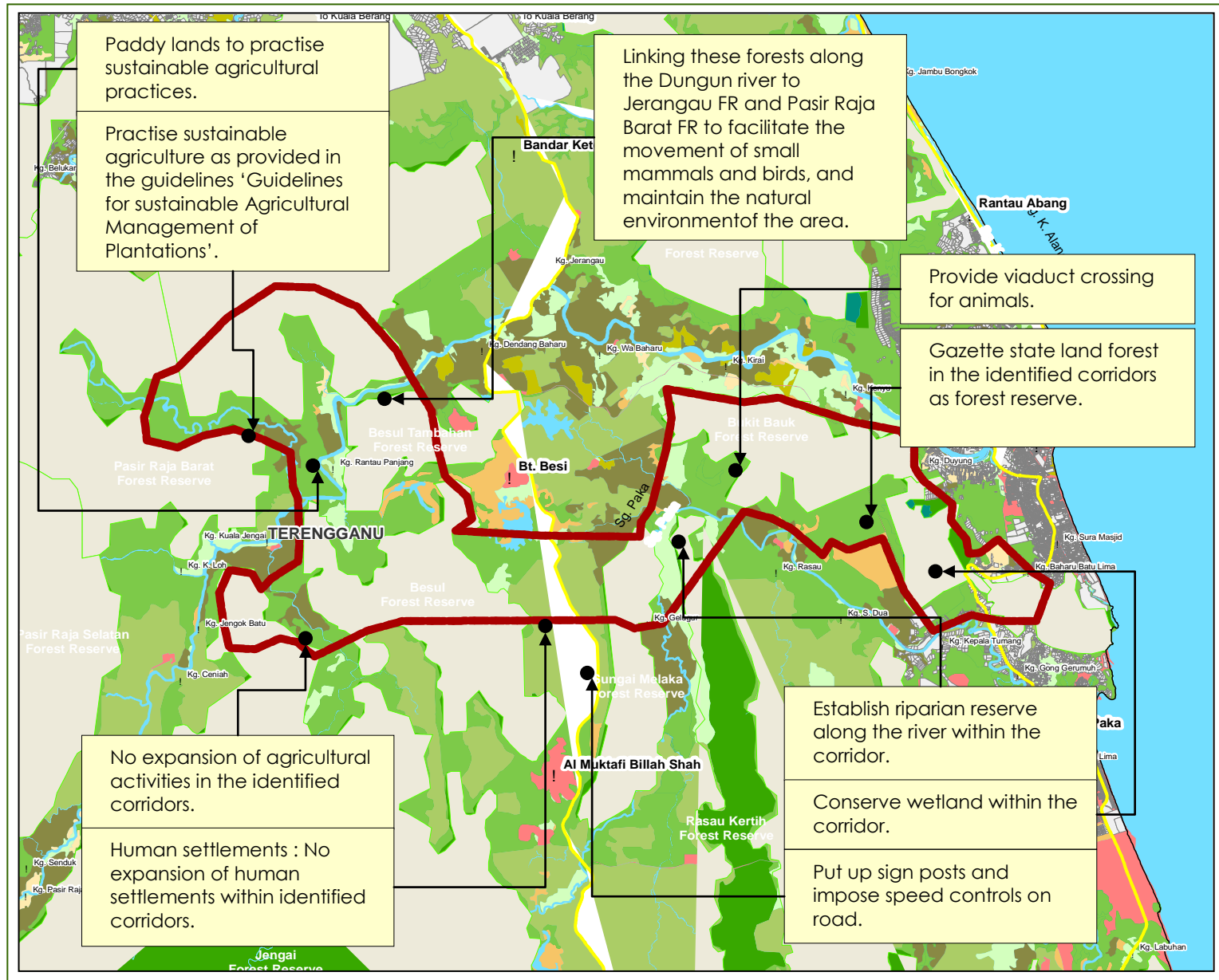
Expected Benefits

- Reduction in human-wildlife conflict.
- Enhanced protection of wetlands and improved river quality.
- Enhanced ecotourism potential of Dungun and Bt Besi.
- Provides a corridor for animals that move through a wide range of forest habitats.

Figure 3.3.9: Highway Development at SL4



**Figure 3.3.10: Implementation Strategy Plan - CFS1-SL4 :
Taman Negara Forest Complex – Terengganu coast**



SL5 : Taman Negara Forest Complex – Terengganu Coast 2

Location	
Ref. No.	SL-5
State	Terengganu
District	Setiu
Mukim	Hulu Setiu / Tasik
Area	18,214 ha

Priority Justification	
-	Secondary Ecological Corridor.
-	Enable to connect Taman Negara Forest Complex to the Terengganu coast.





KEY PLAN



LEGEND (LAND USE ACTIVITIES)

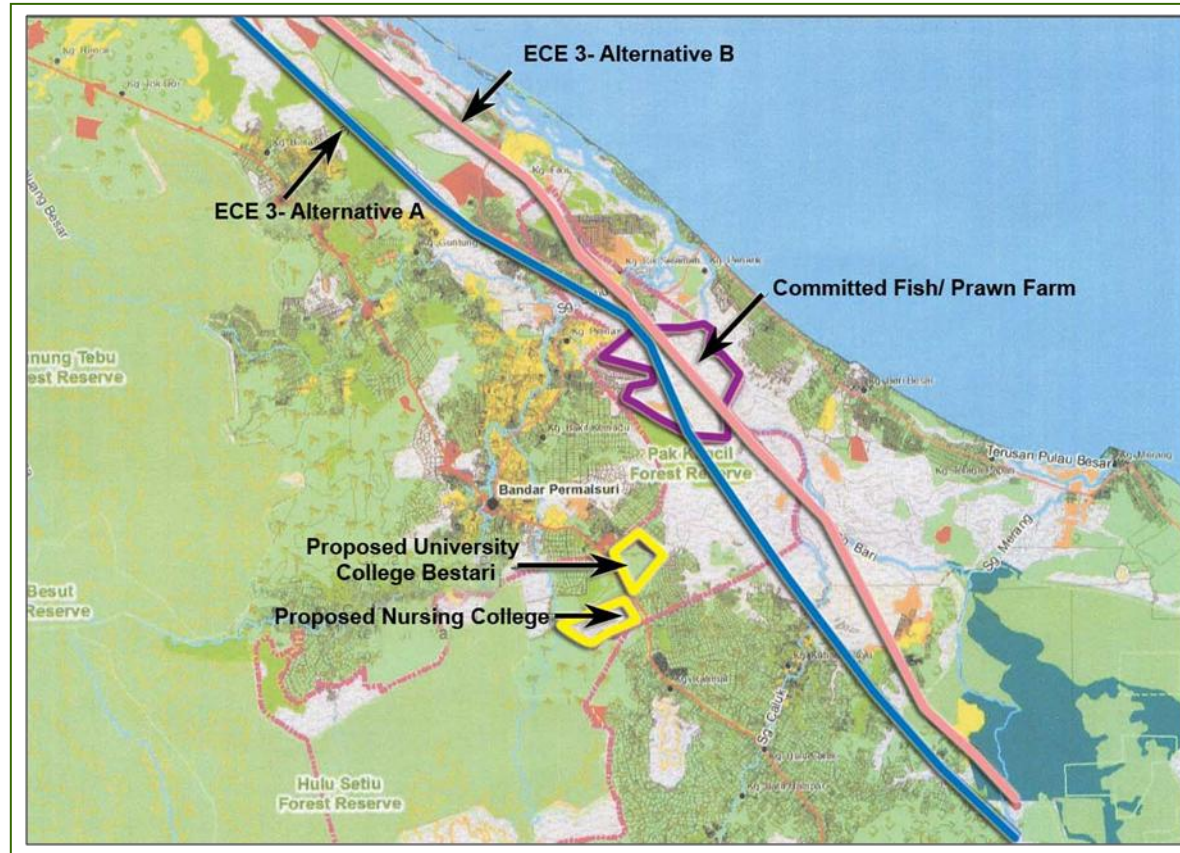
	Built-up Area
	Forest Reserve
	State Land Forest
	Oil Palm
	Rubber
	Others Agriculture
	Scrub
	Paddy
	Cleared Land
	Water Bodies
	Wetlands
	Town / Kampung
	Road
	River
	Corridor

FIGURE 3.3.11
Secondary Linkage 5 (SL5)
Taman Negara Forest Complex -
Terengganu Coast 2

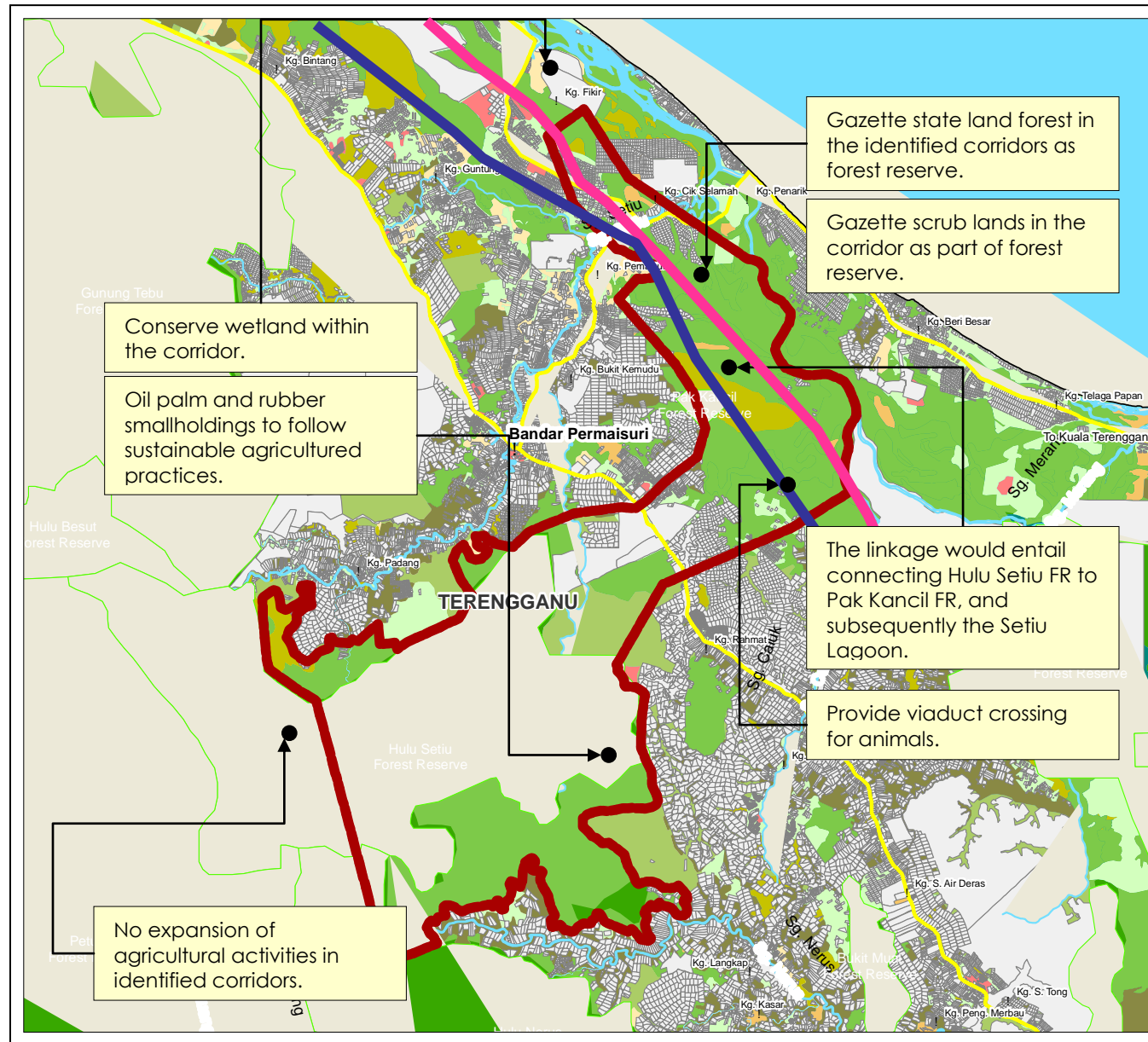
Final Report
CFS 1

<p>Description</p>	<ul style="list-style-type: none"> • A second connection of the 'mountains to the coast' in Terengganu is possible at Setiu. A federal road from Kuala Terengganu to Bandar Permaisuri separates the coastal plains from Hulu Setiu FR, which is contiguous with Lebir FR and consequently Taman Negara. • Located at the foothill of Rabong Hill, an ecotourism attraction of Gua Musang.
<p>Threat / Constraints</p>	<ul style="list-style-type: none"> • Development of oil palm plantations in the inland areas. • Development of Aquaculture Industry Zone in the Setiu areas. • Proposed for expressway to pass the corridor. (See figure 3.3.3). • Proposal for University College and Nursing College within the corridor.
<p>Implementation Strategy</p>	<p><u>Gazettelement of Forest Reserve</u></p> <ol style="list-style-type: none"> 1. Gazette state land forests in the identified corridors as forest reserve under the NFA 1984 2. Gazette scrub lands in the corridors as part of forest reserve under the NFA 1984 <p><u>Forest Management</u></p> <ol style="list-style-type: none"> 3. Need for a landscape-level planning approach whereby a matrix of forest and other agriculture land-use coexists to maintain landscape heterogeneity as stepping stones for wild life and bio-diversity. 4. The linkage would entail connecting Hulu Setiu FR to Pak Kancil FR, and subsequently the Setiu lagoon. <p><u>Land Use Management Control</u></p> <ol style="list-style-type: none"> 5. Follow sustainable agricultural practices for oil palm and rubber smallholdings. 6. No expansion of agricultural activities in identified corridors. 7. Conserve all wetland areas. 8. Proposed university college and nursing college to be relocated outside the corridor. <p><u>Establish wildlife crossing</u></p> <ol style="list-style-type: none"> 9. Put up sign posting and speed controls on existing roads within the corridor 10. Establish wildlife crossing viaducts at ECE within the corridor.
<p>Expected Benefits</p>	<ul style="list-style-type: none"> • Enhanced ecotourism potential of the Setiu Wetlands area. • Enhanced protection of wetlands and improved river quality. • Provides a corridor for animals that move between different forest habitats i.e. hill forest to wetland forest. • Possibility of establishing an ecological link from the hill forest to the Setiu wetlands. • The Merang – Kg Penarik Coastal Beachfront has been identified as a premier coastal tourism resort area under the ECER. This link will provide greater opportunities for diversifying the tourism products in the area. • Greater awareness of the importance of wildlife conservation among the villagers and enhanced incomes from tourism activities

Figure 3.3.12: Committed Development at SL5



**Figure 3.3.13 : Implementation Strategy Plan - CFS1-SL5 :
Taman Negara Forest Complex – Terengganu Coast 2**

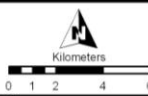


SL6: Taman Negara – Chiku FR

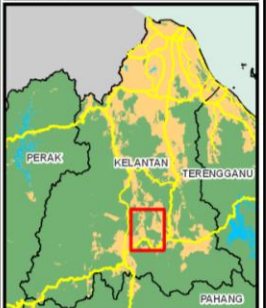
Location	
State	Kelantan
District	Gua Musang
Mukim	Bertam / Galas
Area	20,491 ha

Priority Justification	
-	Secondary Ecological Corridor.
-	Enable to connect Taman Negara and Chiku Forest Reserve.





KEY PLAN



LEGEND (LAND USE ACTIVITIES)

 Built-up Area
 Forest Reserve
 State Land Forest
 Oil Palm
 Rubber
 Others Agriculture
 Scrub
 Cleared Land
 Paddy
 Indigenous Settlement
 Town/Kampung
 Road
 Railway
 State Boundary
 River
 Corridor

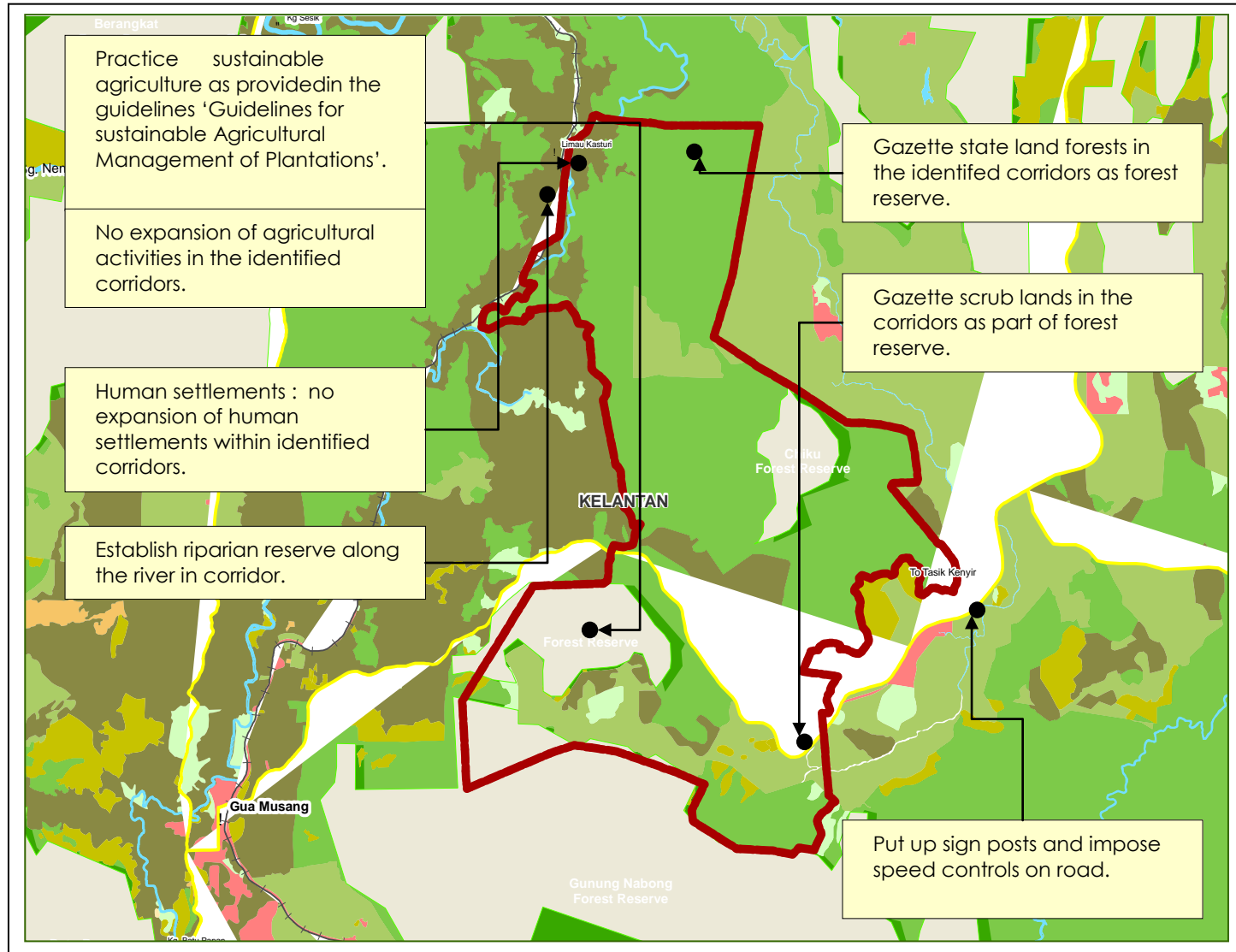
FIGURE 3.3.14

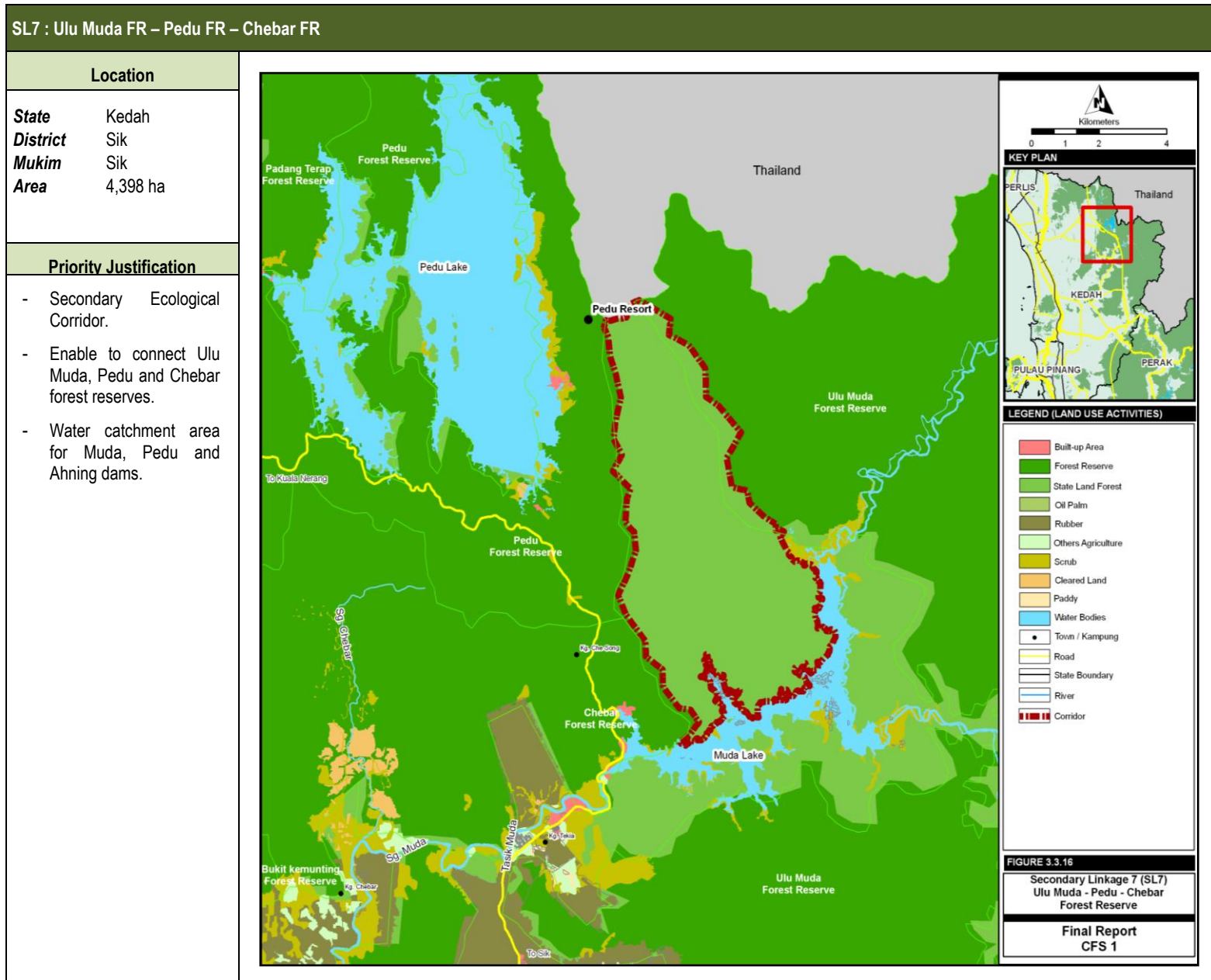
Secondary Linkage 6 (SL6)
Taman Negara - Chiku
Forest Reserve

Final Report
CFS 1

<p>Description</p>	<ul style="list-style-type: none"> • Area to the east of Gua Musang Town. • Land-use consists of mainly reforested areas and oil palm plantations. • While oil palm plantations fringe the northern edges of Taman Negara in Kelantan, it is still possible to establish a somewhat patchy link to the Chiku FR.
<p>Threat / Constraints</p>	<ul style="list-style-type: none"> • It has been ascertained from various sources that this entire area has already been highly degraded, has been earmarked for further agriculture expansion, and is no longer a viable habitat for wildlife (this point needs to be verified following further investigations). • Development of oil palm plantations under the South Kelantan Agropolitan Project near Renok Baru under KESEDAR.
<p>Implementation Strategy</p>	<p><u>Gazettement of Forest Reserve</u></p> <ol style="list-style-type: none"> 1. Gazette state land forests in the identified corridors as forest reserve under the NFA 1984. 2. Gazette scrub lands in the corridors as part of forest reserve under the NFA 1984. <p><u>Create Riparian Corridor</u></p> <ol style="list-style-type: none"> 3. Establish riparian reserve along the river in the corridor. <p><u>Infrastructure Development</u></p> <ol style="list-style-type: none"> 4. Put up sign posts and impose speed controls on road. <p><u>Forest Management</u></p> <ol style="list-style-type: none"> 5. Need for a landscape-level planning approach whereby a matrix of forest and other agriculture land-use coexists to maintain landscape heterogeneity as stepping stones for wild life and bio-diversity. <p><u>Land Use Management Control</u></p> <ol style="list-style-type: none"> 6. Practise sustainable agriculture as provided in the guidelines ‘Guidelines for Sustainable Agricultural Management of Plantations’. 7. No expansion of agricultural activities in identified corridors. 8. No further expansion of human settlements.
<p>Expected Benefits</p>	<ul style="list-style-type: none"> • Provides stepping stone patches of forest for small mammals and birds to move around. • Provides a varied landscape along the Gua Musang – Kuala Berang Highway. • Enhances biodiversity in the southern Kelantan which is being fast transformed into oil palm plantations. • Enhances the ecotourism potential of Gua Musang Town

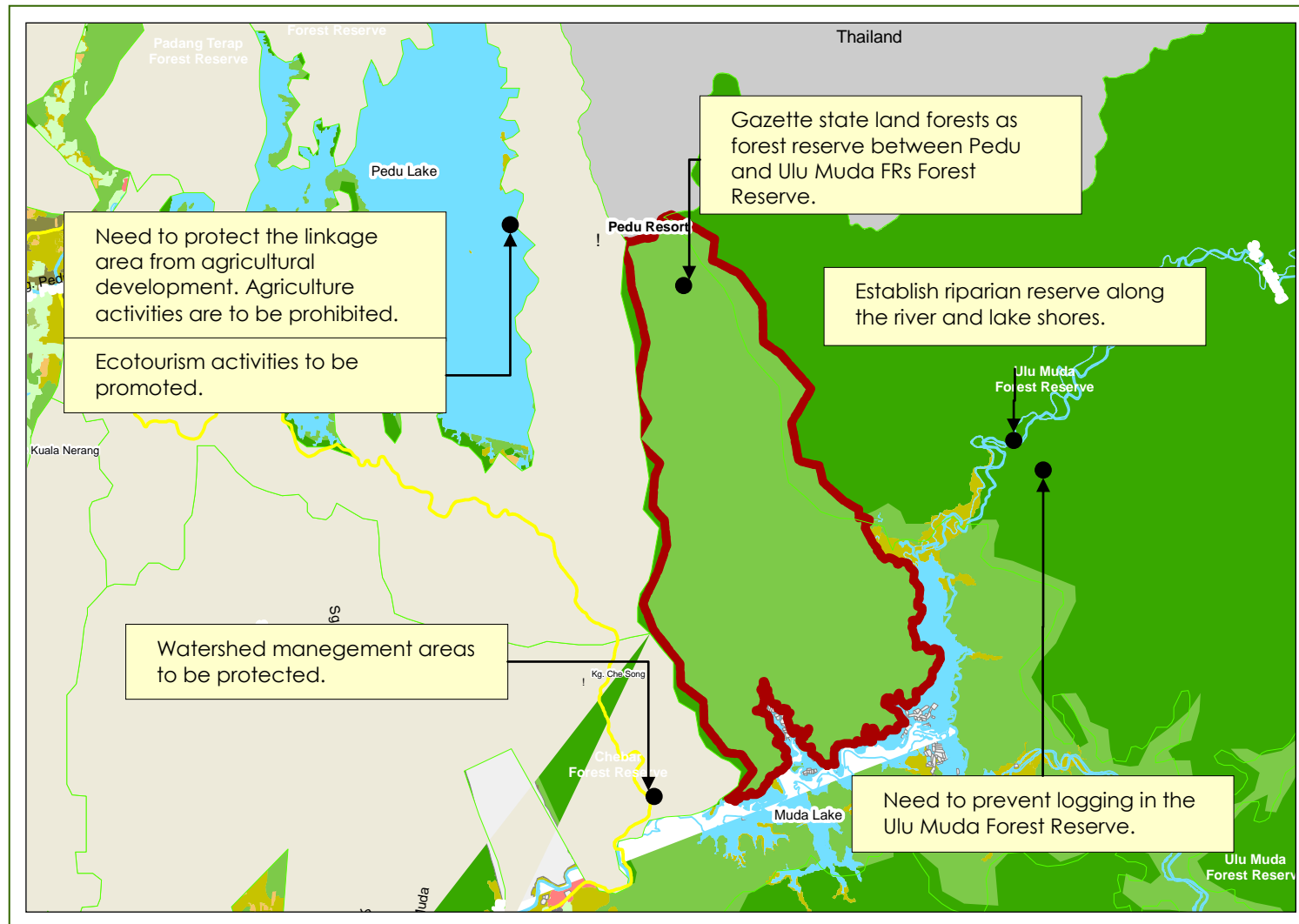
Figure 3.3.15: Implementation Strategy Plan - CFS1-SL6 : Taman Negara – Chiku FR





SL7 : Ulu Muda FR – Pedu FR – Chebar FR	
Description	<ul style="list-style-type: none"> • Ulu Muda FR in the east is separated from the Pedu FR in the west by an extensive state-land forest while the Chebar and Bukit Kemunting FRs are cut off from the forest island in the east by a state road. • Located in the Pedu Lake ecotourism region of Kedah State.
Threat / Constraints	<ul style="list-style-type: none"> • Proposed logging of the Ulu Muda Forest Reserve
Implementation Strategy	<p><u>Gazettement of Forest Reserve</u></p> <ol style="list-style-type: none"> 1. Gazetting the state-land forest between Pedu and Ulu Muda FRs as forest reserve under the NFA 1984. 2. Gazette scrub lands in the corridor as part of forest reserve under the NFA 1984. <p><u>Create Riparian Corridor</u></p> <ol style="list-style-type: none"> 3. Establish riparian reserve along the river and lake shores. <p><u>Infrastructure Development</u></p> <ol style="list-style-type: none"> 4. Put up sign posts and impose speed controls on road. <p><u>Forest Management</u></p> <ol style="list-style-type: none"> 5. Prevent logging in the Ulu Muda Forest Reserve 6. Gazette all forest in the catchment area of the Pedu, Muda and Ahning dams as protection forest under Section 10 of the NFA 1984 <p><u>Land Use Management Control</u></p> <ol style="list-style-type: none"> 7. Protect the linkage area from agricultural development. Agriculture activities are to be prohibited. 8. Promote ecotourism activities. 9. Protect watershed areas.
Expected Benefits	<ul style="list-style-type: none"> • Enhances viability of the Pedu Lake as an ecotourism destination. • Provides stepping stone forest patches for animals to move around. • Further enhances the water catchment functions of the Ulu Muda Forest Reserve as an important area for ensuring adequate water supply to most of Kedah and Penang and the rice growing areas.

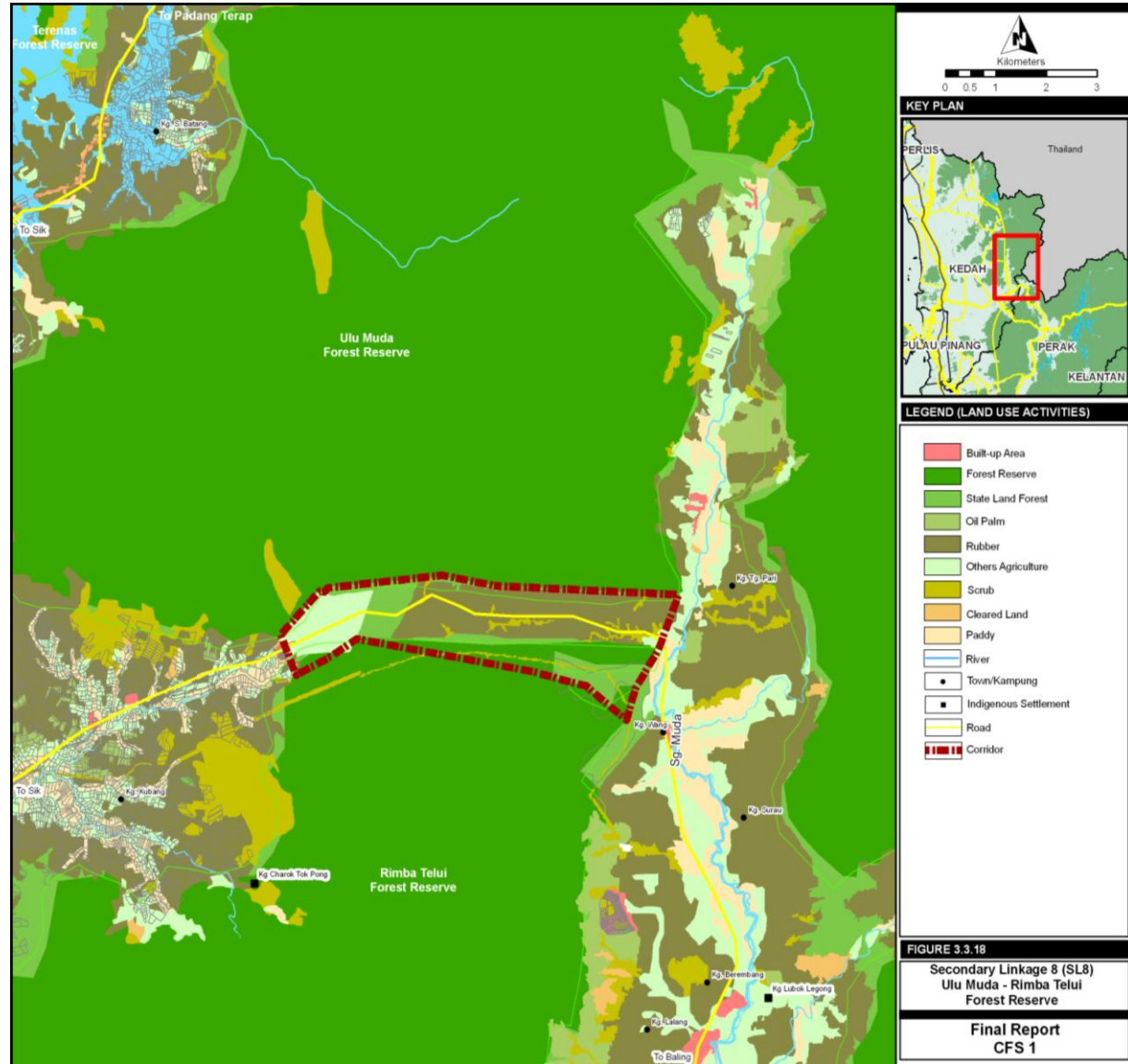
**Figure 3.3.17: Implementation Strategy Plan - CFS1-SL7 :
Ulu Muda FR – Pedu FR – Chebar FR**



SL8 : Ulu Muda FR – Rimba Telui FR

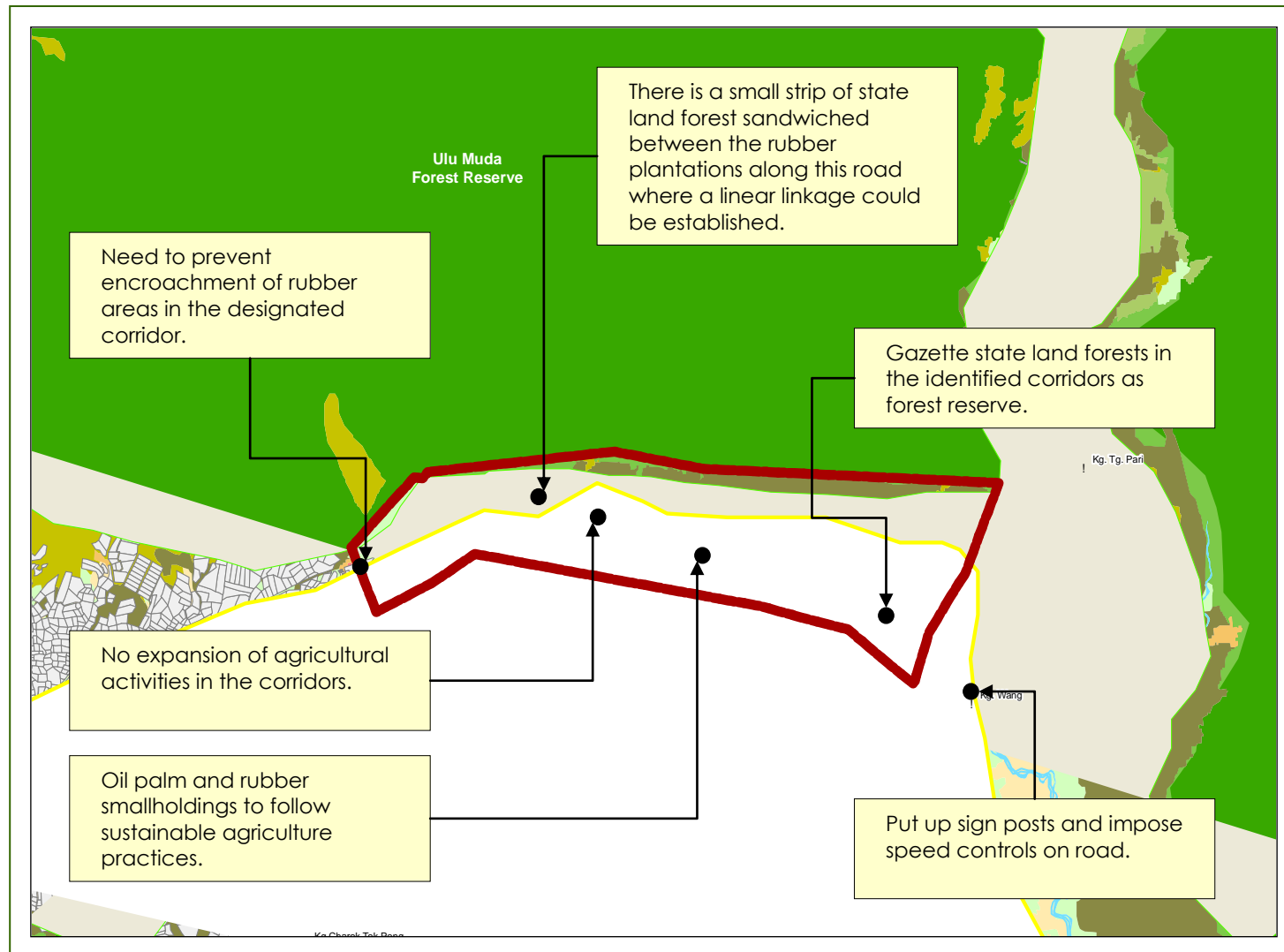
Location	
State	Kedah
District	Sik
Mukim	Sik
Area	1,125 ha

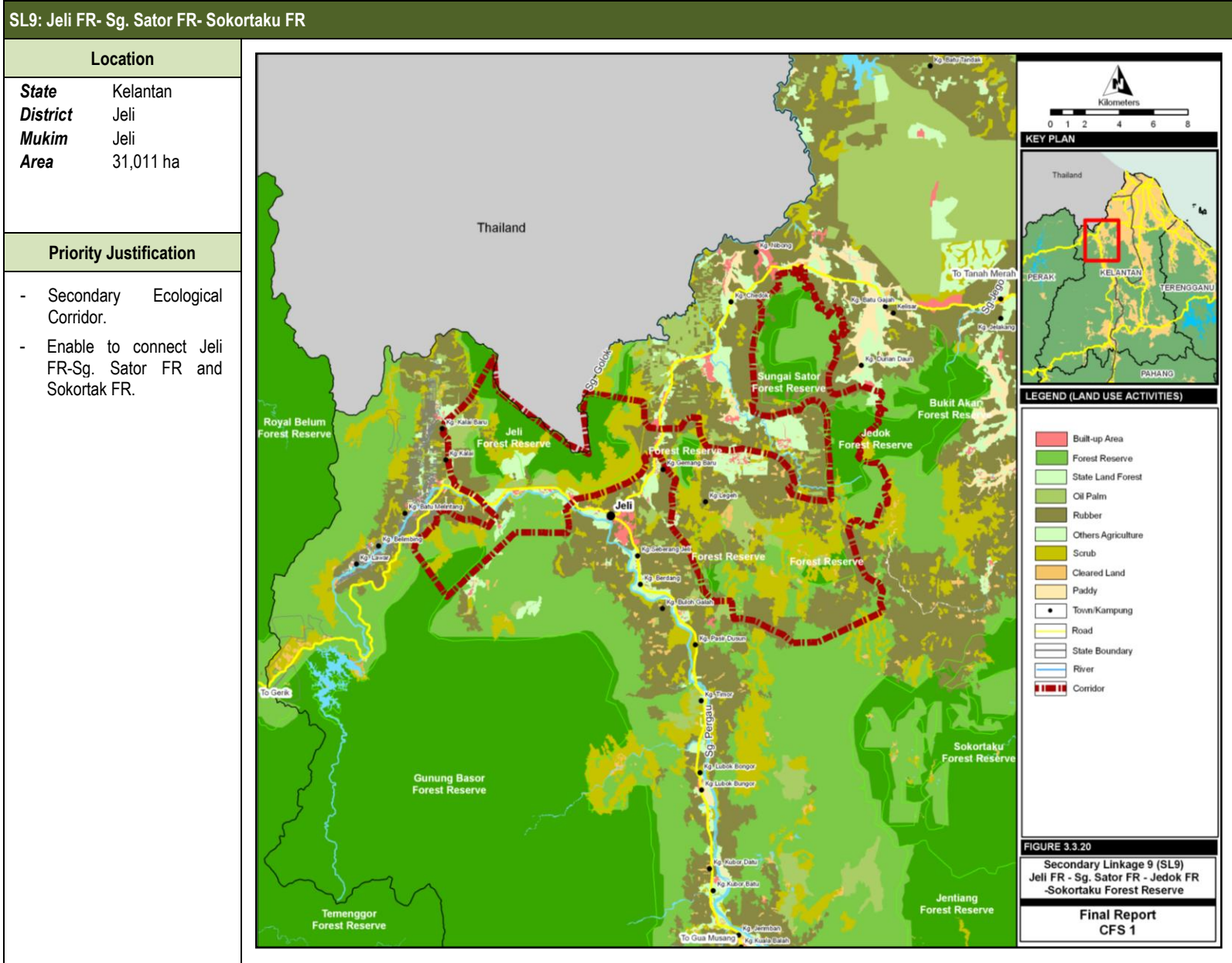
- Priority Justification**
- Secondary Ecological Corridor.
 - Enable to connect Ulu Muda, Pedu and Rimba Telui forest reserves.
 - Water catchment area for Muda, Pedu and Ahning dams.



<p>Description</p>	<ul style="list-style-type: none"> • The Rimba Telui FR in the south is cut off from the Ulu Muda FR by a state (Sik-Baling) road. The road is flanked by a 1km wide stretch of rubber plantation. • Located in the Pedu Lake ecotourism region of Kedah State.
<p>Threat / Constraints</p>	<ul style="list-style-type: none"> • Expansion of rubber areas between Sik and Kg Tanjong Pari
<p>Implementation Strategy</p>	<p><u>Gazettement of Forest Reserve</u></p> <ol style="list-style-type: none"> 1. There is a small strip of state land forest sandwiched between the rubber plantations along this road where a linear linkage could be established. 2. Gazette state land forests in the identified corridors as forest reserve. <p><u>Infrastructure Development</u></p> <ol style="list-style-type: none"> 3. Put up sign posts and impose speed controls on road. <p><u>Land Use Management Control</u></p> <ol style="list-style-type: none"> 4. Prevent expansion of rubber areas in the designated corridor. 5. No expansion of agricultural activities in the corridor. 6. Oil palm and rubber smallholdings to follow sustainable agricultural practices.
<p>Expected Benefits</p>	<ul style="list-style-type: none"> • Enhances the Pedu Lake ecotourism attraction. • Provides opportunity to develop Sik as an ecotourism gateway town. • Increases awareness among the local villagers of the importance of wildlife conservation.

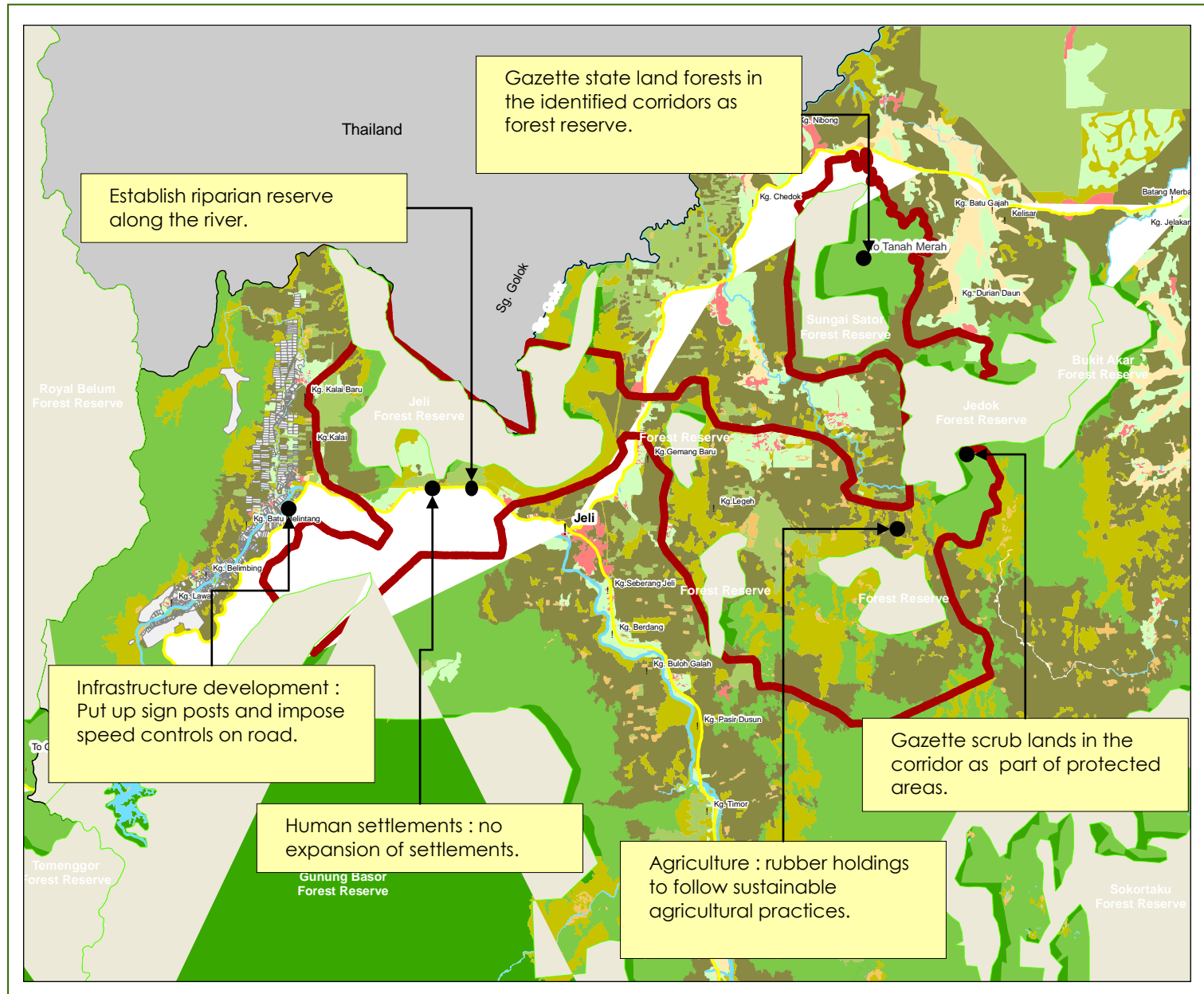
Figure 3.3.19 : Implementation Strategy Plan - CFS1-SL8 : Ulu Muda FR – Rimba Telui FR





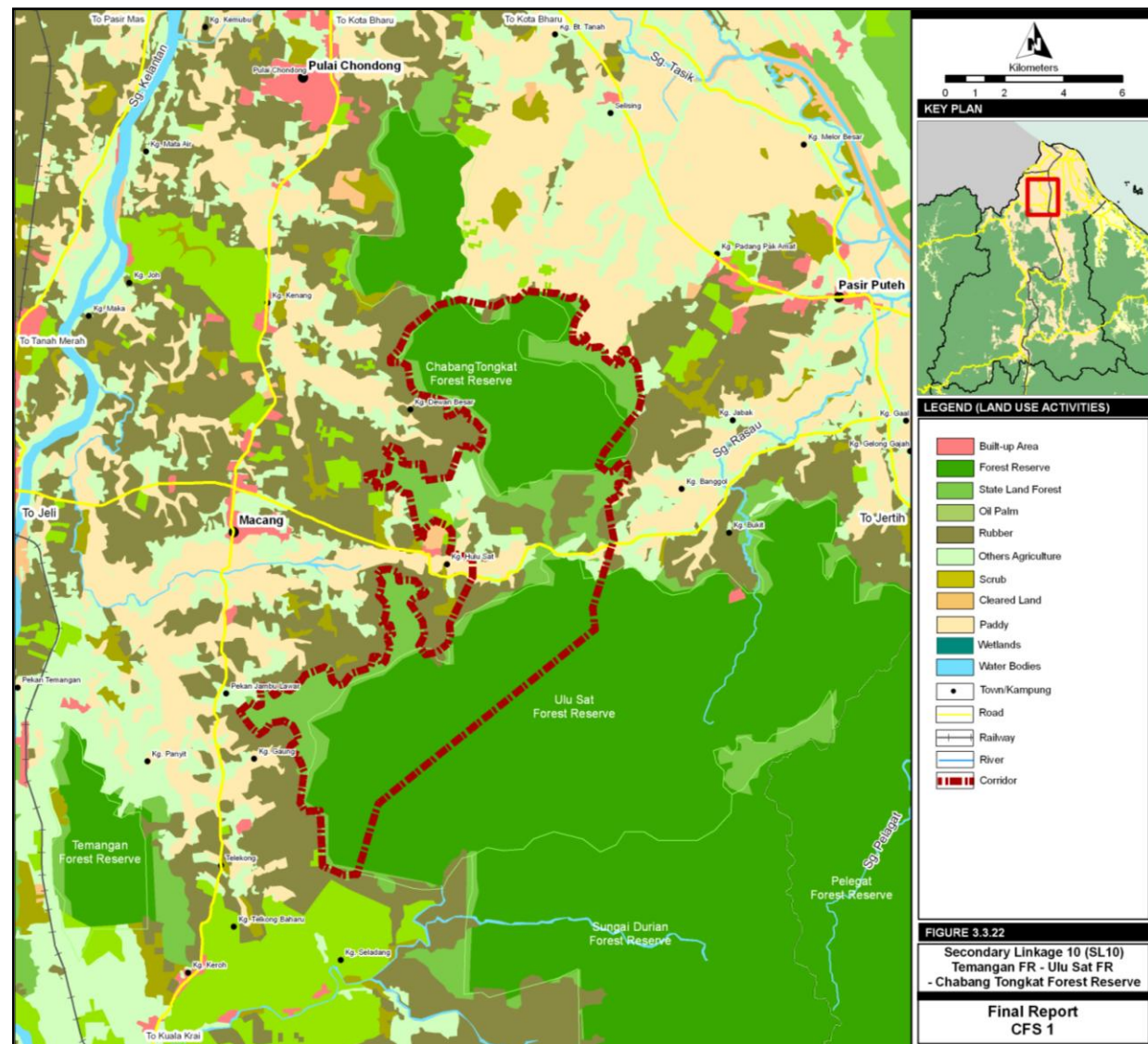
<p>Description</p>	<ul style="list-style-type: none"> This area comprises isolated pockets of forest areas such as the Jeli Forest Reserve, Sg Sator Forest Reserve and the Sokortak Forest Reserve. There have been several incidents of human-wildlife conflict (human-tiger and human-elephant) reported in this area. There are also several on-going initiatives by the DWNP and WWF in developing strategies to reduce such conflicts.
<p>Threat / Constraints</p>	<ul style="list-style-type: none"> Large tracts of forest areas are opened for land development for oil palm and rubber plantations. Urban expansion of Jeli town. New road bridge to Thailand at Bukit Bunga will result in greater trade and commercial activities in the area. Poaching and illegal trade in wildlife.
<p>Implementation Strategy</p>	<p><u>Gazettement of Forest Reserve</u></p> <ol style="list-style-type: none"> Gazette state land forests in the identified corridors as forest reserve under the NFA 1984. Gazette scrub lands in the corridor as forest reserve under the NFA 1984. <p><u>Create Riparian Corridor</u></p> <ol style="list-style-type: none"> Establish riparian reserve along the rivers. <p><u>Establish Wildlife Crossing</u></p> <ol style="list-style-type: none"> Put up sign posts and impose speed controls on road. <p><u>Land Use Management Control</u></p> <ol style="list-style-type: none"> Follow sustainable agricultural practices for rubber holdings. No expansion of human settlements
<p>Expected Benefits</p>	<ul style="list-style-type: none"> Provides stepping stone patches of forest for animals to move around.. Enhance the ecotourism potential of Jeli. Provides opportunities for more research on HWC. Enhances awareness among the village community of the importance of wildlife conservation Provides a safe haven for animals that are poached by enhancing surveillance and monitoring in the corridor. Enhances biodiversity in the area by maintaining forest patches in the area.

**Figure 3.3.21 : Implementation Strategy Plan - CFS1-SL9:
Jeli FR- Sg. Sator FR- Sokortaku FR**



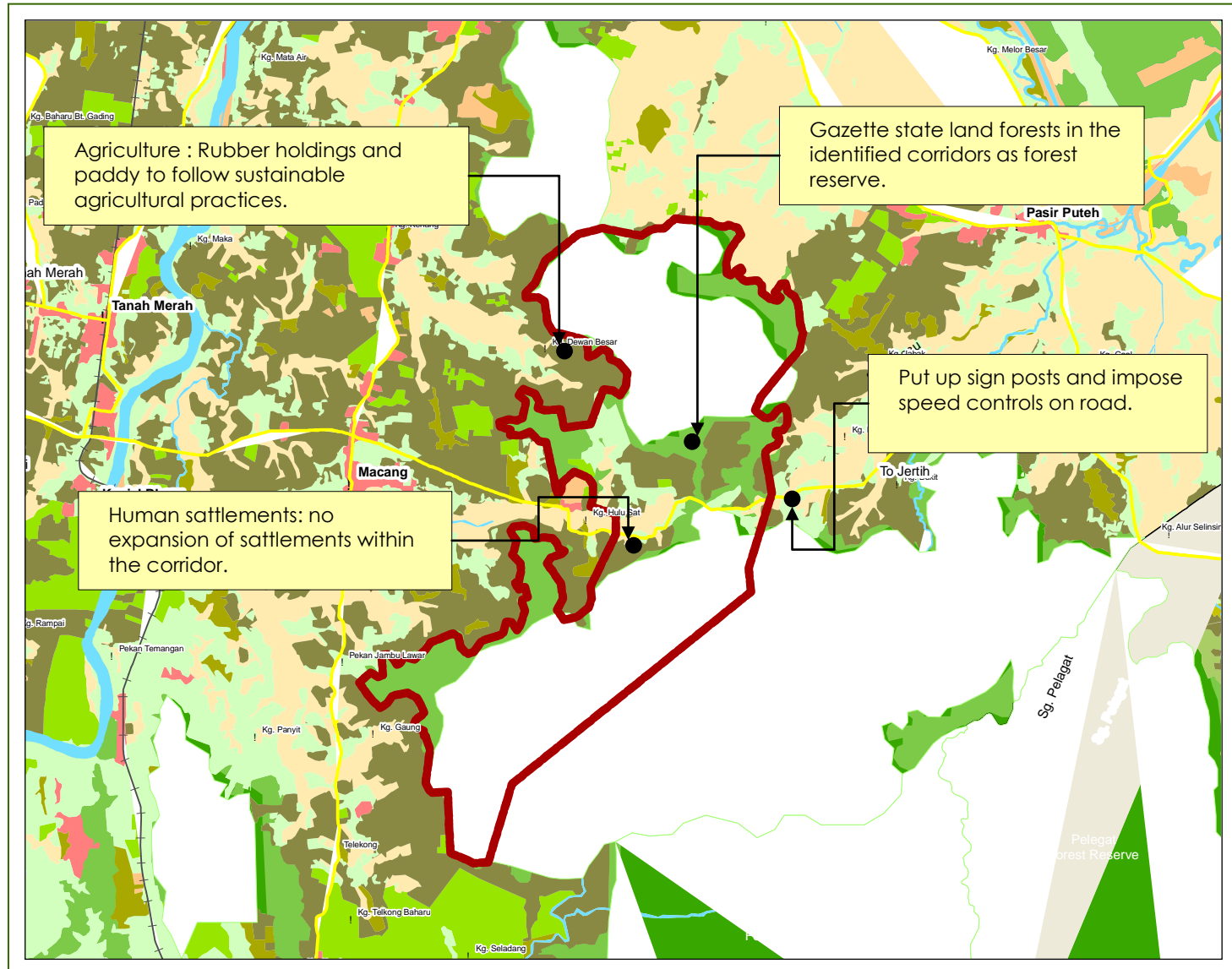
SL10: Chabang Tongkat FR- Ulu Sat FR- Temangan FR

Location	
Ref. No.	SL-10
State	Kelantan
District	Tanah Merah
Mukim	Tanah Merah
Area	16,414 ha
Priority Justification	
-	Secondary Ecological Corridor.
-	Enable to connect Chabang Tongkat FR- Ulu Sat FR- Temangan FR.

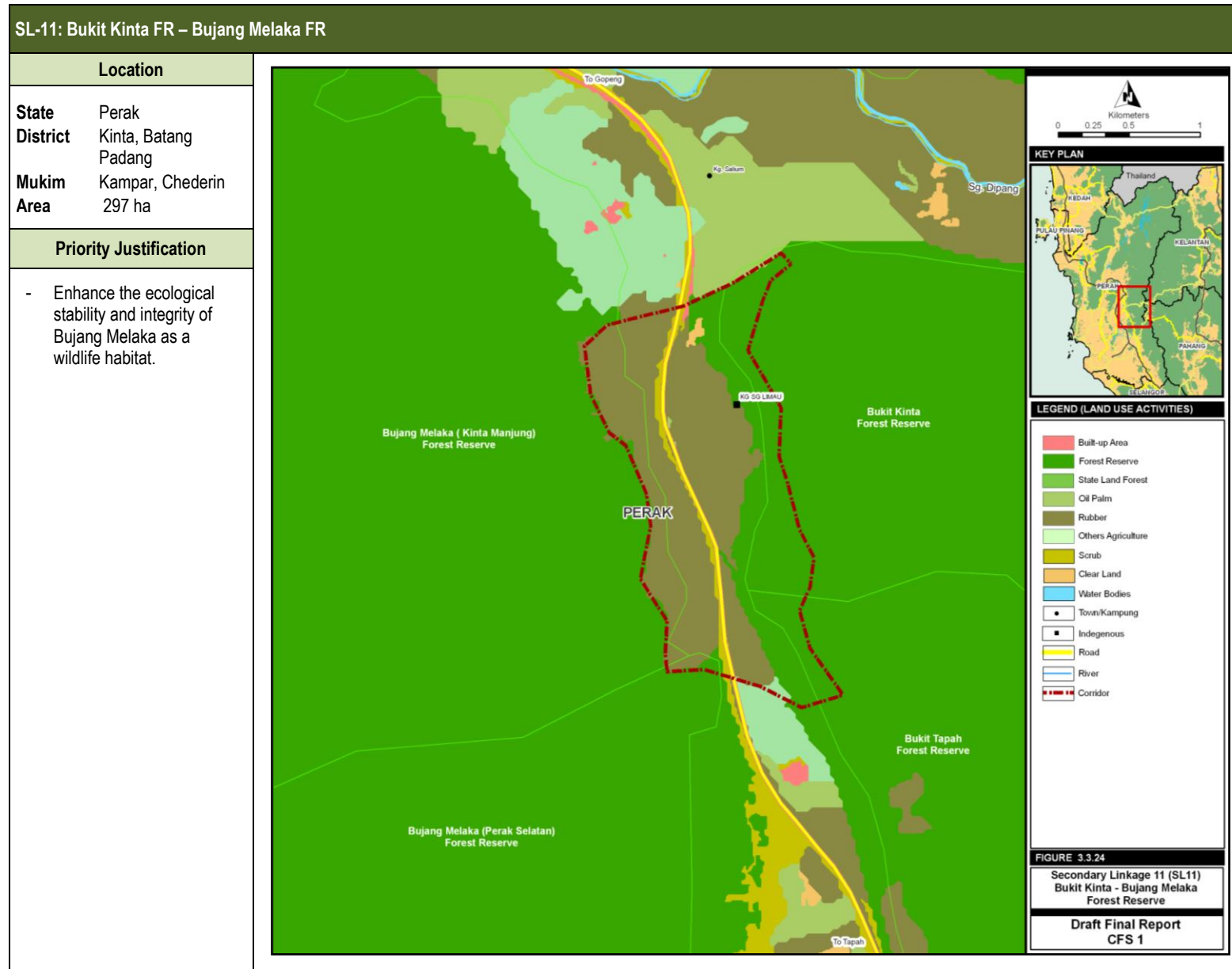


<p>Description</p>	<ul style="list-style-type: none"> This secondary link will provide an ecological corridor between the forest patches in Kelantan and Terengganu. Important forest reserves such as Temangan Forest Reserve north of Kuala Krai, Ulu Sat FR and the Chabang Tongkat FR will be connected through a stepping stone approach.
<p>Threat / Constraints</p>	<ul style="list-style-type: none"> New land development for agriculture and settlements. It is next to the Gua Musang- Kuala Krai – Tanah Merah Growth Corridor.
<p>Implementation Strategy</p>	<p><u>Gazettement of Forest Reserve</u></p> <ol style="list-style-type: none"> Gazette state land forests in the identified corridors as forest reserve under the NFA 1984. <p><u>Infrastructure Development</u></p> <ol style="list-style-type: none"> Put up sign posts and impose speed controls on road. <p><u>Land Use Management Control</u></p> <ol style="list-style-type: none"> Follow sustainable agricultural practices for rubber holdings and paddy.
<p>Expected Benefits</p>	<ul style="list-style-type: none"> Provides stepping stone patches of forest for animals to move between forest islands. Enhances the ecotourism potential of Kuala Krai. Enhances awareness among the village community of the importance of wildlife conservation. Enhances biodiversity in the area by maintaining forest patches in the area.

**Figure 3.3.23: Implementation Strategy Plan - CFS1-SL10:
Chabang Tongkat FR- Ulu Sat FR- Temangan FR**

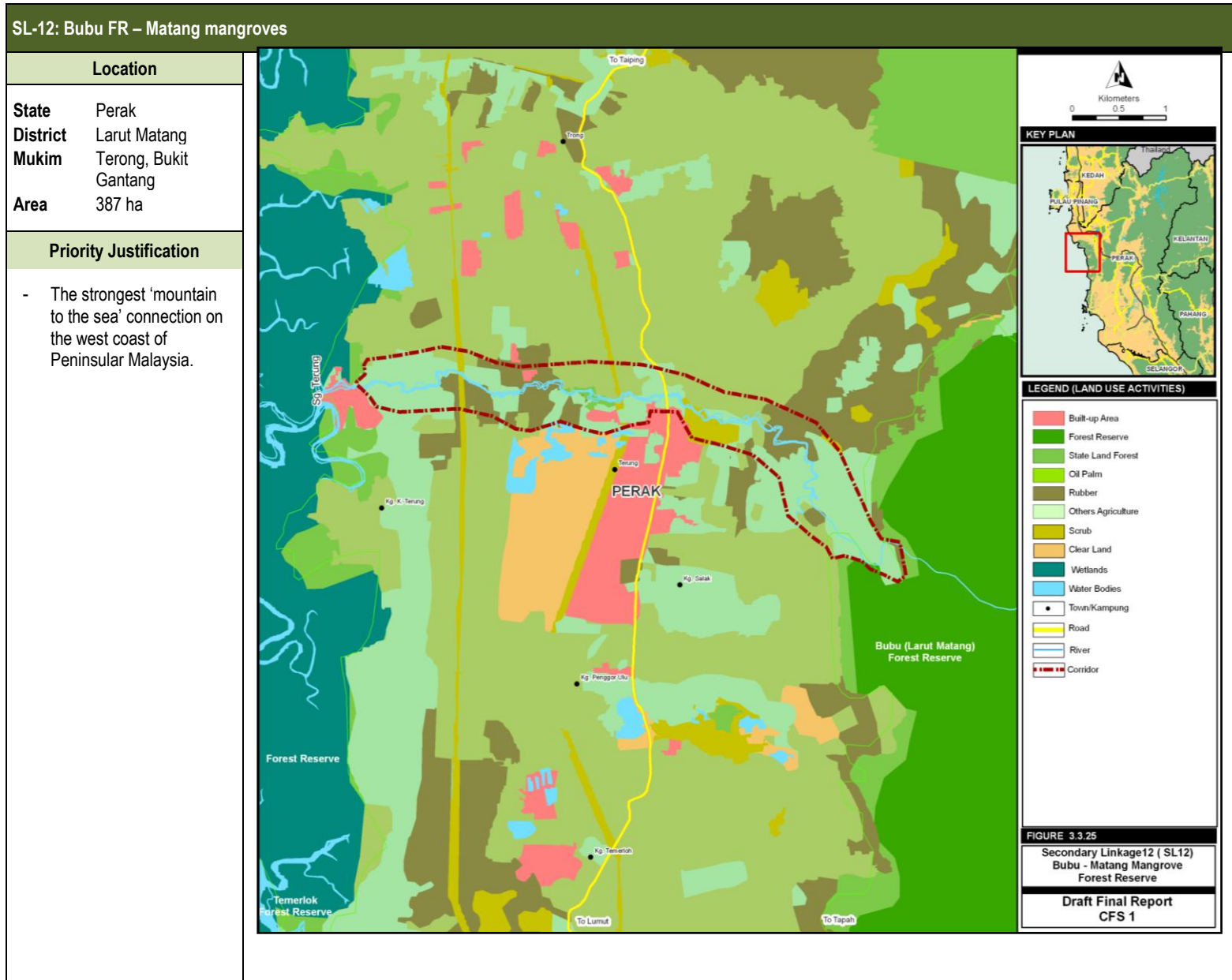


3.3.1 ADDITIONAL POTENTIAL SECONDARY LINKAGES WITHIN CFS1 AREA

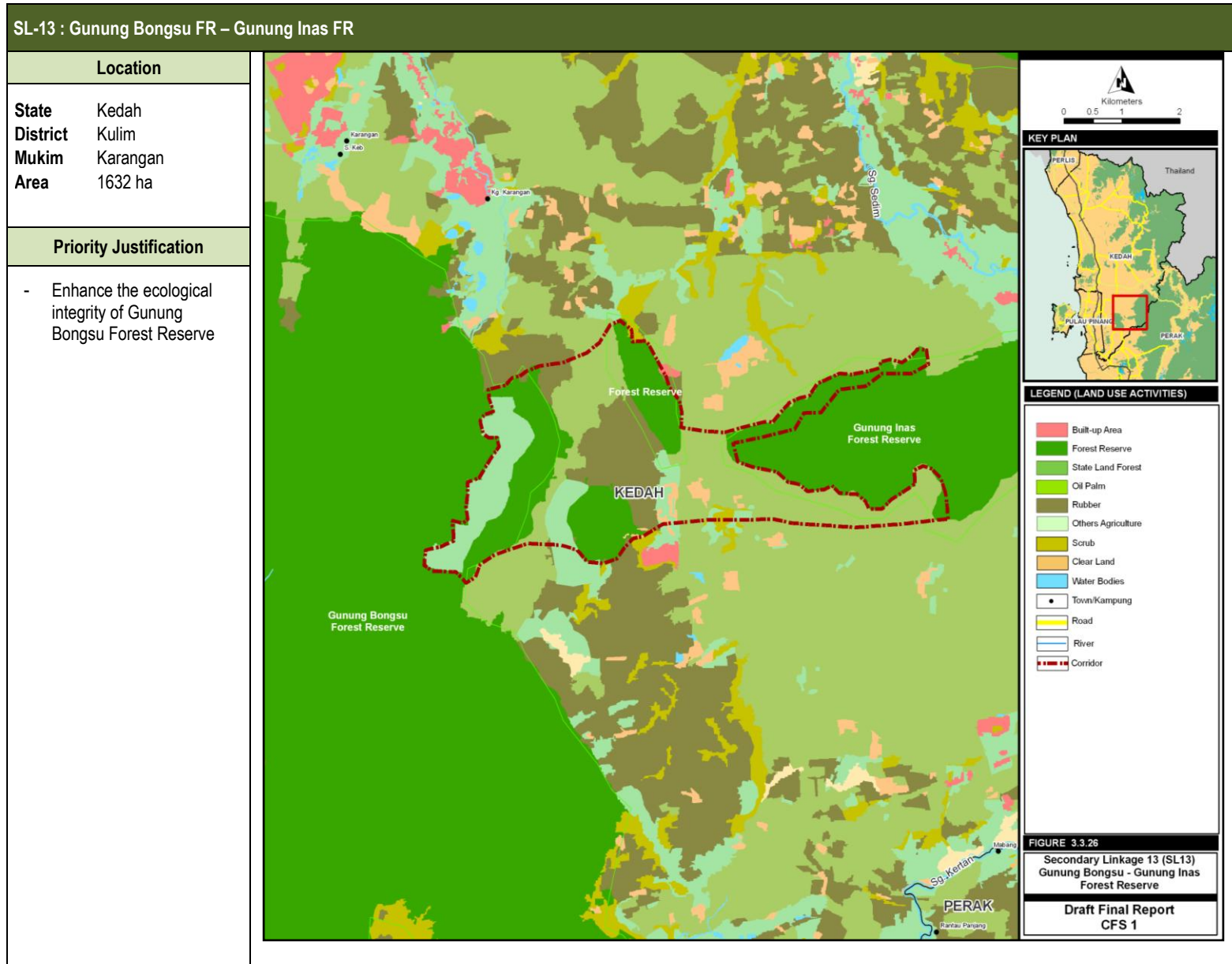




<p>Description</p>	<ul style="list-style-type: none"> • The Bujang Melaka Forest Reserve is a fairly large forest island (around 70km²) located on the foothills of the Main Range, just south of Gua Tempurong. • It is fragmented from the rest of the Main Range forest complex by the North-South Expressway as well as rubber plantations (average 2km wide) and scattered quarrying and old tin mines in the north and south. • The Bujang Melaka Forest Reserve is of high botanical value as it is the type locality for many species (i.e. where plant species were first discovered). • Because of this, in addition to the fact that it is quite sizeable, care should be taken to ensure that Bujang Melaka does not become further isolated from the Main Range.
<p>Threat / Constraints</p>	<ul style="list-style-type: none"> • Conversion to agriculture • Quarrying
<p>Implementation Strategy</p>	<p>Establish Land Use Management Control</p> <ol style="list-style-type: none"> 1. Do not degazette any areas from the Bujang Melaka Forest Reserve 2. No expansion of human settlements or agriculture within the corridor <p>Establish wildlife crossing</p> <ol style="list-style-type: none"> 3. Carry out wildlife survey at Bujang Melaka to determine the type of wildlife crossing that may be required.
<p>Expected Benefits</p>	<ul style="list-style-type: none"> • Ensure viability of plant and animal populations in Bujang Melaka. • Enhance the ecological stability and integrity of the Bujang Melaka forest island as a wildlife habitat.



SL-12: Bubu FR – Matang mangroves	
Description	<ul style="list-style-type: none"> • Arguably, this area has the most potential where a forested connection (or at least a mosaic of forests) from the highlands to the sea to be established on the west coast of Peninsular Malaysia. • Of the many rivers that flow into the Straits of Melaka, Sg. Terung may be the best candidates for this. While there are plantations, land based aquaculture and settlements in the area, there still looks to be a mosaic of riparian forests, swamps and mangroves that can be connected with minimal difficulty. • The maintenance of ecological corridors here, especially within the riparian zone would help maintain the health and productivity of terrestrial, aquatic and marine ecosystems, including the famed Matang mangroves (recognised as the best managed mangrove forest in the world).
Threat / Constraints	<ul style="list-style-type: none"> • Expansion of oil palm plantations into the riparian zone. • Expansion of settlements into the riparian zone.
Implementation Strategy	<p>Gazettelement of River Reserves and Reforestation</p> <ol style="list-style-type: none"> 1. Where possible, gazette river reserves along Sg. Terung to a width of 100m from the high water mark of each side of the river. 2. Re-establish the natural riparian vegetation in the riparian zone. <p>Land Use Management Control</p> <ol style="list-style-type: none"> 3. No expansion of human settlements or agriculture within the river reserve. 4. Existing oil palm plantations to establish riparian buffers along the river.
Expected Benefits	<ul style="list-style-type: none"> • Enable the movement of terrestrial and aquatic species along the riparian zone. • Maintain ecological connection between the Matang mangroves and dryland forests.





FINAL REPORT

<p>Description</p>	<ul style="list-style-type: none"> • Gunung Bongsu Forest Reserve is a fairly large, but totally isolated forest island. • The closest distance between this forest island and the rest of the Bintang Range is where a narrow spur reaches out westwards from the Gunung Inas Forest Reserve. Even so, the closest distance between forests at the end of this spur and in Gunung Bongsu is around 5km. • Therefore, it is felt that the benefits of establishing a primary linkage here is cannot be justified. As such, a secondary linkage is recommended until such time where a primary link becomes justifiable. • In any, case, Gunung Bongsu Forest Reserve should be maintained as a green lung for Kulim.
<p>Threat / Constraints</p>	<ul style="list-style-type: none"> • Agriculture expansion.
<p>Implementation Strategy</p>	<p>Land Use Management Control</p> <ol style="list-style-type: none"> 1. Estate managers and smallholders within the corridor are encouraged to practice sustainable plantation management as outlined in the 'Guidelines on Sustainable Agricultural Management in Plantations' to ensure these areas provide suitable landscape layout for wildlife.
<p>Expected Benefits</p>	<ul style="list-style-type: none"> • Enhance the ecological stability and integrity of Gunung Bongsu Forest Reserve.

3.4 TRANS-BOUNDARY LINKAGES

3.4.1 Overview

A good portion of the northern forests of Peninsular Malaysia lie along the borders with Thailand where trans-boundary habitats provide refuges for large mammals and birds. However, these border areas are being lost to uncontrolled development and exploitation. It is clear that the activities of a country along a border can have far-reaching effects on its neighbour.

The issue of trans-boundary conservation is at the forefront of regional biodiversity planning. Globally, a new and positive trend is to consider trans-boundary protected areas as apart of forest complexes which should be managed as units rather than as separate political entities for wildlife conservation. Large mammals like tigers, rhinos and elephants are low-density species which range over wide areas and require large areas to maintain viable populations. If such species can be conserved in these trans-boundary forests then they may serve as ecological “umbrellas” for the conservation of other elements of biodiversity (which includes the entire gamut of species found, and ecological processes taking place in forests).

Given that many of the drivers of biodiversity loss (e.g. habitat loss) are issues that transcend national boundaries, any realistic solution will need to involve a multi-national and multidisciplinary strategy. Such a strategy should include political, socioeconomic and scientific input. All major stakeholders (governmental, non-governmental, national and international organizations) must be involved.

Six protected areas in Southern Thailand are immediately adjacent to forests in Peninsular Malaysia (**Figure 3.4.1**). The importance of each of these areas are highlighted below. Generally, linkages between the Thai and Malaysian side are already well established. Animals can travel freely from one side to the other as there is usually no fence along the border. In some cases a small “rentis” or trail has been cut to demarcate the border, however this is no obstacle to wildlife at the moment.

3.4.2 Royal Belum State Park – Hala Bala Wildlife Sanctuary

Immediately across the international border from Royal Belum is the Hala portion of Hala-Bala Wildlife Sanctuary which was proclaimed as a wildlife sanctuary in 1996. It demarcates the southernmost rain forests in peninsular Thailand with 434 square kilometers covering the Sangalakiri Range in Narathiwat Province. Although they are a part of the same reserve, Hala Forest is in Amphoe Betong in Yala Province and Amphoe Chanay in Narathiwat Province while Bala Forest, the only part that is open to the public, spans Amphoe Waeng and Amphoe Su Khirin in Narathiwat. The fertile evergreen forest supports a density of huge dipterocarp trees and is home of almost all hornbill species found in Thailand. has 9 out of 12 species of hornbills in Thailand. These include the wrinkled hornbill, helmeted hornbill, Oriental pied hornbill, great pied hornbill, white-crowned hornbill, bushy-crested hornbill, Malayan rhinoceros hornbill, black hornbill, and wreathed hornbill.

Many of the animals found here are on the list of nearly-extinct animals of Thailand. They include the siamang that is totally black in color and nearly double the size of the white-handed gibbon. There is also the agile gibbon that is usually found on Sumatra, Borneo and northern Malaysian jungles and southern Thailand. A survey discovered that four types of protected mammals, which are the Sumatran serow, tapir, marbled cat, and Asian two-horned rhinoceros, inhabit the area.

3.4.3 Royal Belum State Park- Bang Lang National Park

Immediately to the west of Hala-Bala Wildlife Sanctuary is Bang Lang National Park located in Yala Province. It has fertile forests, waterfalls, and caves. Its complex high mountains alternate with hills and plains. It's the watershed area of many streams which then combine to be many important rivers which are Pattani river, Sai Buri river, To Mo canal, Klong Bala canal and Klong Ban-jed canal. Wild animals found in this park include barking deer, serow, wild pig, monkey, langur, gibbon, tapir, guar, Sumatran rhinoceros, banteng, etc. Many birds can be found as well, including the White-rumped Shama, Red-whiskered Bulbul, etc.

Ulu Muda FR/Padang Terap FR- San Kala Khiri National Park

Across the border from Ulu Muda in Kedah is th San Kala Kiri National Park, located in Sabayoy District, Song Khla Province. This park includes Toa Thep Mountain National Forest Reserve, Khao Tan Forest Reserve, Kwan Chedi Forest, Praya Mai Forest, Kwan Kham Pang Forest, Kwan Rasor Forest Reserve, Kwan Nam Ron Forest, Kwan Sor Ror Forest, Bang Pla Forest and Toa Thep forest. Animals found here include seladang, serow, elephant, roulroul, wreathed hornbill, Oriental pied hornbill, Malayan rhinoceros hornbill, great pied hornbill and great Indian hornbill.

3.4.4 Bukit Berangin FR- Khao Nam Khang National Park

Also across the Thai-Kedah border is the Khao Nam Khang National Park. The parks consists of complex mountain ranges stretching southward till Bukit Berangin Forest Reserve in Malaysia. It's an important area which forms the headwaters of many streams (e.g., Na Twee canal, Prik canal, Tub Chang canal, Klong Sai Kaow canal, etc.). Wild animals living in the park include wild pig, bear, barking deer, serow, short-tailed monkeys, gibbons, panthers, civets, tapir, mouse deer, turtles and various species of birds include hornbills, great agus pheasants, red jungle fowls, tree partridges, green peafowls, white-rumped shamas, hill mynas, etc.

3.4.5 Recommendations

It is important that the existing trans-boundary connectivity between Malaysia and Thailand is maintained. The value of the various protected areas on both side of the border is considerably enhanced by the protection of the habitat on the opposite side.

In order to coordinate the management of transboundary protected areas, it is suggested to make use of the various mechanisms available under ASEAN. In addition, proposals on trans-boundary protected areas can be brought up at the Malaysia-Thailand Joint Commission.

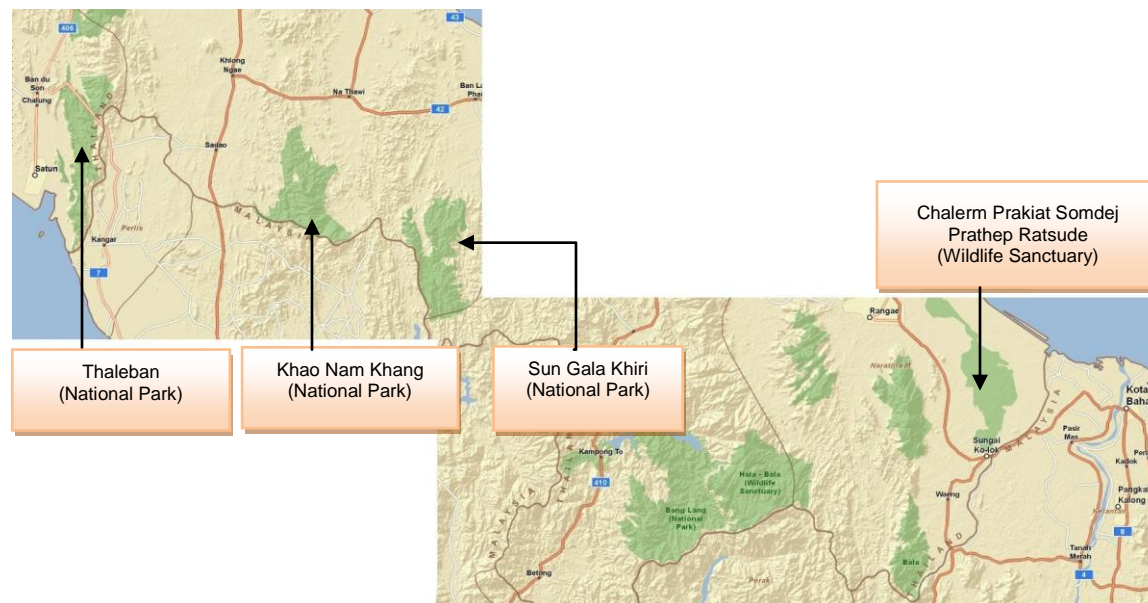
Indeed, from the Thai side, a series of proposals have already been raised and approved by delegates during the 1995 Bangkok workshop on regional trans-boundary protected areas for biodiversity conservation in the Indo-Malaya Peninsular. Two of the key proposals to be re-emphasized here are as follows:-

- i) **19.** *Inform the border committees under the various Foreign Ministries for the countries of the Indo-Malayan region of on-going trans-boundary conservation activities. This will expedite government permission for certain border activities, and help place the issue of trans-boundary conservation on border committee agendas.*

- ii) **20.** Draft a regional agreement, to be initiated by Thailand, on trans-boundary biodiversity conservation to be signed by the governments of the Indo-Malayan region including: Cambodia, China, Lao P.D.R., Malaysia, Myanmar, Thailand and Vietnam. Such an agreement, with support by The Ministry of Foreign Affairs, will promote awareness of the importance trans-boundary biodiversity conservation at the highest government levels.

In Malaysia, where land is a state matter, it is important for the Federal Government to assist the respective state governments in the creation and planning of trans-boundary protected areas. Assistance can take the form of funding feasibility studies for the establishment of each of the proposed sites. This would enable the respective state governments to evaluate the benefits of the trans-boundary protected areas and at the same time determine the kind of mechanism needed to manage them sustainably.

Figure 3.4.1: Transboundary Linkages



04

general guidelines for ecological linkages

Animal Crossing
Guidelines For Human – Wildlife Conflict
Anti-poaching Guidelines For Corridor Linkages
Ecotourism Guidelines For Corridor Establishment
Settlement And Village Development In Ecological Corridor
Guidelines For Sustainable Agricultural Management Practices In
Plantations
Guidelines For Forestry And Reforestation In Ecological Corridor
River Reserve Guidelines In Ecological Corridor





4.0 GENERAL GUIDELINES FOR ECOLOGICAL CORRIDORS

The guidelines in this section provide general framework for implementation of initiatives for ecological linkages in CFS1, and when planning for development within and adjacent the identified ecological corridor.

The guidelines listed below are the guideline that has been used by relevant agencies. However based on this study, these guidelines have been improved (value add) from the existing guideline based on overseas guideline and experiences.

4.1 ANIMAL CROSSING

4.1.1 Introduction

All linear infrastructure, such as roads, highways, railways and pipelines, form barriers that fragment or isolate habitats and restrict animal movement, and consequently the natural functioning of a myriad of ecological processes at the landscape level. Linear barriers are especially detrimental to large animals, which have a large home range such as elephants and tigers.

In roads and highways, animals crossing the road pose a safety hazard to road users as well as to animals. In Europe, for example, it is estimated that some 500,000 vehicle collisions with ungulates occur per year, with 300 people killed and 30,000 injured. In Malaysia, although most road fatalities have involved collision with domestic cattle, there remains a high risk of accidents, especially in areas where large mammals such as elephants and tapirs frequently cross the road, such as along the second east west highway between Gerik and Jeli. Roadkills involving smaller animals are common in many areas, with the usual affected wildlife being macaques, civets, pangolins, snakes and monitor lizards.

4.1.1.1 How to use this guideline

The objective of this document is to provide planners and decision-makers with a general framework of the process required in the planning and designing of wildlife crossings for linear infrastructure (with emphasis on roads and highways). A step-by-step planning framework is provided in the text, including the general approach and critical issues to be considered in planning and design. Examples of elements in wildlife crossings suitable for specific locations are provided in the appendices.¹

¹ Forest Stewardship Council-Standard-001 FSC *Principles and Criteria for Forest Stewardship* (April 2004)

4.1.1.2 Existing Crossings in Peninsular Malaysia

Wildlife crossings in Peninsular Malaysia have been established at several locations. There are two types of existing wildlife crossings:-

- At grade crossings
- Underpass

Existing at grade crossings include the East-West Highway in Perak and the Kluang-Mersing road in Johor. These crossings are marked by advisory traffic signs indicating wildlife crossings. The JKR Arahan Teknik provides standard signages for wildlife crossings. In the case of new roads, advisory traffic signs have been placed by the road designers where required. For example in the new Cameron Highlands – Kuala Lipis road, traffic advisory signs indicating deers have been put in place at strategic locations. **Figure 4.1** shows the sign as installed along the Kluang-Mersing road.

Existing underpasses are located along the new Kuala Berang-Gua Musang road in Terengganu. These underpasses in the form of viaducts were specially created to allow elephants to pass below the road. Three (3) viaducts were constructed. **Figure 4.2** shows one these viaducts. It is noted that elephants have been observed to pass below these viaducts. Perhilitan intends to construct electrical fences along the highway to discourage elephants and other wildlife from crossing at grade. The animals would be funneled to use the newly constructed underpasses.

4.1.2 Planning Wildlife Crossings

The planning and construction of new major infrastructure projects in Malaysia normally requires an Environmental Impact Assessment (EIA). The EIA would contain valuable information on the likely wildlife affected by the project. The EIA may recommend that wildlife crossings be implemented for the project. Where no EIA is conducted, e.g. in road upgrade projects and new minor roads, there is a need for the planner or road designer to make a rational decision if wildlife accommodations need to be considered. The Massachusetts Department of Transportation (DOT) for example has a requirement scenario for wildlife accommodation.



Figure 4.1: Wildlife Advisory Signs along the Kluang-Mersing Road



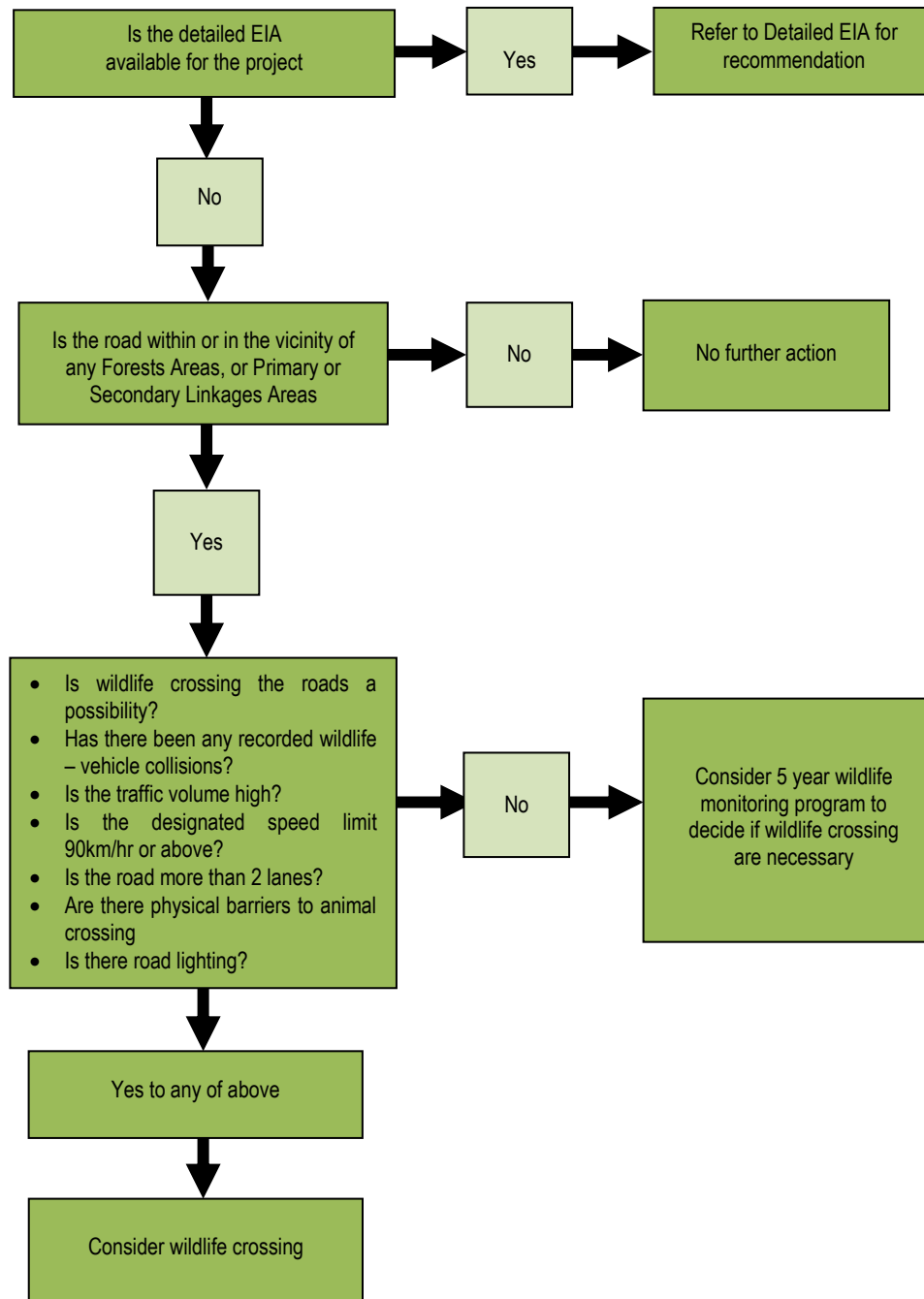
Figure 4.2: Existing viaducts along the Gua Musang – Kuala Berang Road

A proposed decision flow chart for roads (modified from Massachusetts DOT Guidelines) is shown in **Figure 4.3**. The flow chart takes into account factors such as the presence/absence of wildlife, road alignment and road characteristics (volume, design speed etc.) and forms a basic checklist to see whether wildlife crossings need to be considered.

The flow chart uses the following of criteria to decide if a wildlife crossing needs to be considered are based on the following :-

- Presence of Wildlife - If there is a possibility that the road may affect wildlife, crossings should be considered.
- Records of Wildlife Kills/
Wildlife Collision/Conflicts - Record of vehicle – wildlife collisions in Malaysia appears scarce. However, these records are essential as they would prove that wildlife is crossing roads in the area, and therefore wildlife crossings may be necessary.
- Traffic Volume - A higher traffic volume will create a barrier to animal crossing a road, and thus the incidence of roadkill would increase.
- Design Speeds - Higher design speeds would increase the probability of wildlife collision.
- Physical Barriers to Crossings - The road design may deter wildlife crossing. For example, high cuts and fill embankments, deep drains, retaining walls are obstacles that impede wildlife movement.
- Number of Lanes - The number of lanes is an indicator of the actual paved width that the wildlife has to cross. More lanes would generally lead to higher probability of wildlife collision.
- Lighting - Artificial lighting on roads may deter animal movement.

Figure 4.3: Decision Flow Chart



Once a decision has been made to consider wildlife crossings, the following needs to be considered:-

1) Plan at Landscape Level

Although linear infrastructure take up just a small percentage of the landscape, it is important to look at the larger picture when planning for wildlife crossings. This may entail looking at the river basin, or at the entire forest habitats on both sides of the linear infrastructure.

2) Types of Animals

Knowledge of the natural habitats on both sides of the infrastructure, and the animals that are, or could possibly be found there is important to determine the form of connectivity needed. This would enable the planner to know what type/species of animals to cater for, i.e. which need to cross along the infrastructure, based on the species general behavioural ecology and habitat requirements, including movement patterns. For example, gibbons are arboreal species which move across a certain range, but move in the tree canopy, and seldom come down to the ground.

Species lists may be obtained in areas where the Department of Wildlife and National Parks, or NGO's such as WWF-Malaysia and Wildlife Conservation Society (WCS) have conducted surveys. If such lists are unavailable, additional wildlife surveys may be required. The presence of rare, endemic or threatened species may also increase the importance of the crossing.

3) Location of Crossing

Location of crossings should take into account the existing movement patterns of the target species. Although exact points are not easy to ascertain, a number of features in the landscape indicate the most likely natural movement patterns of the animals the landscape. The main landscapes are along river valleys, and along ridges.

Data on roadkills would provide an indication of where animals have been crossing along existing roads and highways. Such data may be obtained from state Wildlife Department offices and JKR. However, in most cases, such lists are neither detailed nor comprehensive. Frequent road users, such as lorry drivers, or villagers living in the vicinity, may also be a good source of anecdotal information.

4) Infrastructure Type and Characteristics

The type of infrastructure would also have a bearing on the crossing. A highway would preclude the use of at grade crossings due to high traffic volumes and the need to maintain travel speeds. Similarly construction of an underpass on a 3 lane dual lane carriage way highway would involve major engineering works as opposed to the works for an underpass on a single lane road. In addition to roads, other linear infrastructures that may require crossings include railway lines and pipelines.

On existing roads, information on future road upgrades and realignments are also necessary. This will assist in correctly locating probable locations for wildlife crossings. In addition, wildlife crossing structures could be incorporated as part of a road upgrade/improvement program. Information on road upgrading programs can normally be obtained from JKR and the Highway Planning Unit of the Ministry of Works.

4.1.2.1 Functional Considerations in Wildlife Crossings

To successfully plan, design, construct and maintain a wildlife crossing, an understanding of the wildlife behaviour is essential. As the target wildlife varies depending on location, input from a wildlife expert/biologist is absolutely critical in the implementation of wildlife crossings. An appreciation of the engineering aspects of the infrastructure would also assist the planner in arriving at a pragmatic solution. Some of the factors that will need further consideration include:-

- Species type and frequency of crossing
- Single specie crossing or multi-species crossing
- Size of crossings – some species prefer larger crossings than others
- Approaches to the crossing – some species prefer approaches to be vegetated
- Light and moisture – some species may require light and moisture within and at the approaches of the culverts
- Openness /view – some species may prefer unobstructed views
- Noise and human activity– most wildlife prefer to be away from human activities

Road characteristics that affect wildlife crossings include the following:-

- Traffic Volume – high volumes precludes at grade crossings
- Traffic Speed – high speed increases risks of vehicle collision
- Road reserve width – dictates how much area the sides of the roads are clear of landscaping
- Pavement width and number of lanes – dictates the length a crossing has to be constructed
- Road shoulder width/type (paved/unpaved) –dictates the length of the crossing
- Bridges, culverts, tunnels, viaducts – may serve as wildlife crossings as well as engineering purposes
- Cut Embankment/Fill embankments – steep slopes may deter animal movement
- Road Side Drains – steep sided/large drains may deter animal crossings
- Road guardrails and fencing – may become barriers to animal crossings
- Road Lighting – may deter species that are sensitive to artificial light

4.1.2.2 Sitting of Crossings

The approach for sitting of crossing structures should be based on a detailed study of wildlife behaviour. This is the best approach to ensure the success of the crossing. It will, however, require detailed observation and recording of the species, over a relatively long period of time. The locations of crossings are then identified based on the animal characteristics. Inputs from biologists are absolutely critical. This approach is recommended.

There are instances where there is anecdotal information that wildlife is crossing an existing road but no detailed study/records on the wildlife are available. In this even, it is suggested that a study is conducted first on the wildlife behavior. If this is not feasible in the short term, crossings can be proposed based on the recommendations of a biologist together with engineering input on feasible locations of crossings. In this scenario, it is recommended that only at grade crossings and/or culvert underpasses are considered. Structures such as tunnels/viaducts are costly structures and require a high degree of certainty of success before they can be considered for implementation.

4.1.3 Types of Wildlife Crossings

There are many types of wildlife crossings available. The form, dimensions and materials used for each construction of the wildlife crossing varies depending on suitability with respect to the target species. The wildlife crossing can take the following forms:

- At grade crossing – where wildlife crosses the road pavement
- Underpasses – where wildlife crosses below the road
- Overpasses- where wildlife crosses above the road

4.1.3.1 At Grade Wildlife Crossing

At grade crossing essentially means that the wildlife will cross the pavement of the road or the railway lines. To avoid collision with the wildlife, traffic behavior need to be controlled. It is recognized that at grade wildlife crossings are not the ideal solution with respect to maintaining connectivity. None the less, at grade crossings can be used as an interim measure where funding is limited or there is limited knowledge of wildlife behavior.

To prevent collisions, an at grade crossing will require:-

- Sufficient road signages/warning signs
- Reducing speed limits

In Northern America and Europe, additional measures to prevent wildlife collisions have been tried such as:-

- Light reflectors
- Fences and barriers
- Heat detectors coupled with warning signs.

Experience in Europe and North America indicates that the success of these measures appear mixed. Drivers tend to ignore road signs and warning sign to slow down for animals.

In the Malaysian context, the wildlife under consideration does not appear to move in large herds. Elephants move in relatively small herds. Vehicle-elephant collisions are uncommon. Nevertheless, it is recognized that despite allowing animals to cross the roads, the road still represents a barrier which deters connectivity. The advantages and disadvantages of at grade crossings are shown in **Table 4.1**.

Table 4.1: Advantages/Disadvantages of At Grade Wildlife crossings

Advantages	Disadvantages
<ul style="list-style-type: none"> • Can be implemented on existing roads easily • Requires little maintenance • Can be applied over a fairly wide stretch of road. • Can be upgraded to underpass/ overpass in the future • Low costs 	<ul style="list-style-type: none"> • Does not promote/encourage connectivity • Does not eliminate risks of vehicle-wildlife collision • Success depends on drivers behaviour • Not suitable for roads with high speed limits. • Not suitable for roads with high traffic volumes

Suggested elements of road design incorporating wildlife crossing at grade include the following:-

- Reduce speed limit - It is suggested that for these stretches the National Speed limit of 90km/hr is reduced to 60 km/hr. Transverse bars to be installed on the road at entrance and exits of crossings.
- Install more advisory road signs.
- Install gantry type road sign at the entrance and exits of the wildlife crossings.
- Slopes/retaining walls - Artificial slopes shall be avoided, where possible. When necessary, slopes shall be as gentle as possible, berms shall be as wide as possible (2.5m including berm drains) to facilitate animal movement. Retaining walls, granite slopes, anchored earth slopes to be avoided, if possible.
- Landscaping - Landscaping shall be provided, where possible, to facilitate animal movement.
- Reserve Width - The reserve width shall be the minimum required for the road standard.
- Pavement Width and Number of Lanes - The pavement width shall be the minimum required for the relevant road standard.
- Guardrails - The guardrails shall be the minimum required for safety reasons. Jersey barriers shall be avoided altogether.
- Road Side Drains - The road side drains shall be shallow and wide rather than deep and steep sided. This will enable wildlife to cross over.
- Fencing - The road shall have no fencing if possible.
- Lighting - The road shall not have of any form of artificial lighting.
- Roadside Furniture/Infrastructure – roadside furniture and infrastructure that may hamper wildlife movement (such as above ground water pipes) shall be avoided.

All the above measures should, however, be consistent with good engineering practice for road design and comply to the relevant safety standards for roads. Some of these measures are shown in **Figure 4.4**.

4.1.3.2 Underpasses

Underpasses are where animal cross below the road/rail. Underpasses can take many forms (**Figure 4.5**). Some of the more common are:-

- Viaducts
- Bridges
- Culverts & Pipes of various types

In Peninsular Malaysia, viaducts have been used to provide crossings for elephants along the Gua Musang – Kuala Berang road. It is understood that since completion of these viaducts elephants have been observed to use the underpasses. Shrubs and plants have been introduced to facilitate animal crossings. In addition, Perhilitan intends to fence the adjacent road reserves to guide elephants to use the underpasses rather than to cross the road at grade.

The advantages/disadvantages of underpasses are summarized in **Table 4.2**.

Table 4.2: Advantages /Disadvantages of Underpasses

Advantages	Disadvantages
<ul style="list-style-type: none"> • Promotes/encourages connectivity • Eliminates vehicle – animal conflict • Does not disrupt traffic • Can be incorporated into road design • A variety of options can be chosen dependent on the species considered 	<ul style="list-style-type: none"> • Relatively high costs if viaducts or bridges • Wildlife needs to be funnelled to use the crossing

Characteristic of underpasses that will facilitate wildlife crossings are as follows:-

1) Dimensions

In general, the bigger the underpass the better it is. For viaducts and bridges to be used for elephants, the suggested clear headroom is 12m and the minimum span between piers is 12m. For round culverts and pipes, the suggested size is between 300mm to 1500mm depending on the species under consideration. It is noted that culverts for drainage can also be used as wildlife crossing. These pipes/culverts should therefore be sized for dual purposes i.e. drainage and wildlife crossings.

2) Gradients/Slopes

For bridges and viaducts, the embankments along the abutments need to be fairly gentle if a flat passage is not available. For culverts/pipes, the gradients within the culverts shall be at the natural stream gradient to maintain constant stream flows. Drops, plunge pools or constrictions along the culvert should be avoided.

3) Cover/Approaches

The areas below bridges and viaducts shall be landscaped to provide cover for wildlife. Approaches to culverts and pipes shall be suitably prepared to facilitate animal crossing.

4) Noise

These are to be kept to a minimum, where possible.

5) Light

Some species require natural lighting in the crossing. The use of slotted drains or grating at the medians of the crossing can provide natural light.

6) Use of Barriers and Funneling Structures

These are fences and other barriers used to funnel wildlife towards the crossing structures. Escape structures could also be considered. Refer to **Figure 4.6** and **Figure 4.7** for examples of barrier and escape structures.

7) Use of Natural Substrates

The bottom of the crossing structures could be natural substrates, where possible. For example, local material and vegetation can be used to fill the bottom floor of box culverts/pipes to simulate the natural environment as much as possible.

4.1.3.3 Overpass Crossing/Ecoducts

Overpass crossings are where wildlife crosses over the infrastructure. These overpasses can take the following forms:-

- Overbridges – specially constructed bridges for wildlife to cross over the road/rail. If large, they are also called ecoducts.
- Tunnels – where the road/rail goes below grade while the wildlife crosses over the road/rail.
- Crossing Cables – where cables/wires are strung across a road to facilitate small animals such as squirrels and monkeys to cross

Suggested characteristics of an overpass bridge:-

- Width - Studies in Europe have recommended that ecoducts shall be at least 50m wide. However this is based on species in Europe and no studies in Malaysia are available. Assuming that the species in considerations are elephants a width of 30m (100') is suggested, subject to detailed studies.
- Cover/Landscaping -. In Europe, ecoducts have been installed with ground cover and planting on top. It is suggested that this practice is adopted. A nominal ground cover of 1.5m would enable shrubs and small trees be planted on top. The choice of landscaping to be determined by the biologist.
- Approaches - In the case of tunnels the approaches to the tunnel do not require modification. For overbridges, it is suggested that the natural terrain is retained. Otherwise a gentle gradient (say 1 in 10) is probably required.

The general forms of an overpass are shown in **Figure 4.8**. There are no known examples of overpasses/tunnels built specially to cater for wildlife crossings in Peninsular Malaysia. Tunnels in Malaysia such as the Genting Sempah tunnel along the Karak Expressway and the Changkat Jering tunnel north of Ipoh along the North South Expressway are in excess of 1,000 m and will enable wildlife to cross on top. It is suggested that where tunnels are a viable engineering option for a road, these tunnels shall be promoted as eco-tunnels as well. In the case of overpass bridges, detailed feasibility studies on the location and need are carried out before they are implemented.

The advantages/disadvantages of overpasses are shown in **Table 4.3**.

Table 4.3: Advantages/Disadvantages of Overpasses

Advantages	Disadvantages
<ul style="list-style-type: none"> Promotes/encourages connectivity Eliminates vehicle – wildlife collision Does not disrupt traffic 	<ul style="list-style-type: none"> High cost (except for cable crossings) High maintenance (except for cable crossings) Wildlife needs to be encourage to use the overpass especially in the case of overbridges, may require fencing the road

4.1.3.4 Selection of Type of Wildlife Crossing

Based on the species under consideration **Table 4.4** summarizes the available options.

Table 4.4: Summary of Options

Animal Category	Road Type	Crossing Category					
		At grade	Overpass			Underpass	
			Over bridge	Tunnel	Cables	Bridges Viaduct	Culverts & Pipes
Large Mammals	Highways & Major Roads	X	✓	✓	X	✓	X
	Minor Roads	✓	✓	✓	X	✓	X
Small Mammals, Reptiles	Highways & Major Roads	X	X	X	✓	X	✓
	Minor Roads	✓	X	X	✓	X	✓
Others (Birds, Fish.)	Highways & Major Roads	N/A	X	X	N/A	X	✓
	Minor Roads	N/A	X	X	N/A	X	✓

Notes:

✓ Likely to be suitable

X Not likely suitable due to either size of wildlife, high probability of vehicle–wildlife collision or high construction cost of crossings
Funnelling/escape structures/barriers may need to be incorporated together with the crossing

It is noted that crossings constructed for the larger mammals (e.g. tunnel) would also enable the smaller mammals and reptiles to cross

4.1.4 Construction

Installation of wildlife crossing on an existing road shall be carried out with minimal impact to the environment. Particular care shall be taken if construction works for the crossing are located along known wildlife trails. The use of natural materials shall be carried out, where feasible.

4.1.5 Post Construction / Maintenance

All roads, bridges and culverts in Malaysia are maintained by the road authority or concessionaire holder. Periodic maintenance of underpasses or overpasses shall be required.

1) Maintenance

- Maintain structures to ensure they are clear of obstructions
- Maintain fencing to minimize duration of breaches
- Maintain slopes, river banks for erosion

2) Monitoring

For all specifically constructed wildlife crossing, it is suggested that the road authority or Perhilitan carries out post construction monitoring to measure the degree success (or failure) of the crossing. Valuable data, can be obtained on the following:-

- Type species of wildlife using the crossing
- Numbers of wildlife
- Frequency of crossings
- Time of crossings



The data collected can then be used to improve the crossing and to assist in the design of future crossings.

Figure 4.4 : At Grade Crossings

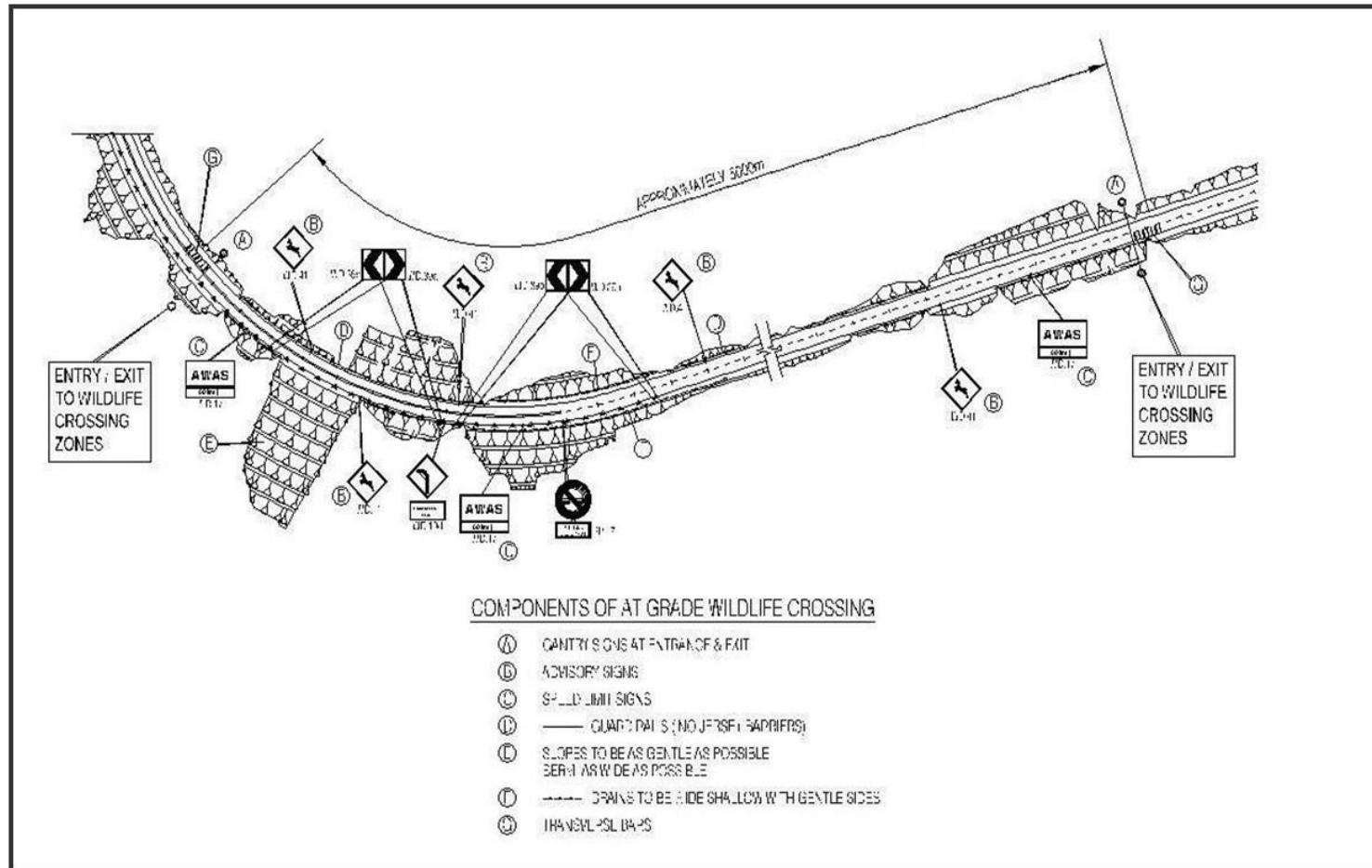


Figure 4.4 (continued) - Details

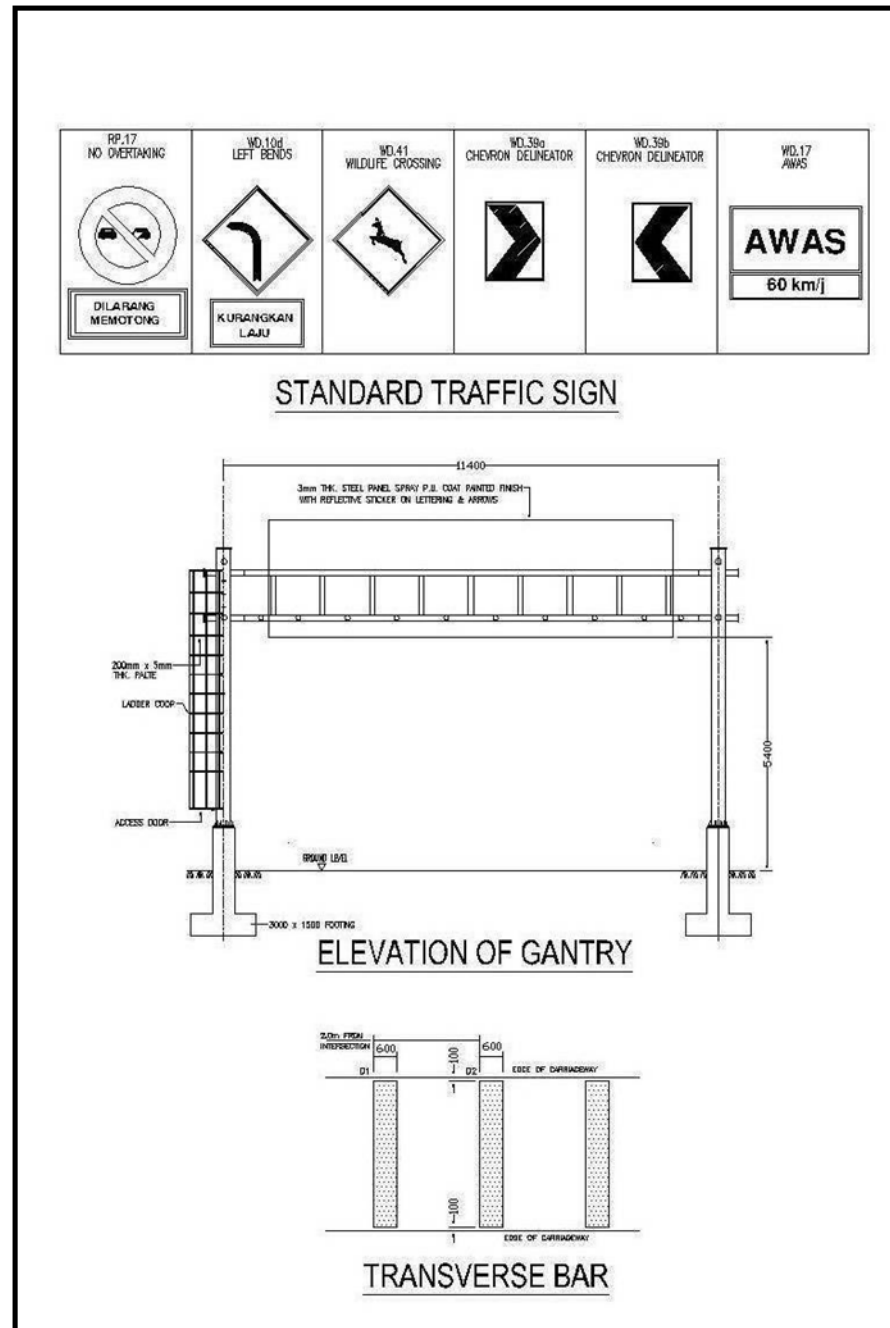


Figure 4.5: Wildlife Crossing Structures – Underpasses

Category: Underpass
Type: Single span bridge
Description: The structure rests on abutments with no intermediate support column. Also called open span bridge.
Benefits: Provides pier free passageway
Disadvantages: More expansive than multi span bridge



Category: Underpass
Type: Multiple span bridge
Description: One or more intermediate support columns between abutments.
Benefits: Able to bridge across greater widths
Disadvantages: Piers may restrict animal movement

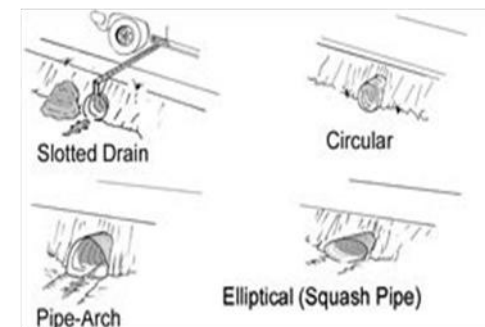
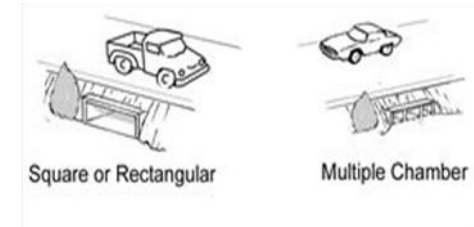


Category: Underpass
Type: Viaduct
Description: Long, multiple span bridge. Has been incorporated in the construction of two highways in the Peninsular i.e. along the Simpang Pulai - Kuala Berang highway (three viaducts) and along the Grik – Kupang highway (five viaducts).
Benefits: Able to span long widths, large areas for animal movement
Disadvantages: Generally more expansive



Figure 4.5 (continued)

Type:	Box culvert
Category:	Underpass
Description:	Square or rectangular corrugated with four sides, including the bottom. Box culverts may be arranged in a horizontal series of small culverts to form multiple chambers.
Material	Precast concrete, cast-in-place concrete, wood
Benefits:	Relatively inexpensive
Disadvantages:	Suitable for smaller/medium sized animals only



Type:	Culvert (continuous)
Category:	Underpass
Description:	Culvert is continuous in circumference. The lower portion may or may not be buried. Sometimes simply called a pipe. Slotted drain culverts are continuous except for a break in the upper portion
Material	Corrugated metal pipe, Cast-in-place concrete, Precast concrete, Wood
Benefits:	Relatively inexpensive
Disadvantages:	Suitable for smaller animals only

Type:	Bottomless culvert
Category:	Underpass
Description:	Culvert is discontinuous in circumference with rounded or square top and natural surface bottom.
Material	Corrugated metal pipe, Metal pats, Precast concrete, Cast-in-place concrete, Wood
Benefits:	Relatively inexpensive
Disadvantages:	Suitable for smaller/medium sized animals only

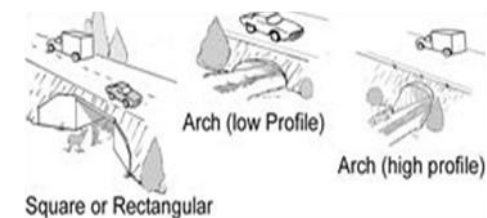


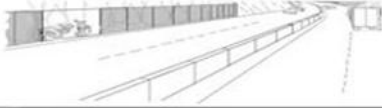
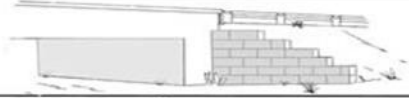




Figure 4.6: Barriers

Common Types of Wildlife Crossing Structures



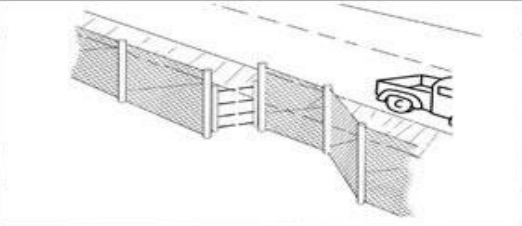
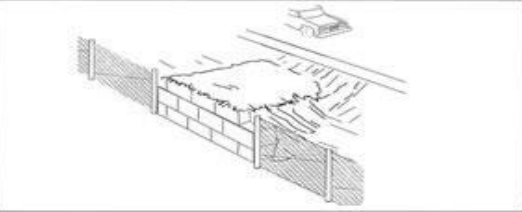
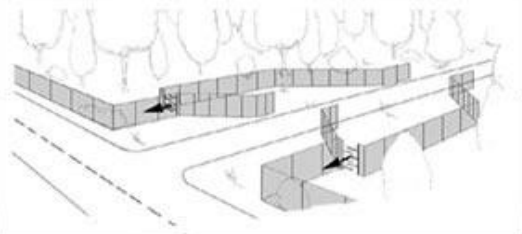
www.wildlifecrossings.info

Category	Definition	Shape	Typical Material
Barrier	Structures designed to stop movement in a given direction.		
Fence	A barrier or diversion structure usually with some type of material between support structures. Often defined by the material between the support structures. Diversion fences are sometimes called <i>drift</i> or <i>guide</i> fences.		Wire Barbed wire Woven wire Chain link Rail Plastic mesh
Electric	Electrified strands that give grounded organisms a shock when touched. Shock is typically intense, but not physiologically damaging.		Braided Rope High-tensile wire
Jersey Barrier	Structures used primarily to affect vehicles direction. Solid or solid with openings.		Concrete
Wall	Solid wall		Concrete Brick Wood
Sound Wall	A solid wall used for absorbing or deflecting sound produced from the highway.		Brick Wood Concrete Sheet Piling
In-roadway Barrier	Support structures for vehicles built over a pit and used to prevent wildlife access across a break in fencing or other barrier. Similar to a cattle guard, but designed for wildlife. Also called <i>deer guard</i> .		

Common Types of Wildlife Crossing Structures



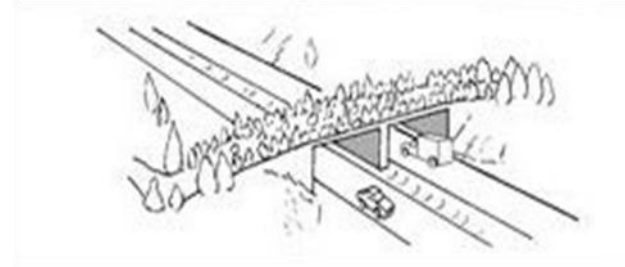
www.wildlifecrossings.info

Category	Definition	Shape	Typical Material
Escape Structure	A structure designed to allow an animal trapped on the roadway by a diversion fence to exit. They allow passage in only one direction to make it easy to escape the roadway, but difficult to enter it.		
One-way Gate	A gate designed to allow passage for the design species in only one direction.		
Ramp			
Funnel Fence			

Drawn by: pkian@coldreams.com

Figure 4.7: Escape Structures

Figure 4.8: Wildlife Crossing Structures -Overpasses



Category:	Overpass
Type:	Wildlife overcrossing
Description:	A grade separation structure designed to allow wildlife to cross over an intersecting roadway. It is usually covered with vegetation. Also called an ecoduct, wildlife bridge, green bridge, or wildlife overpass. The largest overcrossings may be called landscape corridors.
Benefits:	Provides connectivity for a variety of wildlife
Disadvantages:	Expensive
Category:	Underpass
Type:	Tunnel
Description:	The roadway bores through a substantial amount of earth, allowing undisturbed vegetation and soil on top.
Benefits:	Provides connectivity for a variety of wildlife
Disadvantages:	Expensive
Category:	Overpass
Type:	Cable/wire overcrossing
Description:	Cables or wires strung across the road to facilitate movement of wildlife such as monkeys and squirrels
Benefits:	Inexpensive
Disadvantages:	Suitable for smaller and specific species only

4.2 GUIDELINES FOR HUMAN – WILDLIFE CONFLICT

4.2.1 Introduction

Settlements and agricultural areas situated at forest fringes, including those areas adjacent to ecological linkages, are vulnerable to human-wildlife conflict (HWC), which often results in loss of income, damage to property and loss of lives. Among the examples of HWC include:

- Predation by tigers, leopards and clouded leopards on livestock and humans;
- Crop damage and damage to property, particularly by elephants and wild pigs;
- Roadkills of many wildlife species, such as civets, pangolins, monitor lizards and snakes; and
- Nuisance, particularly by macaques.

A number of initiatives have been carried out by the government and NGOs to mitigate and minimise the occurrence of HWC. For example, Perhilitan translocates ‘problem’ elephants to protected forests² and provides monetary compensation for humans attacked by wildlife according to the level of injury or death. WWF-Malaysia has been conducting human-tiger conflict (HTC) mitigation projects since 1999 in Jerangau, Terengganu state, and currently in Jeli, Kelantan state. While it is unlikely that HWC can be completely prevented, it is possible to minimise the occurrences.

4.2.2 Objective

The objective is to provide an outline of Best Management Practices (BMP) to minimise/mitigate HWC at the local level (i.e. plantations and villages).

This guide focuses on the species of most concern, i.e. elephants and tigers (including other large cats). However, this guide can only serve as a basic outline, as the issues and corresponding solutions to HWC are site-specific and need to be handled as such.

4.2.3 Best Management Practices for Human – Elephant Conflict (HEC)

1) Repellents

- a) Noise is a common repellent used especially by plantation workers to warn of human presence and frighten wild animals. Methods that have been used include firecrackers, pipes cannons or ladum (with permission by the authorities), air horns, radios, vehicle horns, shouts, rifle shots and whip-cracking.
- b) Any form of light can also be used as a repellent (e.g., oil lamps) stationed at the perimeter of plantation areas.
- c) Fire serves as a visual and olfactory repellent as smoke from the fire may deter elephants from entering the plantation.

² The removal/translocation of “problem” individuals is an expensive and risky process, and is used as a last resort.

2) Elephant-proof Barriers

- a) As elephants are able to tear down normal fences with ease, electric fencing is usually used to keep elephants from encroaching into plantations. This fence consists of one or more (usually two) strands of high-tensile galvanised steel wires strung at appropriate heights above the ground on hardwood posts. The posts are usually spaced up to 20m apart for a wire tension of 180kg.
- b) Although fairly new in Malaysia and still in the trial phase, the chili-grease fence method has been proven to be effective in other countries to keep wild elephants at bay. It works on the principle that elephants do not like capsaicin -the chemical that makes chili hot. In Africa, string fences are sloshed with chili-infused grease and equipped with alarming cowbells. In addition, briquettes of crushed chili and animal dung are burned, creating a noxious smoke that keeps elephants out of fields.
- c) Trenches have also been used as a barrier. A trench has to be at least 2m deep, 2m across at the top, and 1.5m across at the base to effectively prevent elephants from crossing over. However, trenches have a high rate of failure, especially in wet conditions when the soil is loose. Elephants dig the soil with their forefeet, partly filling up the trench to get across. FELDA has given up using this method in its estates.

3) Guarding

- a) Patrol squads may be formed to carry out daily/nightly monitoring of plantations and villages. The community-based Wildlife Protection Unit operating in the sub-district of Lubok Bongor in Jeli, for example, has shown significant reduction of elephant encroachment into plantations as a result of nightly patrolling.
- b) A watch tower, built on trees or as a standalone structure, can support the patrolling squad in alerting elephant encroachments.
- c) A combination of patrolling squads and noise repellent is the most common and effective way to chase elephants from plantations.

4) Protection of Habitats and Food-Sources

- a) Each and any of the above techniques must be used in combination with the protection of elephant habitat and natural food sources. The animals have to have alternatives to raiding the plantations. It is also critical that they are not bottled up into small patches of forest. In other words, wildlife corridors between patches of natural habitat are an essential part of the mix.

4.2.4 Best Management Practices for Human – Tiger Conflict (HTC)

1) Better Livestock Husbandry

- a) Implementing proper cattle management practices, such as keeping cattle in enclosures / paddocks during the tiger's active hours.
- b) Erecting tiger-proof fences around cattle enclosures / paddocks.
- c) Identifying suitable / safe areas for paddocks and cattle grazing areas which are far from tiger-range areas
- d) BMP for better livestock husbandry can be based on work that has already been done by PERHILITAN and WWF.

2) Creating a Safer Working Environment

Those working in oil palm estate, orchards and rubber plantations bordering forests are vulnerable to tiger attacks. However, a number of practical steps can be taken to mitigate this, namely:

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- a) Tigers are by nature experts at ambush and they tend to be reluctant to strike if the potential prey sees them first. Therefore, dense shrubs and undergrowth in oil palm estates, orchards and rubber plantations should be removed in order to deprive the big cats of cover.
- b) Workers should be equipped with repellents that make loud noise when working in these areas, in order to scare off tigers and wild boars. These include firecrackers, air horns, and radios. The workers should use these repellents when they enter the area, as well as at intervals (e.g. every 30 minutes) to ensure that the animals are aware of continuous human presence in the area.
- c) Oil palm fruits that litter the ground should be minimised, as these tend to attract wild boars which in turn attract tigers into estates.

3) Protection of Habitats and Food-Sources

- a) For the same reason as in the case of elephants, the protection of natural habitats and food sources is essential, along with access to them via wildlife corridors. However, in the case of predators, it is also essential to protect the prey species populations from depletion by hunting. For tigers to have enough natural food, pig and deer populations must be maintained at sufficient levels for the needs of the big cats. This means limiting, or perhaps banning altogether, the hunting of pigs, rusa and kijang.

4) Prevention of Poaching

- a) Another common reason for tiger predation on livestock and humans is because they have been injured by snares or bullets, and are no longer able to hunt their natural prey species. Therefore, the prevention of poaching is an important element in reducing HTC.

4.2.5 Best Management Practices for Human – Wildlife Conflict (General)

1) Education and awareness

- a) Printed material, including posters and leaflets, and video presentations are useful to provide information to the local communities.
- b) Awareness programmes, including dialogues with local communities and school activities in collaboration with NGOs (e.g. WWF-Malaysia) are useful to establish dialogue with the local communities, and to help them to gain a better understanding of the situation and issues.
- c) Training and implementing model projects are useful to provide the affected communities a better understanding of what is required to implement the BMPs.

2) Incentives

- a) Formulate a suitable financial scheme to enable local communities to implement the various guidelines above.
- b) Manage wildlife conservation as a part of eco-tourism development for the local communities where the monetary benefit is from the tourism attracted to the area.

4.3 ANTI-POACHING GUIDELINES FOR CORRIDOR LINKAGES

4.3.1. Introduction

The objective of the CFS Masterplan is to re-establish, maintain and enhance connectivity between the most significant or important remaining areas of natural forests in Peninsular Malaysia. One major concern is that these areas may concentrate the movement of animals, and thus become 'hotspots' for poaching of wildlife.

Illegal trade in wildlife is a lucrative business, mainly because there is a high global demand for animal parts. As such, poaching is rampant in Peninsular Malaysia; and is not only carried out by locals, but also by foreigners. If preventive measures are not taken to ensure that ecological corridors in the CFS1 are not utilized by poachers, then the CFS would fail to serve its purpose to maintain wildlife populations. On the contrary, it may even be detrimental to wildlife.

4.3.2 Objective

The objective of these guidelines is to list key steps which need to be taken to ensure that illegal hunting and the wildlife trade that provides its most powerful incentive are controlled so that such activities do not negate the purpose and effectiveness of the ecological linkages and related wildlife crossing structures. This set of guidelines is to be used by the management authority of the linkage.

4.3.3 Guidelines

To ensure the guidelines are more effective, they are devised and applied both at national and local levels.

4.3.3.1 National Level

These are as follows:

- a) Ensure adequate level of co-operation between key government agencies to combat wildlife crimes (which include all activities related to illegal poaching and trade in wildlife). The agencies include the Forestry Department of Peninsular Malaysia (FDPM), the Department of Wildlife and National Parks (PERHILITAN), State Park Management Authorities, the Royal Malaysian Police, Unit Pencegah Penyeludup (UPP) and the Royal Malaysian Customs. Particular areas to focus on include resource sharing and coordination on enforcement and monitoring, and streamlining of the databases.
- b) Formulate a national level masterplan to combat wildlife crimes. This plan should contain targets, comprehensive strategies and define roles and responsibilities of respective agencies.
- c) Ensure that laws are adequate to prevent, deter, or strictly control commercial wildlife trade (including its transport and sales), and that mechanisms are established so that laws are enforced.
- d) Ensure that laws are adequate to prevent, or strictly control, the sale of modern hunting technologies, especially shotguns, cartridges and wire snares; and that mechanisms are established so that laws are enforced. In particular:
 - o No new shotgun licences to be issued.
 - o Strict control on shotgun cartridge purchases. (This should also be enforced for RELA members).

- e) Ensure that administrative mechanisms and trained personnel are sufficient for anti-poaching laws to be enforced effectively.
- f) Minimize the construction of roads or any linear structures through linkage areas. Ensure the potential impacts of these infrastructure on wildlife (and in particular its implications on poaching activities) are assessed; and appropriate mitigation measures are put in place.
- g) Ensure that monitoring and feedback mechanisms are in place so that the local anti-poaching strategies are adaptive, realistic, and known to be having the effect of eliminating hunting pressure from the linkage areas.
- h) Promote education and awareness programmes on conservation of wildlife, and the need to reduce hunting, at all levels: decision makers, general public, schools and local communities.
- i) Measures should be applied to increase the formal responsibility of rural communities for wildlife management.
- j) Additional protected areas and/or expansion of nearby existing protected area should be considered so as to secure particular wildlife resource areas, such as salt licks, special feeding grounds, etc.
- k) A large-scale habitat and wildlife survey of the linkage areas is needed so as to identify possible poaching threats, and to provide an operational context for monitoring and enforcement.
- l) Establish a wildlife crime hotline to encourage public reporting of possible crimes against wildlife.

4.3.3.2 Local Level

These are as follows:

- a) The management authorities should work closely with the Department of Wildlife and National Parks and other relevant agencies to combat poaching.
- b) An officer should be appointed within the management authority whose particular responsibility would be to monitor events related to wildlife illegal hunting and trade, and to recommend actions as appropriate.
- c) Hunting activities should be monitored through periodic general surveys, and by review of wildlife trade.
- d) Control access points to key wildlife habitats (these may include viaducts, old logging roads and other trails leading into the jungle) through daily monitoring, stationing checkpoints or roadblocks at strategic points along the main road.
- e) Where animals have to be attracted to the use of crossing-points through such measures as establishing artificial salt-licks, these should be given operational protection and, if possible, they should be withdrawn once the animals are used to the route.



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- f) Enforcing current laws against poaching and on the use of different hunting technologies.
- g) Ensure that mechanisms exist so that community members are closely involved in monitoring of hunting activities [refer to guideline (h)(i)].
- h) Increase the formal responsibility of rural communities for wildlife management. These should include:
 - i) Appointment of paid individuals from such communities, such as the appointment of “Honorary Wildlife Rangers” by Sarawak Forest Department (1999) or “Honorary Wildlife Wardens” by Sabah Wildlife Department (2002) to assist in carrying into effect provisions of the respective wildlife conservation laws or as a mark of recognition of valuable services rendered to wildlife and wildlife habitat conservation in the state;
 - ii) Gazettement for exclusive hunting rights for specific communities in forests outside the linkage areas.
- i) Reduce the local demand for wild meat by establishing programmes to provide domestic animals (or other sources of protein for rural nutritional needs).
- j) Limit or prevent the conversion of land under linkage areas; thereby maintaining essential habitats for wildlife and limiting access for poachers.
- k) Establish registers of local residents allowed to hunt; and mechanisms to ensure that non-registered outsiders cannot hunt there.
- l) Conduct education and awareness programmes targeting local community, so that they are aware of the poaching problems, potential solutions, and the long-term benefits of conserving wildlife.
- m) Explore opportunities for wildlife-based tourism.
- n) Enforcement against common offences:
 - i) Trading (buying and selling) of wild meat in urban areas
 - ii) Wild meat in restaurants
 - iii) Wild meat in rural areas
 - iv) Trading of wild animal parts as souvenirs
 - v) Trading of wild animals as medicines
 - vi) Possessing any part or derivative of all protected species
 - vii) Keeping wild animals (totally protected, protected and non-protected species) as pets
 - viii) Hunting totally protected and protected animal species
 - ix) Trade of wild animals for the international black market
 - x) Collection and trading of protected plants
 - xi) Operating a commercial wildlife farm

4.4 ECOTOURISM GUIDELINES FOR CORRIDOR ESTABLISHMENT

4.4.1 Development Plan and Management Plan of Ecotourism Products within the Wildlife Corridor

The wildlife corridor and its surrounding areas can be planned according to zones, so that different management objectives and regulations can be outlined. In general, the zones of tourism areas within the wildlife corridor of CFS1 are divided into the following categories (Table 4.5):

Table 4.5: Tourism Area Zoning Categories for CFS1

ECOTOURISM ZONES	CHARACTER	ZONING OF CFS1 WILDLIFE CORRIDOR
Sanctuary zone	Where people are excluded	None
Wilderness zone	A limited number of visitors are permitted only on foot	<ul style="list-style-type: none"> • Core Area • Buffer Area
Tourism / visitor use zone	Area where visitors are encouraged in various compatible ways. Divided into 2 subcategories : 1- Extensive Use – where park infrastructures are permitted for low density recreational use 2- Intensive Use – where relatively high concentrations of visitors are expected (paved roads, visitor centre, visitor supply store, formal campgrounds and accommodations). High degree of management attention is needed.	Tourism Area
Development zone	Concentration of tourism facilities	Gateway Town / Outside the Ecological Linkage

Source: CFS1 Study

For the purpose of the study, ecological linkages have been divided into two main components, i.e. core area and buffer area. Both the areas fall under the ‘Wilderness Zone’ of the above category, where a limited number of visitors are permitted. Ecotourism guidelines on both core area and buffer area for all primary corridors are as shown in Table 4.6 while Table 4.7 elaborates ecotourism guidelines for all secondary corridor.

Table 4.6: Primary Wildlife Corridor Ecotourism Guidelines

ZONES	PRIMARY CORRIDOR : ECOTOURISM DEVELOPMENT GUIDELINES	Refer to
Application of Guideline	<ul style="list-style-type: none"> ✓ Development within wildlife corridor within 10km from of all International and National Level Ecotourism Destinations ✓ Development within all primary linkages / corridor ✓ Ecotourism developments within areas of state ecotourism destinations such as state park which falls within secondary corridor 	



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ZONES	PRIMARY CORRIDOR : ECOTOURISM DEVELOPMENT GUIDELINES	Refer to
Core area	<ol style="list-style-type: none"> 1. No major tourism development is permitted 2. Extensive Use – where tourism infrastructures is permitted for low density recreational use 3. Only tourism facilities / structures related to wildlife viewing at safe distance (approximately 250 meters) and nature trails are allowed, provided after a thorough survey of walking time, natural characteristic and animals' behaviour. Maintenance schedule to be provided. 4. Minimum wildlife – tourist's interaction is allowed. 5. Use of automobiles and other vehicles is strictly limited. Speed control to be employed on the existing road. 6. Establish tourist rules of conduct including minimum/controlled visitation at night and in specific provided area only 7. Site planning and construction of tourist accommodation and facilities need to be : <ul style="list-style-type: none"> • Minimise high impact tourism facilities such as accommodation and road into the corridor to form impediments to movement and increase harmful edge effects. • Maximize tourism land uses adjacent to the corridor that reduce human impacts to the corridor. • Only ecolodges can be provided. Other types of accommodation facilities are not allowed. • Offer a minimum of comfortable basic needs • Unique character style • Focus on activities/education • Activities are nature-based e.g. . hiking, bird watching , caving • Development integrated with local environment • Profit maximization based on product fulfilling ecotourist expectations through strategic design, location and quality surrounding • Key attraction are the environment • Site plan designed for minimal change to existing landform • Basic infrastructure and utilities provision should be located to minimize disruptions of nature. • If located next to the corridor, put conservation easements on adjacent lots to prohibit structures nearest the corridor. • Construction material mainly wood and palm based • Contractors and supervising engineers focus on maintenance of all aspect of site quality • Temperature regulation based on overall design feature and on fans <p>In appropriate locations, install educational signs about the corridor and the species that could potentially use the corridor.</p>	<ul style="list-style-type: none"> • PL1, PL2 and, Other core areas to be identified in future detail studies of the linkages.

ZONES	PRIMARY CORRIDOR : ECOTOURISM DEVELOPMENT GUIDELINES	Refer to
Buffer area	<p>8. Operations of tourist accommodation need to follow some code of practice, including :</p> <ul style="list-style-type: none"> • Minimum wildlife – tourists' interaction is allowed. • Develop strict lighting restrictions for the tourism facilities adjacent to the corridor to prevent light pollution into the corridor. Lights must be directed downward and inward toward the facilities provided. • No domestic pets are to be allowed in the corridor. Cats and dogs should be trapped and returned to owners if they have a collar, or • No domestic pets are to be allowed in the corridor. Cats and dogs should be trapped and returned to owners if they have a collar, or brought to the animal shelter if they have no identification tags. 	<ul style="list-style-type: none"> • PL1, PL2 and, Other buffer areas to be identified in future detail studies of the linkages.
	<p>9. Promotion effort including :</p> <ul style="list-style-type: none"> • Marketing and promotion of ecological linkages with the surrounding regions tourism products (approximately 50 km). • The 5 Rs are emphasized (reduce, re-use, recycle, repair, rethink) • Hearty meals using ingredients sourced locally, often a cultural influence • Guides and nature interpreters operation • Educate tourism operators adjacent to the corridor about the regulations (lighting, mowing the buffer, no trespass, etc.) and ask each of them to watchdog the corridor for trespass. 	<ul style="list-style-type: none"> • All linkages and ecotourism areas within their vicinities
Ecotourism area	<p>10. Tourism facilities such ecolodges are encouraged. Other type of comfortable accommodation can be allowed with low-density dwellings.</p> <p>11. Encourage tourism players in practicing responsible tourism with the following code of practice:</p> <ul style="list-style-type: none"> • Contributes to local economy • Respect culture and invest in social capital • Promote local guide tours and activities • Efficient usage of resources • Responsible waste management • Commits to protecting the local environments • Develops capacity for continual improvement <p>12. Negative impacts of wildlife tourism need to be addressed. Among the impacts area:</p> <ul style="list-style-type: none"> • Direct disturbance of wildlife - Higher visitation means higher chances of disturbance • Pollution of water resources among others from land opening • Solid wastes and littering by tourists consumed by animals • Sewage pollution form unplanned tourist support facilities • Loss of vegetation in the vicinity of lodges and resorts • Hunting tourism is treat to wildlife • Trampling of vegetation due to off road driving and hiking • Alteration of ecosystems and animal behaviour due to intense tourism activities • Rapid deterioration of facilities due to heavy use, inadequate regulation, and poor management of both the infrastructures and visitors behaviour 	<p>All linkages and ecotourism areas within their vicinities</p>

ZONES	PRIMARY CORRIDOR : ECOTOURISM DEVELOPMENT GUIDELINES	Refer to
<p>Development Zone and Gateway towns</p>	<ul style="list-style-type: none"> • Higher densities of accommodation facilities can be provided. • Intensive use in tourism development zone contains most tourism facilities and services to be allowed such as visitor centre, visitor supply stores and visitors parking. • Hotels, restaurants, stores and transport facilities such as airstrips should be encouraged in gateway towns. 	<ul style="list-style-type: none"> • Within all gateway towns • PL2 (Banding Island Tourist Development Zone) • PL3 (Bandar Baru Lojing) • PL7 (Kuala Koh and Pengkalan Gawi Kenyir Lake) • SL2 (Persona Rimba Resort, Kenong) • SL7 (Pedu Resort)

Source: CFS1 Study

Table 4.7: Secondary Wildlife Corridor Ecotourism Guidelines

ZONES	SECONDARY CORRIDOR : ECOTOURISM DEVELOPMENT GUIDELINES	Refer to
Application of Guideline	All ecotourism developments within secondary linkages / corridors	
Special Management Areas	<ol style="list-style-type: none"> 1. Medium low and low density accommodations are encouraged within the Special Management Areas. Ecologdes and other types suitable to the local surrounding village settings and environments are also permitted. 2. Site planning and construction of tourist accommodation and facilities need to be : <ul style="list-style-type: none"> • Profit maximization based on product fulfilling ecotourist expectations through strategic design, location and quality surrounding • Site plan designed for minimal change to existing landform • Basic infrastructure and utilities provision should be located to minimize disruptions of nature. • If located next to the corridor, put conservation easements on adjacent lots to prohibit structures nearest the corridor. • Construction material mainly wood and palm based. Minimal use of bricks and other materials that complement the surroundings are allowed. • In appropriate locations, install educational signs about the corridor and the species that could potentially use the corridor. 3. Operations of tourist accommodation need to follow some code of practice, including : <ul style="list-style-type: none"> • Focus on nature-based activities/education e.g. hiking, bird watching, caving. Agrotourism, culture tourism, education tourism and other related to homestay programs are allowed. • Minimum wildlife – tourists’ interaction is allowed. • Develop lighting restrictions for the tourism facilities adjacent to the corridor to prevent light pollution into the corridor. Lights must be directed downward and inward toward the facilities provided. 4. Encourage tourism players in practicing responsible tourism with the following code of practice: <ul style="list-style-type: none"> • Contributes to local economy • Respect culture and invest in social capital • Promote local guide tours and activities • Efficient usage of resources • Responsible waste management • Commits to protecting the local environments • Develops capacity for continual improvement 5. Negative impacts of wildlife tourism need to be addressed. Among the impacts area: <ul style="list-style-type: none"> • Direct disturbance of wildlife - Higher visitation means higher chances of disturbance • Pollution of water resources among others from land opening • Solid wastes and littering by tourists consumed by animals • Sewage pollution from unplanned tourist support facilities • Loss of vegetation in the vicinity of lodges and resorts • Hunting tourism is treat to wildlife. No hunting seasons need to be exercise particularly during month of November every year. • Trampling of vegetation due to off road driving and hiking • Alteration of ecosystems and animal behaviour due to intense tourism activities • Rapid deterioration of facilities due to heavy use, inadequate regulation, and poor management of both the infrastructures and visitors behaviour 	All ecotourism developments within secondary linkages / corridors and their surrounding vicinities.
Forest and Riparian Reserves	<ol style="list-style-type: none"> 6. Low density accommodations / ecologdes can be allowed within suitable areas of forest reserves (such as in recreational forest, state park etc) 7. Small scale scientific and research facilities related to wildlife and ecotourism can be allowed. 8. Sustainable agrotourism activities can be encouraged except of livestock / animal rearing particularly within range of 5 kilometre distance from the edge of forests, subjected to land use class control. 	

ZONES	SECONDARY CORRIDOR : ECOTOURISM DEVELOPMENT GUIDELINES	Refer to
Development Zone and Gateway towns	9. Higher densities of accommodation facilities can be provided. 10. Intensive use in tourism development zone contains most tourism facilities and services to be allowed such as visitor centre, visitor supply stores and visitors parking. 11. Hotels, restaurants, stores and transport facilities such as trains and boat services should be encouraged in gateway towns to serve the corridor.	

Source: CFS1 Study

4.4.2 Other Related Guidelines

1) Carrying Capacity for Ecotourism Sites within CFS Wildlife Corridor

Specific carrying capacity study needs to be carried out for all ecotourism areas within the CFS wildlife corridor particularly for all primary corridors. Major factors in carrying capacity are physical/environmental or ecological, social, economic and managerial. Every development plan and management plan for ecotourism are should contain a section on carrying capacity and limits of acceptable change.

Physical/environmental factors to be considered are:-

- i) The size of the area, the size of the usable space within it
- ii) Fragility of environment
- iii) Wildlife resources
- iv) Specific behavioural sensitivity of certain wildlife to humans
- v) Topography and vegetation cover, which may conceal or reveal both visitors and damage they caused
- vi) Whether building space, water supply, garbage and sewage disposal capability are limiting factors.

Social factors to be considered in determining carrying capacity involve both local residents and visitors, and include:-

- i) Opinion of local residents
- ii) Potential future adverse social impacts on local communities
- iii) Viewing patterns, whether visitor viewing and use is concentrated in space and time
- iv) Tourists viewing pattern
- v) Visitors opinion
- vi) Availability of facilities

Management / economic factors to be considered in the exercise are:-

- i) Design and viewing spots, trails, etc for different user groups and distribution of visitor pressure
- ii) provision of adequate information and interpretation services
- iii) Durability of materials used for construction
- iv) Policies and facilities available to spread visitor usage between peak and off season

If there are signs that the environment is deteriorating e.g. erosion paths, fewer sightings of wildlife, increasing accidents rates, and the manager of ecotourism site need to initiate Limits of Acceptable Change study. The manager can decide how much detrimental change can be accepted, and modify practices when or before this limit is reached.

2) Ecotourism Site Planning

The site planning of all ecotourism development within the wildlife corridor need to abide to general principles to be followed:-

- i) All development components planned need to have certain functions in relation of facilities in the site and to overall objectives on the ecological corridor.
- ii) Man-made structures should interfere as little as possible to natural ecosystem. Where feasible, locate facilities on perimeter of the core area or in buffer area.
- iii) Recognized the optimal sociological use-limits of the site, as well as safety and convenience factors.
- iv) Design with constraints of the resource and implications. Careful identification of technical requirements needed, with consideration of whether, convenient of access and site condition.
- v) Designate a clear area for emergency evacuation of medical emergencies.
- vi) Bioclimatic design criteria should be applied with use of local materials and non-toxic materials.
- vii) Nature trails to be designed to provide path and to be interpreted. A nature trail should be short and serves the purpose of ecotourism education and awareness. Nature trails need to be clean and well maintained. Rubbish to be taken out from the ecotourism area.

4.5 SETTLEMENT AND VILLAGE DEVELOPMENT IN ECOLOGICAL CORRIDOR

For each ecological corridor, certain land use activities and development are normally permitted according to the type of ecological corridor identified (**Figure 4.9**).

4.5.1 Primary Corridor

The planning and development guidelines are as follows:

- 1) Restricted development and no human settlement. For existing human settlement and activities within the primary corridor, it shall be relocated, and private land involved will be acquired, if necessary.
- 2) The types of development that are normally permitted within the primary corridor are :-
 - Facilities for forest and wildlife management purposes
 - Scientific research
 - Selected agriculture development (refer to Sustainable Agriculture Management Guidelines within Ecological Corridor in Section 4.6).
 - Appropriate ecotourism development (refer to Ecotourism Guidelines in Section 4.4).



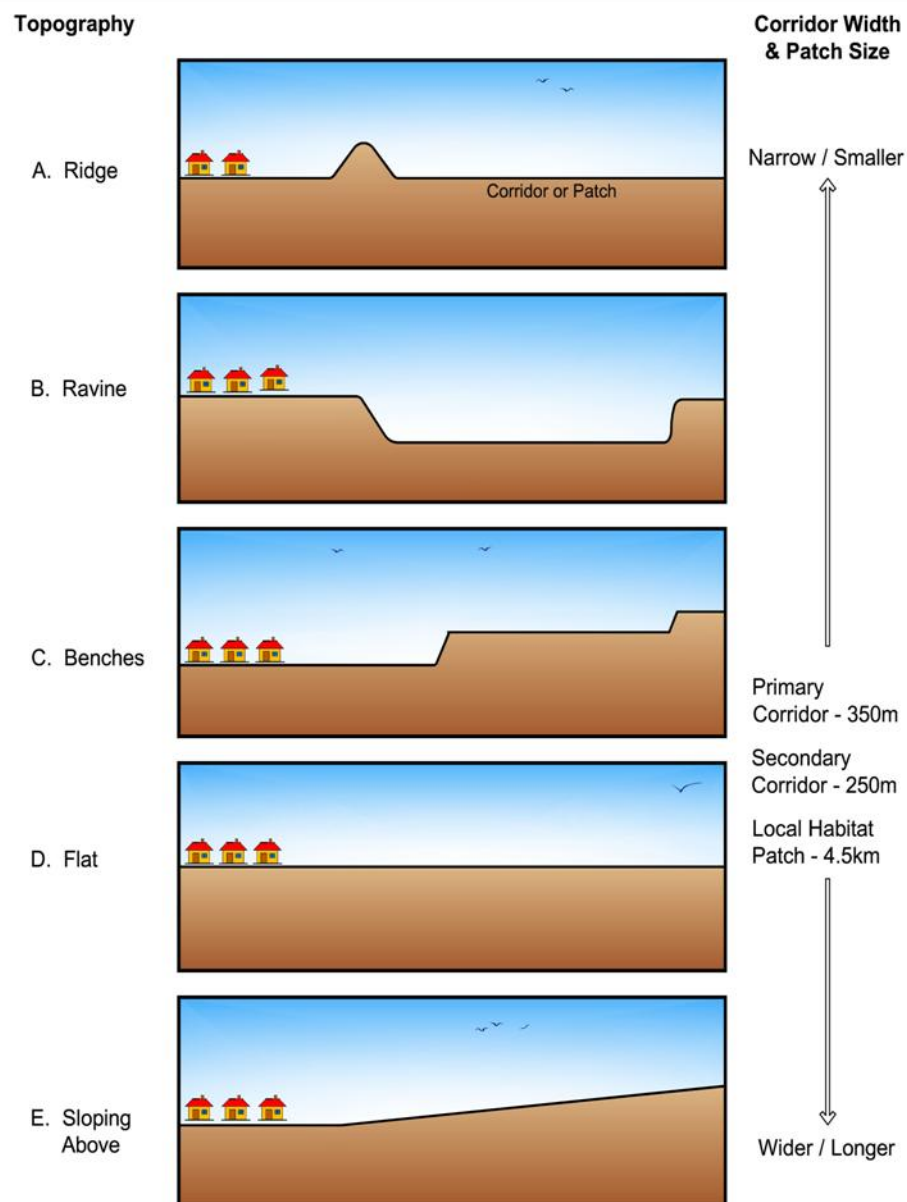
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- 3) Suitable fencing shall be installed around the adjacent settlement area to deter / prevent wildlife attack and property damage.

4.5.2 Secondary Corridor

- 1) No expansion and intensification of existing settlement are allowed except it meets local needs, e.g. children setting new households.
- 2) The types of development that are permitted:
 - Within the designated human settlement, appropriate development and human activities without causing serious auditory and olfactory disturbances that will deter wildlife movement through the ecological corridor.
 - Facilities for forest and wildlife management purposes
 - Scientific research
 - Selected agriculture development (refer to Sustainable Agriculture Management Guidelines within Ecological Corridor in Section 4.6)
 - Appropriate ecotourism development (refer to Ecotourism Guidelines in Section 4.4)
 - Any linear developments (such as roads, railways or pipelines) should incorporate appropriate wildlife crossings and associated mitigation measures.
- 3) Suitable fencing shall be installed around the existing human settlement and adjacent developed area.

Figure 4.9: Settlement Management Strategy



Note: A ridge or ravine attenuates at least 60% of light and sound. Slope >25° are inadequate for corridor function.



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4.6 GUIDELINES FOR SUSTAINABLE AGRICULTURAL MANAGEMENT PRACTICES IN PLANTATIONS

4.6.1 Introduction

The following guidelines on sustainable agricultural management practices in plantations are derived mainly to meet the requirement of the 'Round Table of Sustainable Palm Oil' (RSPO) requirements and the Department of Agriculture guidelines on the development of steep land. Oil palm plantations are the major agricultural land use in the CFS1 area, besides rubber. Some of these plantations are planted on fragile ecosystems, such as steep land. RSPO requires that production and use of palm oil must be done in a sustainable manner based on economic, social and environmental viability.

The objective of RSPO is to promote sustainable development of the oil palm industries. RSPO has developed a set of standards called the Principles & Criteria (P&C) that define practices for sustainable palm oil production. RSPO's Principles and Criteria (P&C) for sustainable palm oil production are based on these principles:

- 1) Commitment to transparency;
- 2) Compliance with applicable laws and regulations;
- 3) Commitment to long-term economic and financial viability;
- 4) Use of appropriate best practices by growers and millers;
- 5) Environmental responsibility and conservation of natural resources and biodiversity;
- 6) Responsible consideration of employees and of individuals and communities affected by growers and mills;
- 7) Responsible development of new plantings; and
- 8) Commitment to continuous improvement in key areas of activity.

4.6.2 Purpose of Guidelines

The purposes are:

- To promote the development of a globally acceptable sustainable agricultural management practices in oil palm and rubber plantations based on economic, social and environmental viability;
- These guidelines are intended for the field managers of the rubber and oil palm plantations and mills as well as relevant government agencies and corporate bodies; and
- These guidelines will help to reduce the negative impacts of agricultural practices in plantations on the environment and the ecosystems in and around ecological corridors.

4.6.3 Management Principles

The management principles are:

- Use of appropriate best practices management that minimise and control erosion and degradation of soils by oil palm and rubber growers
- Use appropriate practices that maintain the quality and availability of surface and ground water.
- Effective management of pests, diseases, weeds and invasive introduced species using appropriate Integrated Pest Management (IPM) techniques.
- Use of Agrochemicals in a way that does not endanger health, the environment and wild life.

- Environmental responsibility and conservation of natural resources and biodiversity in the plantations
- Maintaining the status of rare, threatened or endangered species and high conservation value habitats
- Disposal of waste in an environmentally and socially responsible manner.
- Responsible development of new plantations.
- Increasing biodiversity by providing a habitat for indigenous flora and fauna through a combination of forest and riverine conservation areas within the plantations.
- All the principles and guidelines below apply to all primary and secondary corridors

All the principles have to apply on all the corridors (Primary and Secondary Corridors)

PRINCIPLES	GUIDELINES
<p>1. Use of appropriate best practices management that minimise and control erosion and degradation of soils by oil palm and rubber growers</p>	<div> </div> <ul style="list-style-type: none"> • Slope of more than 30 degrees should not be planted with oil palm or rubber but left under natural vegetation • Practise land conservation techniques on steep land i.e. where slope is between 6 to 30 degrees through the following means : <ol style="list-style-type: none"> Shorten the length of the slope by constructing terraces Use of broad-bench terraces sloping inwards Construction of contour and perimeter drains Planting cover crops Construction of drains in the form of steps to cushion the flow of water during heavy rain fall Construction of toe drainage Construction of silt traps/ pits Construction of buffer bunds or maintaining existing river buffer zones Mulching

	<ul style="list-style-type: none"> x. Staggering land clearing to minimize exposure of bare land xi. Land clearing during the dry season to prevent soil erosion xii. Minimal tillage xiii. Planting base on contour xiv. Use of light machinery in field operations
<p>2. Use of appropriate practices that maintain the quality and availability of surface and ground water</p>	<p>Growers and millers should address the effects of their use of water and the effects of their activities on local water resources. A 'Water Management Plan' should be put in place and these may include:</p> <ul style="list-style-type: none"> • Taking account of the efficiency of use and renew ability of sources. • Ensuring that the use of water does not result in adverse impacts on other users. • Avoiding contamination of surface and ground water through run-off of soil, nutrients or chemicals, or as a result of inadequate disposal of waste including palm oil mill effluent (POME). • Appropriate treatment of mill effluent and regular monitoring of discharge quality, which should be in compliance with national regulations.
<p>3. Effective management of pests, diseases, weeds and invasive introduced species using appropriate Integrated Pest Management (IPM) techniques.</p>	<p>Growers should apply recognised IPM techniques, incorporating cultural, biological, mechanical or physical methods to minimise use of chemicals. Native species should be used in biological control wherever possible.</p>
<p>4. Use of Agrochemicals in a way that does not endanger health, the environment or wildlife.</p>	<ul style="list-style-type: none"> • There is no prophylactic use of pesticides, except in specific situations identified in national Best Practice guidelines. Use of chemicals categorized as World Health Organisation Type 1A or 1B, or listed by the Stockholm or Rotterdam Conventions, and paraquat, is reduced and/or eliminated. • Growers should actively seek to identify alternatives to these agrochemicals. • Where available use selective pesticides that are specific to the target pest, weed or disease and which have minimal effect on non-target species.
<p>5. Environmental responsibility and conservation of natural resources and</p>	<p>Environmental impact assessment should be undertaken to cover the following activities, where they are relevant:-</p> <ul style="list-style-type: none"> • Building new roads, processing mills or other infrastructure. • Putting in drainage or irrigation systems.

<p>biodiversity in the plantations</p>	<ul style="list-style-type: none"> • Replanting or expansion of planting area. • Disposal of mill effluents • Clearing of remaining natural vegetation. <p>Impact assessment may be a non-restrictive format e.g. ISO 14001 EMS and/or EIA report incorporating elements spelt out in this criterion and raised through stakeholder consultation. Documented management action plans addressing issues raised from the above impact assessment, which is monitored annually.</p> <p>Environmental impacts may be identified on soil and water resources, air quality, biodiversity and ecosystems, and people’s amenity both on and off-site.</p> <p>It is important that where activities, techniques or operations change over time, identifications of impacts, and any required mitigation, are updated as necessary.</p> <p>For smallholder schemes, the scheme management has the responsibility to undertake impact assessment and to plan and operate in accordance with the results. Individual smallholders would not be expected to undertake formal impact assessments (unless there is a legal requirement) but should have a good understanding of the potential negative impacts of their activities and appropriate mitigation techniques.</p> <p>National interpretation should consider any national legal requirements together with any other issues that are not required by law but are nevertheless important.</p>
<p>6. Maintaining the status of rare, threatened or endangered species and high conservation value habitats</p>	<p>The status of rare, threatened or endangered species and high conservation value habitats, if any, that exist in the plantation or that could be affected by plantation or mill management, shall be identified and their conservation taken into account in management plans and operations.</p> <p>Information should be collated includes both the planted area itself and relevant wider landscape-level considerations (such as wildlife corridors). This information should cover:</p> <ul style="list-style-type: none"> • Presence of protected areas that could be significantly affected by the grower or miller. • Conservation status (e.g. IUCN status), legal protection, population status and habitat requirements of rare, threatened, or endangered species that could be significantly affected by the grower or miller. • Identification of high conservation value habitats, such as rare and



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	<p>threatened ecosystems, that could be significantly affected by the grower or miller.</p> <p>If rare, threatened or endangered species, or high conservation value habitats, are present, appropriate measures for management planning and operations will include:</p> <ul style="list-style-type: none"> • Ensuring that any legal requirements relating to the protection of the species or habitat are met. • Avoiding damage to and deterioration of applicable habitats. • Controlling any illegal or inappropriate hunting, fishing or collecting activities; and developing responsible measures to resolve human-wildlife conflicts (e.g., incursions by elephants). <p>The information gathering should include checking available biological records and consultation with relevant government departments, research institutes and interested NGOs if appropriate. Depending on the biodiversity values that are present, and the level of available information, additional field survey work may be required.</p> <p>For individual smallholders, a basic understanding of any applicable species or habitats, together with their conservation needs, will be sufficient.</p> <p>For national interpretation, appropriate sources of information include government or international lists of threatened species ('red data lists'), national wildlife protection legislation, authorities responsible for protected areas and species, or relevant NGOs.</p>
<p>7. Disposal of waste in an environmentally and socially responsible manner.</p>	<p>All waste products and sources of pollution should be documented. This includes pesticide containers. Having identified wastes, a waste management and disposal plan must be developed and implemented, to avoid or reduce pollution.</p> <p>The waste management and disposal plan should include measures for:</p> <ul style="list-style-type: none"> • Identifying and monitoring sources of waste and pollution. • Improving the efficiency of resource utilisation and recycling potential wastes as nutrients or converting them into value-added products (e.g. through animal feeding programmes). • Appropriate disposal of hazardous chemicals and their containers. Surplus chemical containers should be disposed of or cleaned in an environmentally and socially responsible way (e.g. returned to the vendor or cleaned using a triple rinse method), such that there is no risk of contamination of water



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	sources or to human health. The disposal instructions on manufacturer's labels should be adhered to.
8. Responsible development of new plantations	<p>A comprehensive and participatory independent social and environmental impact assessment is undertaken prior to establishing new plantations or operations, or expanding existing ones, and the results incorporated into planning, management and operations.</p> <p>The potential impacts of all major proposed activities should be assessed prior to development. The assessment should include:-</p> <ul style="list-style-type: none"> • Assessment of the impacts of all major planned activities, including planting, mill operations, roads and other infrastructure. • Assessment, including stakeholder consultation, of High Conservation Values that could be negatively affected. • Assessment of potential effects on adjacent natural ecosystems of planned developments, including whether development or expansion will increase pressure on nearby natural ecosystems. • Identification of watercourses and assessment of potential effects on hydrology by planned developments. Measures should be planned and implemented to maintain the quantity and quality of water resources. • Baseline soil surveys and topographic information, including the identification of marginal and fragile soils, areas prone to erosion and slopes unsuitable for planting. <ul style="list-style-type: none"> - Analysis of type of land to be used (forest, degraded forest, cleared land). - Analysis of land ownership and user rights. - Analysis of current land use patterns. - Assessment of potential social impact on surrounding communities of a plantation, including an analysis of differential effect on women versus men, ethnic communities, migrant versus long-term residents.
9. Increasing biodiversity by providing a habitat for indigenous flora and fauna through a combination of forest and riverine	<p>Areas of natural forest should be maintained on land in the plantation unsuitable for cultivation</p> <p>Biodiversity Within and Around the Estate</p> <ul style="list-style-type: none"> • Abandon oil palm growing in unprofitable areas and convert such areas into wildlife reserves. • Riparian reserves and wildlife corridors composed of natural forests



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conservation areas within an oil palm estate.	<p>should be maintained in palm oil plantations to provide habitats for indigenous plants and animals</p> <ul style="list-style-type: none">• Enhance the farm environment for locally important, rare or endangered species by providing appropriate habitats and adopting the right cultural practices, including the avoidance of pesticide damage to beneficial flora and fauna.• Link riparian and other reserve areas within the estate and neighbourhood wherever possible to form wildlife corridors and refuges.• Plant more native trees in areas where they do not interfere with plantation operations. There are frequently opportunities in housing and recreation areas, along roadsides and in otherwise vacant land.
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Sources:

1. RSPO Principles and Criteria for Sustainable Palm Oil Production. October 2007
2. Department of Agriculture : Guidelines on Steepland Development

4.7 GUIDELINES FOR FORESTRY AND REFORESTATION IN ECOLOGICAL CORRIDOR

The guidelines for forestry and reforestation in the CFS1 vary depending on the type of forest present in the area. This study has identified three distinct legal classes of forest. These three forest types can be termed as Type A (National Parks & Wildlife Reserves); Type B (Forest Reserves); and Type C (forests on state land or alienated land). Ideally, all areas identified as critical linkages in the CFS should be protected. Inside the core areas of priority linkages, all forest should be protected to ensure that connectivity is maintained or enhanced. In such situations, Type C Forest should be turned into Type A or B Forest.

1) Forestry Guidelines for Connectivity in Type A Forests

The management of Type A Forest (National Parks & Wildlife Reserves) often assumes that the area actual has adequate tree cover to allow for connectivity. However, this is not always the case, with a number of Type A areas requiring reforestation and protection. Nevertheless, the main thrust of management in Type A Forest is to maintain forest cover and (where appropriate) to expand protection to cover areas presently under Type B or C Forests. It should almost go without saying that Type A Forest should not be excised for non-forest purposes. Furthermore, the construction of infrastructure, such as park headquarters or roads, should pay particular attention to impacts on connectivity within the protected area.

2) Forestry Guidelines for Connectivity in Type B Forests

Extensive guidelines for the management of Type B Forests (Forest Reserves) already exist. In the Malaysian context, these guidelines have been encapsulated in the various “Malaysian Criteria and Indicators” (MC&I) standards developed by the Forestry Department and the Malaysian Timber Certification Council (MTCC). In particular, Principle 9 of the MC&I (which is based on the Forest Stewardship Council (FSC) standard¹) highlights the importance of maintaining large landscape-level forests, i.e. high conservation value forests.

The identified critical linkages for all large forest complexes should retain wildlife corridors of at least 500m width under natural forest cover (protected as protection forest under Section 10 of the National Forestry Act 1984). Any linear developments (such as roads, railways or pipelines) should incorporate appropriate wildlife crossings and associated mitigation measures.

Type B Forests in critical linkages should not be excised for non-forest purposes unless measures have been taken to ensure that landscape-level connectivity is maintained. On the contrary, any existing bottlenecks should be strengthened by reserving additional areas as forest reserves and protected areas.

3) Forestry Guidelines for Connectivity in Type C Forests

In addition to the standards and guidelines mentioned above, some principles have been established for the maintenance of forests outside Type A and B forest. These standards are not specifically for Type C Forests (forests on state land or alienated land) but they should be applied where-ever such forest forms part of a critical linkage of the CFS and has yet to be reserved as Type A or B forest.

The FSC Principles and Criteria for Responsible Forest Management apply to all types of forest and contain the same provisions as the MC&I Principle 9 for Type B Forest. Furthermore, the MC&I for Forest Plantations and the Criteria of the Roundtable for Sustainable Palm Oil (RSPO) provide additional guidance for the management of Type C Forest. More details regarding the conservation and restoration of natural forest in agricultural plantations are given in the section on agriculture.

4) Forestry Guidelines for Connectivity outside Critical Linkages

Type B Forest outside of critical linkages may be excised for non-forest purposes in accordance with the provisions of the National Forestry Act 1984 as long as connectivity within and between forest complexes is maintained. The landscape-level impact of forest excision and conversion should be considered with reference to the CFS Masterplan.

5) Forestry Guidelines for Other Areas inside Critical Linkages

Most of the critical areas identified in the CFS include non-forested areas outside of Type A or Type B Forest. In such instances, it will often be necessary to undertake replanting to ensure the reforestation of wildlife corridors.

There are a number of existing guidelines for reforestation in Peninsular Malaysia. In terms of reforestation to restore connectivity of the CFS, the two main questions will be where and what to plant.

The issue of planting location is addressed in some detail in the section on the critical linkages that have been identified in this study. In general, it will often be necessary for the gaps between forest islands to be bridged by the planting or natural regeneration of forest corridors. These corridors can follow natural features such as rivers or ridge tops; in such cases there may be existing river reserves or hill reserves that can be used. Alternatively, forest corridors can be routed along reserves for linear infrastructure such as roads or utility lines. A schematic representation of such a system is given in Figure 4.10 below.

The issue of species choice depends to a large extent on the particular circumstances of individual site. However a number of general guidelines are available. In particular, The et al³ recommended 74 native tree species that are suitable for planting in harsh conditions.

This selection was made based on the following criteria:-

- Suitability for planting in open areas;
- Abundance of seed supply due to regularity of flowering and fruiting;
- Growth rates; and
- Attractive features such as lush foliage, flowering and tree shape.

³ Tho, Y. P., K. M. Wong, S. K. Yap, and K. M. Kochummen. 1983. Towards an uniquely Malaysian urban landscape through an emphasis on the planting of indigenous trees. pp. 281-297. In *Rekreasi Luar di Malaysia (Outdoor Recreation in Malaysia): Jalan bicara seminar kebangsaan hutan, taman negara dan taman bandaran untuk rekreasi, 26-28 September, 1983, Serdang, Selangor, Malaysia* (Wan Sabri, W. M., M. Rusli, A. Kamis, H. Mohd. Basri, and J. Mohd. Zin, eds.). Fakulti Perhutanan, Universiti Pertanian Malaysia. 406 pp.

However, this list did not explicitly consider the attractiveness of the tree species for wildlife. On the other hand, a study by WWF-Malaysia came up with a list of tree species particularly important for birds⁴.

One recent study⁵ published by FRIM has determined a list of species rated as “excellent” choices for reforestation of degraded land based on ecological value, growth rates as well as other relevant criteria, these species include the following:

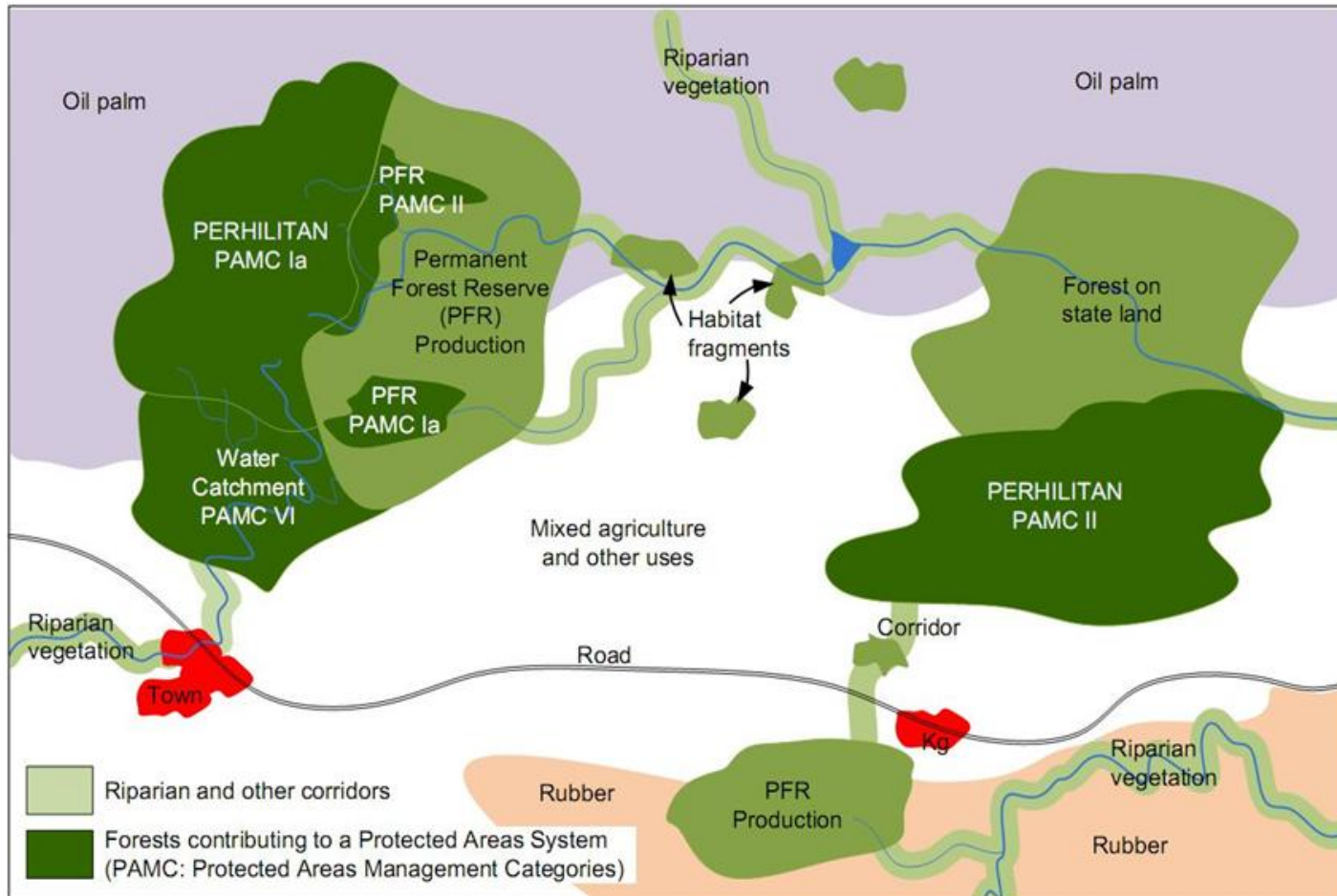
- *Canarium littorale* (Kedondong)
- *Dipterocarpus caudatus* (Keruing Gasing)
- *Dyera costulata* (Jelutong)
- *Hopea nutans* (Giam)
- *Koompassia malaccensis* (Kempas)
- *Parkia roxburghii* (Kupang)
- *Parkia speciosa* (Petai)
- *Sandoricum koetjape* (Sentul)
- *Shorea acuminata* (Meranti Rambai Daun)
- *Shorea leprosula* (Meranti Tembaga)
- *Streblus elongatus* (Tempinis)

In addition, fig trees (Pokok Ara) belonging to the genus *Ficus* spp. (e.g. *F. benghalensis*) are particularly suitable for enhancing the presence of wildlife.

⁴ Christopher J. Hails, Mikail Kavanagh, Kanta Kumari and Ishak Ariffin. 1990. *Bring Back the Birds*. WWF Malaysia, Kuala Lumpur.

⁵ Shono, K, S.J. Davies & Y.K. Chua. 2007. Performance of 45 native tree species on degraded lands in Singapore. *Journal of Tropical Forest Science* 19 (1): 25-34.

Figure 4.10: A Landscape Approach to Biodiversity Protection*



Note: *It considers areas set aside for permanent long-term protection by various agencies under a common Protected Areas System based on Protected Areas Management Categories

4.8 RIVER RESERVE GUIDELINES IN ECOLOGICAL CORRIDOR

4.8.1 Purpose of Guideline

The purpose of this guideline is to preserve the remaining riparian habitat and re-establish a continuous riparian ecosystem along the river linking to the wildlife corridor. This guideline is to ensure that the areas within the river reserve maintain the essential natural character specifically in relation to the scale of development around the area.

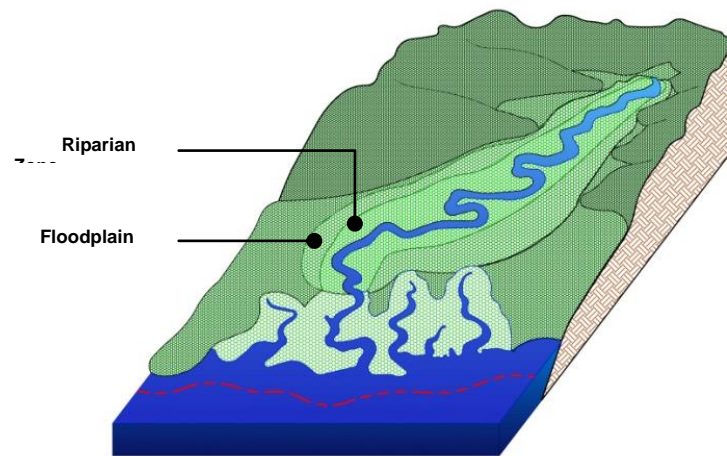
Rivers can have a variety of values because of their ecological processes such as:

Habitat	<ul style="list-style-type: none"> Rivers are biologically diverse and productive habitats. They provide habitat for some endangered species of flora and fauna as well as corridors for wildlife.
Ecological systems	<ul style="list-style-type: none"> Rivers are part of life support systems, through processes such as nutrient cycling, energy flows, breakdown of toxicants, conversion of carbon dioxide to oxygen, recharge of underground water supplies, and water storage. The conservation value of rivers and their catchments derives from their scientific, habitat, ecological, rarity and intrinsic values. Protection of a river system will protect many other inter-related ecological systems and processes.
Water quality protection	<ul style="list-style-type: none"> Many rivers supply high quality water for downstream use, including potable water supply, irrigation, waste disposal, fisheries, aquaculture, and navigation.
Aesthetic	<ul style="list-style-type: none"> Rivers have significant aesthetic values to many people because of their characteristics, such as scenic beauty, natural or undeveloped qualities.
Social	<ul style="list-style-type: none"> Rivers and river floodplains have been a focus area for human activity (settlement, transportation, communications, recreation and etc.).
Recreational	<ul style="list-style-type: none"> Rivers and their catchments are attractive for a number of water-based recreational or eco-tourism activities, including canoeing, rafting, boating, fishing, swimming, camping, trekking, rock climbing, photography, nature studies, sightseeing, picnicking and etc.
Economic	<ul style="list-style-type: none"> Rivers and their catchments have economic values for activities including water extraction, mining, forestry and agriculture.

For this part, the following definitions (**Figure 4.11**):-are being used

- The **riparian zone** is the channel margin (or banks), which forms part of the floodplain; and
- The **floodplain**, which includes the riparian zone, is that part of the land adjacent to the river that is subject to flooding and consisting of a mosaic of aquatic and terrestrial environments that are intricately linked with the river.

Figure 4.11: Illustration Showing the Section of Floodplain and Riparian Zone of the River



4.8.2 Management Principles

- All the management principles have to apply at the corridors which have rivers or water bodies.

1) Maintaining River Values

- In order to preserve river values, the essentially natural condition of a river and its associated parts of the catchment need to be maintained.
- The biological diversity and ecological processes associated with rivers should be maintained, by maintaining indigenous plant and animal populations in their natural communities.
- River reserve should be provided along the river based on the width of the river (refer **Table 4.8** and **Figure 4.12**). No man-made structure or major development is being permitted in the river reserve.
- River reserve should consist of native existing or planted trees, shrubs, grasses and turf well-suited to the area (refer **Figures 4.13** and **Figure 4.14**).
- Disturbance to hydrological, geomorphological, and biological processes of the rivers by modern development can be minimised by undertaking only those activities that leave the river environment substantially unmodified including low-impact eco-tourism activities or water-based recreational;

Table 4.8: River Reserve Provided Based On the Width of the River

River Width	River Reserve
> 40 m	50 m
20 – 40 m	40 m
10 – 20 m	20 m
5 – 10 m	10 m
< 5 m	5 m

Source: JPS Malaysia

Figure 4.12: Schematic Diagram of River Reserve

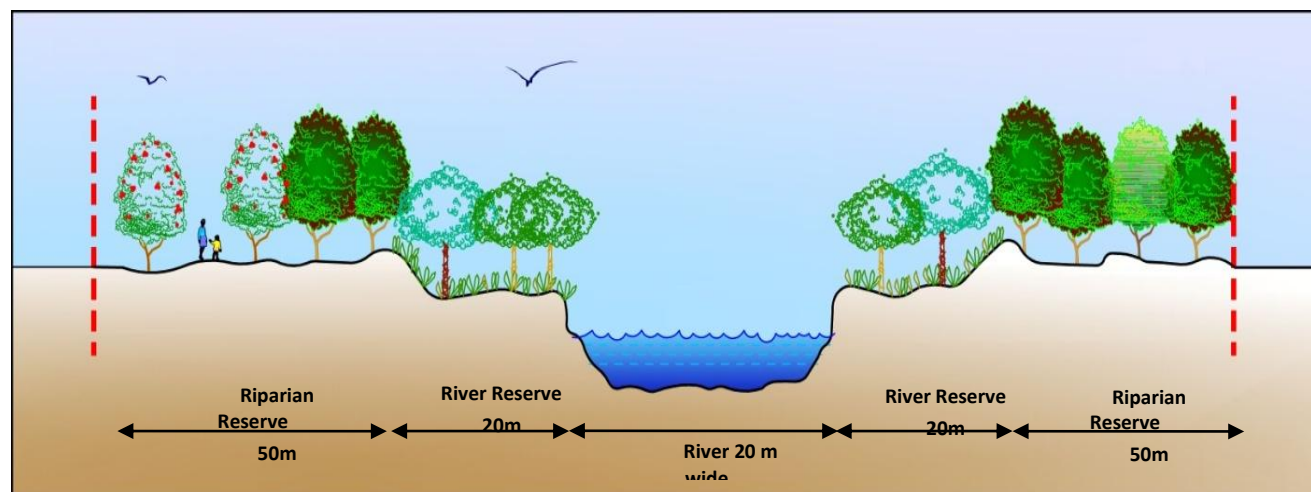


Figure 4.13: Design Recommendations for Riparian Zone

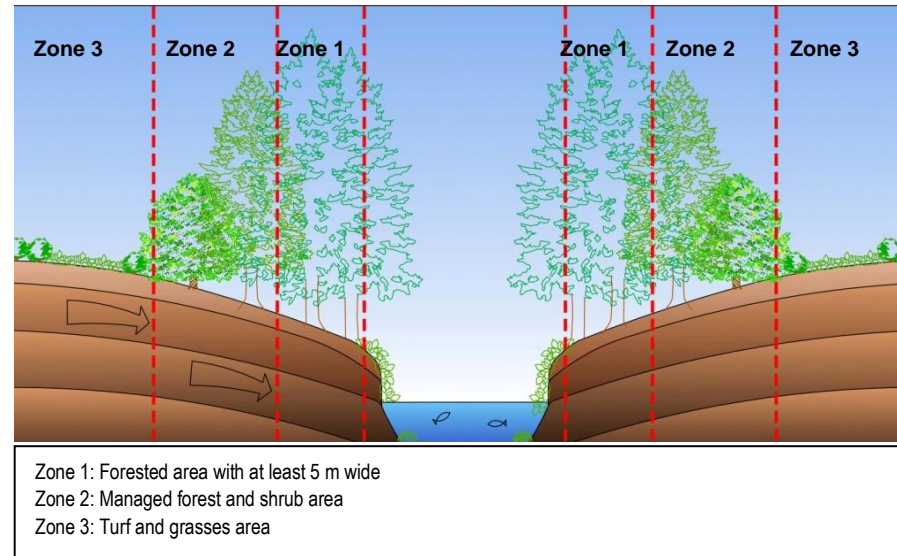
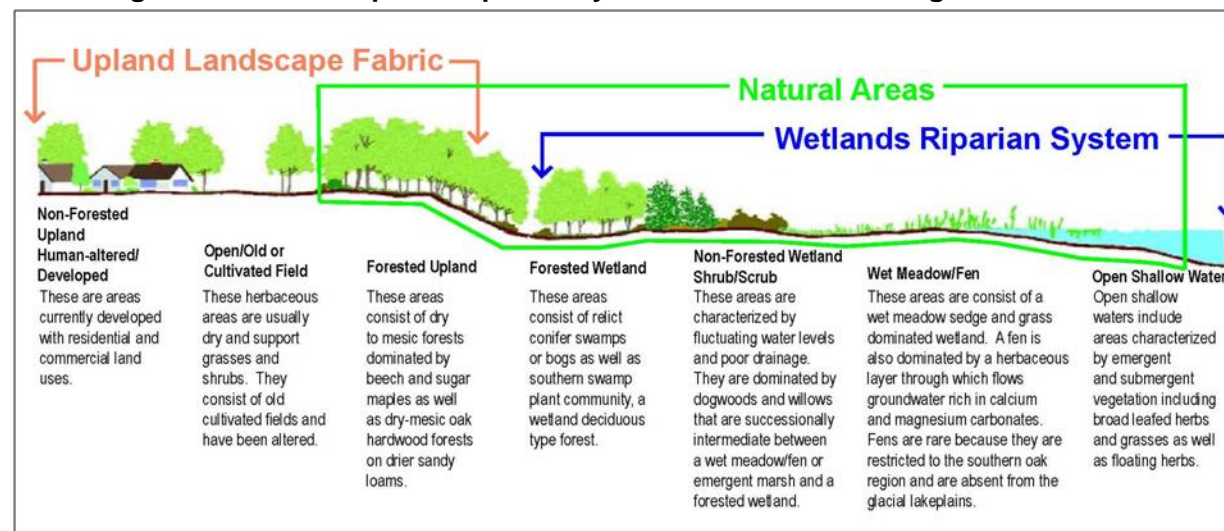


Figure 4.14: Example of Riparian System in Southeast Michigan





FINAL REPORT

Source: Oakland County Planning & Economic Department Services

2) Ecologically Sustainable Development

Ecologically sustainable development (ESD) was defined by the Commonwealth Government in 1990 as:

“Using, conserving and enhancing the community’s resources so that ecological processes, on which life depends, are maintained, and the quality of life, now and in the future, can be increased.”

Therefore, the economic, aesthetic, recreational, social and health values related to the river system cannot be overstated. Here are some general principles for ecological sustainable development (**Figure 4.15**) to be followed:-

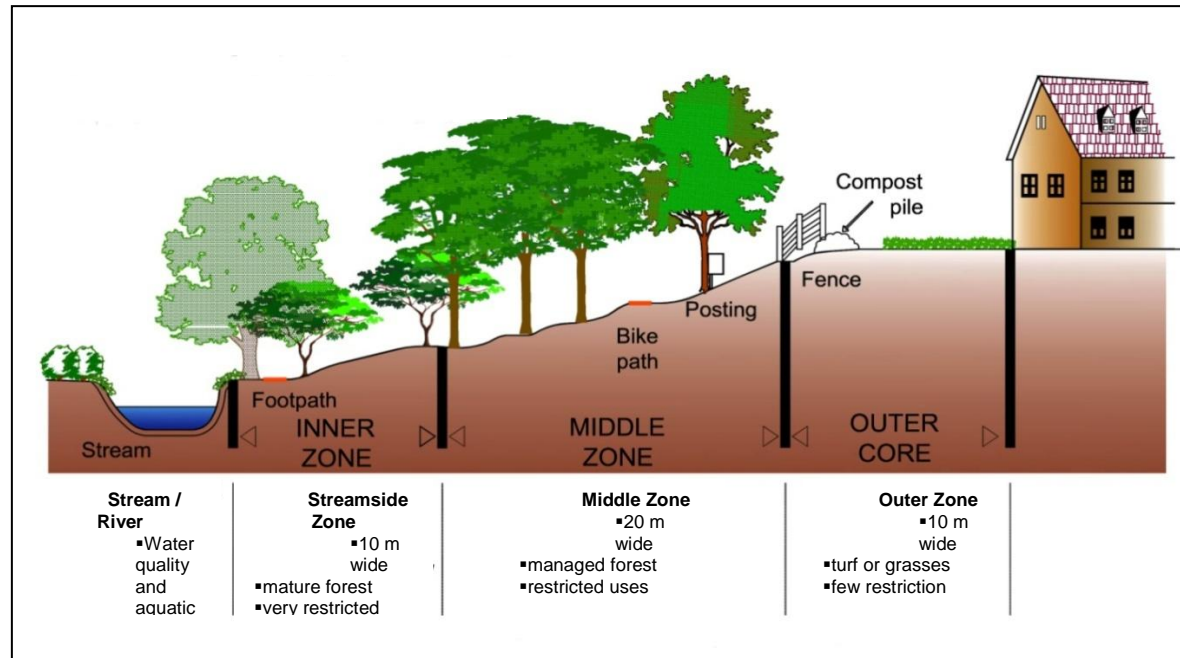
- Preserve a native forested buffer zone adjacent to the watercourse.
- Restrict clearing, construction and development within the 100-year floodplain area.
- Any development should be sited outside a riparian buffer.
- Areas adjacent to riparian buffer are only allowed for low intensity development.
- All industrial use and landfill are prohibited in the vicinity of the riparian buffer.
- Capitalize on the river as a community asset by developing pathway connection point, parallel trails, canoe and kayak routes, and related community park, recreation features as appropriate with minimal structural development.
- Selectively encourage new development on the river utilizing green building Leadership in Energy and Environmental Design (LEED) principles and best management practices to maintain water quality.
- Provide ample setbacks for sanitary facilities on the developed area.
- Establish structural setbacks from rivers and streams.

3) Integrated Catchment Management

Integrated Catchment Management (ICM) principles as they would apply to rivers include:

- protection of a river should incorporate management of the river catchment to prevent unacceptable disturbance to its natural condition;
- a coordinated and cooperative approach by all relevant land and water management, both public and private, should be used to protect rivers from existing and potential impacts; and
- a framework for the planning and management of rivers should involve the identification and management of all available land, water, human and biological resources within a catchment in order to optimise the value of sustainable beneficial uses of the physical environment

Figure 4.15: Schematic Diagram of a Three-stage Buffer for an Ecologically Sustainable Development Area



4) Management Planning Process

The management planning processes include:

- A management planning process is required for river and its catchment, which recognises the special characteristics and values of that area and identifies any potential threats not already covered by existing plans. This may be part of a planning process for a broader area (for example, a national park).
- All stakeholders should be involved in the management planning process for rivers on public lands, including industry, local and State Government, and the community.
- Aboriginal people (*orang asli*) should be involved in the management of rivers and catchments on their traditional lands. Management of rivers principally for their river values may not be appropriate in areas where the conservation of river values is contrary to *orang asli* interests.
- Ongoing monitoring and research should be carried out to determine the existence or risk of unacceptable impacts or changes, and to allow preventative and remedial actions to be taken.
- Management operations that conflict with the maintenance of river values should only be carried out for genuine emergency and essential purposes, where there is no realistic alternative means of achieving those purposes.

05

implementation

Institutional Framework (Generic)
Implementation Strategies And Agencies
Finance And Funding Mechanisms
Review And Assessment
Legal Implications
Awareness, Education And Communications Strategy





Table 5.3.10: Estimated Costs of Ecological Linkages

1) Primary Linkages (PL)

LIST / NAME OF LINKAGES BY RANK	IMPLEMENTATION STRATEGY	COST RM'000	FUNDING MECHANISM	SOURCES OF FUND	NEXT KEY STEPS
PL1	TO LINK SUNGAI YU FR-TANUM FR-TAMAN NEGARA				
	Forest Reserve and Acquisition of Land.				
	1. Gazette Tanum FR within the Core Area as Protected Forest under s10 NFA.				
	2. Gazette all state land forests and within the core as Protected Forest under s10 NFA, and state land forests within the buffer as forest reserve under NFA.	27,815.4	Federal Budget/New mechanism	Federal Revenue/Trust Fund/Carbon Trading	Detailed feasibility study & costing.
	3. Gazette scrub land within the core as Protected Forest under s10 NFA and scrub land within Buffer as forest reserve under NFA.	13,687.2	Federal Budget/New mechanism	Federal Revenue/Trust Fund/Carbon Trading	Detailed feasibility study & costing.
	4. Long term strategy: Extend the boundary of Taman Negara Pahang to include the Core Area.				
	5. Create riparian reserve of 50 m on either side of the rivers of Sg. Temau, Sg. Tanum and Sg. Yu.	n.a.	Federal Development Budget	Federal Revenue	Detailed design & costing
	6. Build animal crossings at 1.3km (overpass) and 3km (viaduct) from Sg. Yu Bridge. Prohibit road widening within the linkage.	} 42,000.00			
	7. Infrastructure development: install road sign postings and impose speed control on roads.				
	8. Land use Management Control:				
	<ul style="list-style-type: none"> Plantation agencies in the area to adopt RSPO and obtain certification and create wildlife corridors. 		Private CSR Initiatives/ NGOs Partnership	Private Sector	Establish grant programme to promote & target awareness campaign
	<ul style="list-style-type: none"> Monitor the animal crossing programme. 	5,640.0	Federal Development Budget	Federal Revenue	
	<ul style="list-style-type: none"> Immediate freeze on land alienation and development in the corridor, plus any TOL land is not allowed to be renewed. 				



LIST / NAME OF LINKAGES BY RANK	IMPLEMENTATION STRATEGY	COST RM'000	FUNDING MECHANISM	SOURCES OF FUND	NEXT KEY STEPS
	<ul style="list-style-type: none"> The wildlife corridor should be promoted as the most accessible part of the premier ecotourism destination of Taman Negara. Establish viewing towers. 	300.0	Federal Development Budget	Federal Revenue	Detailed design & costing
	9. Awareness campaign.	200.0	Federal Development Budget	Federal Revenue	Detailing & costing
	Sub-total cost	89,642.6			
PL2	TO LINK BELUM FR-ROYAL BELUM FR-TEMENGGOR FR				
	Extend Belum FR to include Royal Belum Forest & gazette as Protected Forest.				
	1. Extend Gerik FR & gazette state forest lands and scrub in linkage as Protected Forest.	334,297.0	Federal Budget/New mechanism	Federal Revenue/Trust Fund/Carbon Trading	Detailed feasibility study & costing.
	2. Build wildlife crossings such as viaduct or overpass.	} 120,990.0	Federal Development Budget	Federal Revenue	Prepare detailed programmes ign & costing
	3. Infrastructure development: install road sign postings and impose speed control on roads.				
	4. Land use Management Control:				
	<ul style="list-style-type: none"> Prohibit expansion of agriculture along the entire stretch of this highway in order to maintain the conservation and ecotourism benefits. Acquire cleared land and reforest. 	1,400.5	Federal Development Budget	Federal Revenue	Detailed feasibility study & costing.
	5. Establish checkpoints at various parts of the highway to counter poaching.	} 14,160.0	Federal Development Budget	Federal Revenue	Detailed design & costing
	6. Long-term monitoring to identify critical elephant crossing sites.				
	7. Establish wildlife viewing areas within core area and associated tourism facilities within suitable location.	300.0	Federal Development Budget	Federal Revenue	Detailed design & costing
	8. Promote this linkage as 'Jumbo Trail' in line with National Ecotourism Master Plan	n.a.	Federal Development Budget	Federal Revenue	Prepare detailed programmes & costing
	9. Awareness campaign.	1,200.0	Federal Development Budget	Federal Revenue	Prepare detailed programmes & costing
	Sub-total Cost	472,347.5			
PL3	TO LINK LOJING FR-SG BROK FR				
	1. Gazette state forests as forest reserve.	57,520.8	Federal Budget/New	Federal Revenue/Trust	Detailed feasibility



LIST / NAME OF LINKAGES BY RANK	IMPLEMENTATION STRATEGY	COST RM'000	FUNDING MECHANISM	SOURCES OF FUND	NEXT KEY STEPS
	2. Gazette state land under scrub land use as forest reserve.	5,565.2	mechanism	Fund/Carbon Trading	study & costing.
	3. Infrastructure development: install road sign postings and impose speed control on roads.	288.0	Federal Development Budget	Federal Revenue	Detailed design & costing
	4. Establish riparian reserve along the rivers.	n.a.	Federal Development Budget	Federal Revenue	Detailed design & costing
	5. Land use Management Control: linkage to be promoted as ecotourism attraction for Lojing.	n.a.	Federal Development Budget	Federal Revenue	Prepare detailed programmes & costing
	6. Awareness campaign.	200.0	Federal Development Budget	Federal Revenue	Prepare detailed programmes & costing
	Sub-total Cost	63,574.0			
PL4	TO LINK PADANG CHONG FR-SG. KUAH FR- BELUKAR SEMANG FR				
	1. Gazette state land forests as forest reserve.	56,123.7			
	2. Establish riparian reserve along the rivers.	n.a.	Federal Development Budget	Federal Revenue	Detailed design & costing
	3. Acquire and reforest all cleared land.	4,955.7			
	4. Infrastructure development: install road sign postings and impose speed control on roads.	264.0	Federal Development Budget	Federal Revenue	Detailed design & costing
	5. Land use Management Control:				
	<ul style="list-style-type: none"> Human settlement: No expansion of human settlement within identified linkage. 				
	<ul style="list-style-type: none"> Agricultural land: Rubber estates to follow sustainable agricultural practices (SAP) guidelines. 		Private CSR Initiatives/NGOs Partnership	Private Sector	Establish grant programme to promote & target awareness campaign
	<ul style="list-style-type: none"> No expansion of agricultural activities. 				
	6. Awareness campaign.	200.0	Federal Development Budget	Federal Revenue	Prepare detailed programmes & costing
	Sub-total Cost	61,543.4			
PL5	TO LINK ULU MUDA FR (ULU MUDA)-GUNUNG INAS FR (BINTANG HIJAU)				
	1. Extend Ulu Muda FR & gazette state land forest as forest reserve.	24,120.4	Federal Budget/New mechanism	Federal Revenue/Trust Fund/Carbon Trading	Detailed feasibility study & costing.
	2. Extend Gunung Inas FR & gazette state land forest as Protected Forest.				
	3. Infrastructure development: install road sign postings and impose speed control on roads.	264.0	Federal Development Budget	Federal Revenue	Detailed design & costing



LIST / NAME OF LINKAGES BY RANK	IMPLEMENTATION STRATEGY	COST RM'000	FUNDING MECHANISM	SOURCES OF FUND	NEXT KEY STEPS
	4. Land use Management Control: Agricultural land: rubber estates to follow sustainable agricultural practices. Agricultural cultivation (rubber) to follow SAP guidelines.	n.a	Private CSR Initiatives/NGOs Partnership	Private Sector	Establish grant programme to promote & target awareness campaign
	5. .Awareness campaign.	200.0	Federal Development Budget	Federal Revenue	Prepare detailed programmes & costing
	Sub-total Cost	24,584.4			
PL6	TO LINK ULU JELAI FR -HULU LEMOI FR-BUKIT BUJANG FR-BUKIT JERUT FR				
	1. Gazette state land forest and scrub land as forest reserves.	177,635.5	Federal Budget/New mechanism	Federal Revenue/Trust Fund/Carbon Trading	Detailed feasibility study & costing.
	2. Acquire and reforest cleared land.	1973.1	Federal Development Budget	Federal Revenue	Detailed feasibility study & costing.
	3. Establish riparian reserve along rivers.	n.a.	Federal Development Budget	Federal Revenue	Detailed design & costing
	4. Infrastructure development: install road sign postings and impose speed control on roads.	498.0	Federal Development Budget	Federal Revenue	Detailed design & costing
	5. Land use Management Control:				
	<ul style="list-style-type: none"> Control conversion of land along road in the linkage. 				
	<ul style="list-style-type: none"> Agricultural land: Rubber estates to follow SAP guidelines. 	n.a	Private CSR Initiatives/NGOs Partnership	Private Sector	Establish grant programme to promote & target awareness campaign
	<ul style="list-style-type: none"> Increase patrol and enforcement around viaducts to discourage poaching. 	n.a.	Federal Development Budget	Federal Revenue	Prepare detailed programmes & costing
	6. Awareness campaign.	200.0	Federal Development Budget	Federal Revenue	Prepare detailed programmes & costing
	Sub-total Cost	180,306.6			
PL7	TO LINK TAMAN NEGARA-LEBIR FR-TEMBAT FR (GREATER TAMAN NEGARA)				
	1. Gazette Lebir FR as a Protected Forest.				
	2. Gazette state land forest as forest reserve.	24,058.3	Federal Budget/New mechanism	Federal Revenue/Trust Fund/Carbon Trading	Detailed feasibility study & costing.
	3. Infrastructure development: install road sign postings and impose speed control on roads.	384.0	Federal Development Budget	Federal Revenue	Detailed design & costing
	4. Land use Management Control:				



LIST / NAME OF LINKAGES BY RANK	IMPLEMENTATION STRATEGY	COST RM'000	FUNDING MECHANISM	SOURCES OF FUND	NEXT KEY STEPS
	<ul style="list-style-type: none"> No development activity to be permitted along the dry land forest between Tasik Kenyir's water edge and stretch of border with Kelantan. 				
	<ul style="list-style-type: none"> Oil palm and rubber smallholdings to follow SAP guidelines. 	n.a	Private CSR Initiatives/NGOs Partnership	Private Sector	Establish grant programme to promote & target awareness campaign
	<ul style="list-style-type: none"> Promote as part of ecotourism destination of Taman Negara Kuala Koh and Kenyir Lake. 	n.a.	Federal Development Budget	Federal Revenue	Prepare detailed programmes & costing
	5. Awareness campaign.	200.0	Federal Development Budget	Federal Revenue	Prepare detailed programmes & costing
	Sub-total Cost	24,642.3			
PL8	TO LINK KENDERONG FR (BINTANG HIJAU)-BINTANG HIJAU (HULU PERAK) FR- BELUKAR SEMANG FR				
	1. Gazette state forest land along road and viaducts as forest reserve.	83,385.5	Federal Budget/New mechanism	Federal Revenue/Trust Fund/Carbon Trading	Detailed feasibility study & costing.
	2. Reforest areas around viaducts.	461.5	Federal Development Budget	Federal Revenue	Detailed feasibility study & costing.
	3. Establish riparian reserve along Sg. Rui.		Federal Development Budget	Federal Revenue	Detailed design & costing
	4. Land use Management Control:				
	<ul style="list-style-type: none"> Increase patrol and enforcement around the viaduct areas 	n.a	Federal Development Budget	Federal Revenue	Prepare detailed programmes & costing
	<ul style="list-style-type: none"> Develop artificial salt licks and reforest around them. 	n.a	Federal Development Budget	Federal Revenue	Detailed design & costing
	5. Infrastructure development: install road sign postings and impose speed control on roads.	348.0	Federal Development Budget	Federal Revenue	Detailed design & costing
	6. Enhance park management system through human resource development.	n.a.	Federal Development Budget	Federal Revenue	Prepare costing for approval
	7. Awareness campaign.	200.0	Federal Development Budget	Federal Revenue	Prepare detailed programmes & costing
	Sub-total Cost	84,395.0			
PL9	TO LINK BINTANG HIJAU LARUT MATANG FR-BINTANG HIJAU KUALA KANGSAR FR				
	1. Gazette state land forest as forest reserve.	2,406.1	Federal Budget/New	Federal Revenue/Trust	Detailed feasibility



LIST / NAME OF LINKAGES BY RANK	IMPLEMENTATION STRATEGY	COST RM'000	FUNDING MECHANISM	SOURCES OF FUND	NEXT KEY STEPS
2.	Gazette state land along road as forest reserve.		mechanism	Fund/Carbon Trading	study & costing.
3.	Acquire cleared land and reforest.	6,069.2			
4.	Infrastructure development: install road sign postings and impose speed control on roads.	324.0	Federal Development Budget	Federal Revenue	Detailed design & costing
5.	Establish riparian reserve.	n.a	Federal Development Budget	Federal Revenue	Detailed design & costing
6.	Land use Management Control: Relocate Deer Farm.				
7.	Awareness campaign.	200.0	Federal Development Budget	Federal Revenue	Prepare detailed programmes & costing
	Sub-total Cost	8,999.3			
	TOTAL COST PRIMARY LINKAGES	1,010,035.1			



2) Secondary Linkages (SL)

LIST/ NAME OF LINKAGES BY RANK	IMPLEMENTATION STRATEGY	COST RM'000	FUNDING MECHANISM	SOURCES OF FUND	NEXT KEY STEPS
SL1	TO LINK LEBIR FR-RELAJ FR-ULU TEMIANG FR-SERASA FR-JENTIANG FR-GUNUNG STONG FR				
	1. Gazette state land forests as forest reserve.	267,793.6	Federal Budget/New mechanism	Federal Revenue/Trust Fund/Carbon Trading	Detailed feasibility study & costing.
	2. Gazette scrub land as forest reserve.	42,807.9			
	3. Gazette Gua Ikan (limestone) as part of Serasa FR.				
	4. Establish riparian reserve along the rivers	n.a	Federal Development Budget	Federal Revenue	Detailed design & costing
	5. Infrastructure development: install road sign postings and impose speed control on roads.	528.0	Federal Development Budget	Federal Revenue	Detailed design & costing
	6. Land use Management Control:				
	<ul style="list-style-type: none"> Agricultural land: Rubber estates to follow SAP guidelines 	n.a	Private Initiative	Private Fund	Initiate private sector- state partnership
	<ul style="list-style-type: none"> Human settlements: no expansion of existing settlements within linkage. 				
	7. Develop Gua Ikan as ecotourism attraction	n.a.	Federal Development Budget	Federal Revenue	Detailed design & costing
	8. Awareness campaign.	100.0	Federal Development Budget	Federal Revenue	Prepare detailed programmes & costing
	Sub-total Cost	311,229.5			
SL2	TO LINK KRAU WR-SOM FR –YONG FR –BENCHAH FR-KERAMBIT FR-GUNUNG BENON FR				
	1. Gazette state land forests as forest reserve.	197,543.5	Federal Budget/New mechanism	Federal Revenue/Trust Fund/Carbon Trading	Detailed feasibility study & costing.
	2. Gazette scrub land as part of forest reserve.	11,433.4			
	3. Gazette established corridors as part of Krau Wildlife Reserve				
	4. Establish riparian reserves along Sg. Som (entire length); Sg. Kenong, Sg. Darah, Sg. Ceka (Kuala Som to Kuala Rengat). Riparian reserves to have minimum width of 50m on both sides.	n.a	Federal Development Budget	Federal Revenue	Detailed design & costing
	5. Infrastructure development:				
	<ul style="list-style-type: none"> Develop crossings for small animals along road. 	n.a			
	<ul style="list-style-type: none"> Prohibit road widening within corridors. 				



LIST/ NAME OF LINKAGES BY RANK	IMPLEMENTATION STRATEGY	COST RM'000	FUNDING MECHANISM	SOURCES OF FUND	NEXT KEY STEPS
	<ul style="list-style-type: none"> Install road sign postings and impose speed control on roads. 	249.0	Federal Development Budget	Federal Revenue	Detailed design & costing
6.	Forest Management:				
	<ul style="list-style-type: none"> Reforestation and enrichment planting on gazetted riparian reserves and cleared land. 	15,584.0	Federal Development Budget	Federal Revenue	Prepare detailed programmes & costing
	<ul style="list-style-type: none"> No degazettement of Som FR, Hulu Mas FR, Bukit Taching FR, Jerantut Tambahan FR, Kerambit FR, and Krau FR. 				
7.	Land use Management:				
	<ul style="list-style-type: none"> Agricultural land: Rubber estates to follow SAP guidelines. 		Private CSR Initiatives/NGOs Partnership	Private Sector	Establish grant programme to promote & target awareness campaign
	<ul style="list-style-type: none"> Human Settlements: Establish special management zones to reduce wildlife animal-human conflicts. 				
	<ul style="list-style-type: none"> Eco-tourism: promote wildlife corridors as an attraction for National Park (Jerantut) and Kenong Rimba Park (Pahang State Park. Construct viewing towers. 	300.00	Federal Development Budget	Federal Revenue	Prepare detailed programmes & costing
8.	Awareness campaign.	100.00	Federal Development Budget	Federal Revenue	Prepare detailed programmes & costing
	Sub-total Cost	225,209.9			
SL3	TO LINK BINTANG HLAND IJAU (HULU PERAK) FR-PAPULUT FR-PIAH FR				
	1. Gazette state land forests as forest reserve.	9,499.0	Federal Budget/New mechanism	Federal Revenue/Trust Fund/Carbon Trading	Detailed feasibility study & costing.
	2. Establish riparian reserve along river and lakes in the corridors.		Federal Development Budget	Federal Revenue	Prepare detailed programmes & costing
	3. Infrastructure development: install road sign postings and impose speed control on roads.	267.0	Federal Development Budget	Federal Revenue	Detailed design & costing
	4. Land use Management :				
	<ul style="list-style-type: none"> Rubber estates to follow SAP guidelines. 		Private CSR Initiatives/NGOs Partnership	Private Sector	Establish grant programme to promote & target awareness campaign
	<ul style="list-style-type: none"> No expansion of agricultural activities in the corridors 				



LIST/ NAME OF LINKAGES BY RANK	IMPLEMENTATION STRATEGY	COST RM'000	FUNDING MECHANISM	SOURCES OF FUND	NEXT KEY STEPS
	<ul style="list-style-type: none"> Human settlements: No expansion of human settlements in the corridors 				
	5. Awareness campaign.	100.0	Federal Development Budget	Federal Revenue	Prepare detailed programmes & costing
	Sub-total Cost	9,866.0			
SL4	TO LINK JERANGAU FR –PASIR RAJA BARAT FR- BESUL TAMBAHAN FR –BESUL FR-BUKIT BAUK FR				
	1. Gazette state land forests as forest reserve.	129,232.9	Federal Budget/New mechanism	Federal Revenue/Trust Fund/Carbon Trading	Detailed feasibility study & costing.
	2. Establish riparian reserves along the rivers.		Federal Development Budget	Federal Revenue	Prepare detailed programmes & costing
	3. Forest Management: Conserve wetlands.				
	4. Infrastructure development: install road sign postings and impose speed control on roads.	345.0	Federal Development Budget	Federal Revenue	Detailed design & costing
	5. Land use Management:				
	<ul style="list-style-type: none"> Agricultural land: 				
	<ul style="list-style-type: none"> i. Oil palm and rubber smallholdings to follow SAP guidelines. 		Private CSR Initiatives/NGOs Partnership	Private Sector	Establish grant programme to promote & target awareness campaign
	<ul style="list-style-type: none"> ii. Paddy lands to adopt SAP guidelines. 		Private CSR Initiatives/NGOs Partnership	Private Sector	Establish grant programme to promote & target awareness campaign
	<ul style="list-style-type: none"> iii. No expansion of agricultural activities. 				
	<ul style="list-style-type: none"> Human settlements: No expansion of human settlements in the corridors. 				
	6. Awareness campaign.	100.0	Federal Development Budget	Federal Revenue	Prepare detailed programmes & costing
	Sub-total Cost	129,677.9			
SL5	TO LINK PAK KANCIL FR-HULU SETIU FR				
	1. Gazette state land forests as forest reserve.	102,809.3	Federal Budget/New mechanism	Federal Revenue/Trust Fund/Carbon Trading	Detailed feasibility study & costing.
	2. Gazette scrub lands as part of forest reserve.	7,878.5			
	3. Infrastructure development: install road sign postings and impose speed control on roads.	258.0	Federal Development Budget	Federal Revenue	Detailed design & costing
	4. Land use Management:				
	<ul style="list-style-type: none"> Agricultural land: 				



LIST/ NAME OF LINKAGES BY RANK	IMPLEMENTATION STRATEGY	COST RM'000	FUNDING MECHANISM	SOURCES OF FUND	NEXT KEY STEPS
	i. Oil palm and rubber smallholdings to follow SAP guidelines.		Private CSR Initiatives/NGOs Partnership	Private Sector	Establish grant programme to promote & target awareness campaign
	ii. No expansion of agricultural activities in corridors.				
	iii. Conserve all wetlands.				
	5. Awareness campaign.	100.0	Federal Development Budget	Federal Revenue	Prepare detailed programmes & costing
	Sub-total Cost	111,045.8			
SL6	TO LINK GUNONG NABONG FR-CHIKU FR-RELAI FR-TMN NEGARA				
	1. Gazette state land forests as forest reserve.	111,382.2	Federal Budget/New mechanism	Federal Revenue/Trust Fund/Carbon Trading	Detailed feasibility study & costing.
	2. Gazette scrub lands as part of forest reserve.	3,361.9			
	3. Establish riparian reserve along river.		Federal Development Budget	Federal Revenue	Prepare detailed programmes & costing
	4. Infrastructure development: install road sign postings and impose speed control on roads.	312.0	Federal Development Budget	Federal Revenue	Detailed design & costing
	5. Land use Management:				
	• Agricultural land:				
	i. Oil palm and rubber smallholdings to follow SAP guidelines.				
	ii. No expansion of agricultural activities in corridors.		Private CSR Initiatives/NGOs Partnership	Private Sector	Establish grant programme to promote & target awareness campaign
	• Human settlements: No expansion of human settlements in the corridors				
	6. Awareness campaign.	100.0	Federal Development Budget	Federal Revenue	Prepare detailed programmes & costing
	Sub-total Cost	115,156.1			
SL7	TO LINK ULU MUDA FR-PEDU FR-CHEBAR FR				
	1. Gazette state land forests as forest reserve.	95,009.2	Federal Budget/New mechanism	Federal Revenue/Trust Fund/Carbon Trading	Detailed feasibility study & costing.
	2. Gazette scrub lands as part of forest reserve.	1,086.9			
	3. Establish riparian reserve along rivers and lake shores.		Federal Development Budget	Federal Revenue	Prepare detailed programmes & costing
	4. Infrastructure development: install road sign postings and impose speed control on roads.	240.0	Federal Development Budget	Federal Revenue	Detailed design & costing



LIST/ NAME OF LINKAGES BY RANK	IMPLEMENTATION STRATEGY	COST RM'000	FUNDING MECHANISM	SOURCES OF FUND	NEXT KEY STEPS
	5. Forest Management: Restrict logging in Ulu Muda FR				
	6. Land use Management:				
	• Prohibition of agricultural activities.				
	• Promotion of eco-tourism activities.		Federal Development Budget	Federal Revenue	Prepare detailed programmes & costing
	• Protection of watershed management areas.				
	7. Awareness campaign.	100.0	Federal Development Budget	Federal Revenue	Prepare detailed programmes & costing
	Sub-total Cost	96,436.1			
SL8	TO LINK ULU MUDA FR-RIMBA TELUAI FR				
	1. Gazette state land forests as forest reserve.	6,449.9	Federal Budget/New mechanism	Federal Revenue/Trust Fund/Carbon Trading	Detailed feasibility study & costing.
	2. Infrastructure development: install road sign postings and impose speed control on roads.	291.0	Federal Development Budget	Federal Revenue	Detailed design & costing
	3. Land use Management:				
	• Agricultural land:				
	i. Oil palm and rubber smallholdings to follow SAP guidelines.		Private CSR Initiatives/NGOs Partnership	Private Sector	Establish grant programme to promote & target awareness campaign
	ii. No expansion of agricultural activities in corridors.				
	4. Awareness campaign.	100.0	Federal Development Budget	Federal Revenue	Prepare detailed programmes & costing
	Sub-total Cost	6,840.9			
SL9	TO LINK JELI FR-SUNGGAI SATOR FR-JEDOK FR-SOKORTAKU FR				
	1. Gazette state land forests as forest reserve.	130,922.8	Federal Budget/New mechanism	Federal Revenue/Trust Fund/Carbon Trading	Detailed feasibility study & costing.
	2. Gazette scrub lands as part of forest reserve.	131,773.2			
	3. Establish riparian reserve along river.				
	4. Infrastructure development: install road sign postings and impose speed control on roads.	372.0	Federal Development Budget	Federal Revenue	Detailed design & costing
	5. Land use Management:				



LIST/ NAME OF LINKAGES BY RANK	IMPLEMENTATION STRATEGY	COST RM'000	FUNDING MECHANISM	SOURCES OF FUND	NEXT KEY STEPS
	<ul style="list-style-type: none"> Agricultural land: Rubber smallholdings to follow SAP guidelines. 		Private CSR Initiatives/NGOs Partnership	Private Sector	Establish grant programme to promote & target awareness campaign
	<ul style="list-style-type: none"> Human settlements: No expansion of settlements 				
	6. Awareness campaign.	100.0	Federal Development Budget	Federal Revenue	Prepare detailed programmes & costing
	Sub-total Cost	263,168.0			
SL10	TO LINK TEMANGAN FR-CHABANG TONGKAT FR-ULU SAT FR				
	1. Gazette state land forests as forest reserve.	26,473.3	Federal Budget/New mechanism	Federal Revenue/Trust Fund/Carbon Trading	Detailed feasibility study & costing.
	2. Infrastructure development: install road sign postings and impose speed control on roads.	276.0	Federal Development Budget	Federal Revenue	Detailed design & costing
	3. Land use Management: Agricultural land: Rubber holdings and paddy to follow SAP guidelines.		Private CSR Initiatives/NGOs Partnership	Private Sector	Establish grant programme to promote & target awareness campaign
	4. Awareness campaign.	100.0	Federal Development Budget	Federal Revenue	Prepare detailed programmes & costing
	Sub-total Cost	26,849.3			
	TOTAL COST SECONDARY LINKAGES	1,295,479.5			
	TOTAL COST ALL LINKAGES	2,30,514.6			

- Notes:
- (1) SAP: Sustainable Agricultural Practices; CSR: Corporate Social Responsibility
 - (2) Value of state forest lands is imputed from average market price of agricultural land. Assume value is equivalent to 25% of average market price.
 - (3) Cleared land is assumed to be alienated. In primary linkages, it is assumed that cleared land in linkages is acquired and reforested.
 - (4) Infrastructure costs are available only for priority corridors such as PL1, PL 2 and SL2. In remaining linkages, infrastructure costs are estimated based on length of roads, and minimum number of road sign postings and gantry signs. The infrastructure development costs of remaining linkages are underestimated.
 - (5) Preliminary budget costs for awareness campaigns are estimated.
 - (6) Only available cost estimates are shown.
 - (7) Total estimated cost for all linkages exclude imputed annual revenue loss from state forest land.



5.3.5 Economic Analysis of Implementing the Ecological Linkages

The objective of the economic analysis here is to determine the economic viability of implementing all the ecological linkages identified. It does not replicate or replace any detailed cost-benefit analysis undertaken for any selected priority corridor. The findings are to show whether it is feasibility to embark on developing the ecological corridors, taking into consideration that such linkages and the forest complexes they link to are among the world's major sources of biodiversity. The key assumption here is that these ecological linkages will enhance the forest complexes, and therefore are potential carbon sink. When certified, the carbon storage is marketed and sold, either on the open private market or through the World Bank's carbon finance unit. A precautionary note here as the findings here are preliminaries, and need further studies to become certifiable and marketable.

5.3.5.1 Assumptions in the Economic Model

The assumptions are:-

- 1) The areas of state forests are in hectares are obtained the maps in the fact sheets. The areas assumed to store carbon include scrublands and grasslands within the linkages.
- 2) The values of state forestlands are assumed at 25% of the market value of agricultural lands of the respective states. The average market prices per hectare of agricultural lands are estimated for each state from the Property Market Reports of 2007 and 2006. (Perak: RM52,000 per hectare; Pahang: RM75,000 per hectare; Kelantan: RM39,000 per hectare; Kedah: RM87,000 per hectare; Terengganu: RM54,000). All prices are current prices.
- 3) Annual loss in forest revenue is estimated for each linkage on per hectare basis. It is assumed that in assigning state forestlands for the ecological linkages, the various states would lose opportunities for earning forest revenue from such lands. Average forest revenue per hectare of forest opened is estimated from the Annual Report of the Forestry Department (2006). The estimates on a per hectare basis are: Kedah (RM4,200), Kelantan (RM2,800), Pahang (RM 3,200), Perak (RM 2,800), and Terengganu (RM2,800). Based on the areas of state land forests, the imputed loss of annual income is estimated for each linkage.
- 4) Cleared land in primary linkages is assumed to be acquired and reforested. The assumed reforestation cost is US\$1,500 per hectare. Based on an exchange rate of RM3.543 to US1\$ (Bank Negara Rate @ November 8, 2008), the adjusted cost per hectare in Ringgit is RM5,314 per hectare.
- 5) Recurrent costs are assumed at 1% of the costs of land. They are projected to rise at 1% annually. Recurrent costs cover management, legal, financing, insurance, brokerage, and all incidental costs and expenses associated with certification and carbon trading.
- 6) The residual land value, at the end of the 20-year period, is assumed to be two-thirds of the land value, assuming that the state forestland is usually alienated on a 60-year lease, and that by the end of the plan period, the lands still have values equivalent to 1/3 of their original values.



- 7) State forests in the ecological linkages are assumed to have the capacity to store carbon storage equivalent to 115tC per hectare. This value is lower than that which is used for permanent forests (see Brown and Pearce, "The Economic Value of Non-market Benefits of Tropical Forests: Carbon Storage, ' in Weiss, J. The Economics of Project Appraisal and Environment, (1994)).
- 8) The global price of carbon is assumed to be at US\$50 per tonne of carbon (see Benítez, P. McCallum, I., Obsersteiner, M., and Yamagato Y., " Global Potentail for Carbon Sequestration: Geographical Distribution. Country Risk and Policy Implications, "Ecological Economics, 60; 572-583. 2007). Allowing for the possibility that the linkages may be able to access the voluntary market where prices are lower, the economic analysis assumes an average price of US\$30 per tonne of carbon in the base model.
- 9) The period of committed carbon storage is up to 20 years (see World Bank Carbon Finance Unit, "World Bank Carbon Pricing Approach, " which talks of a credit period being typically for 7 years, renewal twice for a potential period of up to 21 years or a single, non-renewal period of 10 years. This credit period is independent of any commitment period specified under the Kyoto Protocol, which runs from 2008-2012).
- 10) Sensitivity analyses are undertaken. It allows for (i) higher market values of state forestlands equivalent to 50% of market agricultural land price (ii) a fall in the carbon price to US\$20 per metric tonne, and US\$15 per metric tonne.

5.3.5.2 Findings of the Economic Analysis

The estimated annual carbon income for each corridor is given in **Table 5.3.11** as a comparison with the development cost for each corridor. The estimated carbon income is an annual income flow. When completed, certified as tradeable credits, the ecological corridors could yield an annual income flow of RM 1.8 billion in terms of foreign exchange, based on an average market price of US\$30 per metric tonne of certified carbon. The estimates do not make any allowance for upward price adjustments. The markets are likely to be large corporations in the US, European Union and Japan.

The results of the economic analysis are given in **Table 5.3.12**. The estimated carbon stored by the protected state forest lands and scrub lands in the ecological linkages is 17.0 million metric tonne, and if certified and traded, could yield an annual income of RM 1,809.1 million, assuming the credits can be sold at US\$30 per metric tonne. The EIRR is 22 %, which indicates the economic feasibility of the ecological linkages, as the internal rate of return is very much higher than the opportunity cost of capital of 4.3% reflected in the interest rate of 5-year government securities as @ June 2008 (Treasury, Economic Report, 2008-2009).



Table 5.3.11: Estimated Annual Carbon Income for Each Corridor

	Linkage	Cost RM'000	Estimated ANNUAL Carbon Credit Income RM'000
PL1	To link Sungai Yu FR-Tanum FR-Taman Negara	87,703.8	25,660.5
PL2	To Link Belum FR-Royal Belum FR-Temenggor FR	465,127.9	308,359.7
SL2	To Link Krau WR-Som FR –Yong FR –Benchah FR-Kerambit FR-Gunung Benon FR	220,647.9	141,006.6
	Total Cost – Priority Linkages	773,479.5	475,086.8
PL3	To Link Lojing FR -Sg Brok FR	65,974.0	79,344.8
PL4	To Link Padang Chong FR-Sg. Kuak FR- Belukar Semang FR	58,728.6	52,443.1
PL5	To Link Ulu Muda FR (Ulu Muda)-Gunung Inas FR (Bintang Hijau)	26,984.8	13,607.2
PL6	To Link Ulu Jelai FR -Hulu Lemoi FR-Bukit Bujang FR-Bukit Jerut FR	180,733.5	115,212.7
PL7	To Link Taman Negara-Lebir FR-Tembat FR (Greater Taman Negara)	36,670.1	30,263.1
PL8	To Link Kenderong FR (Bintang Hijau)-Bintang Hijau (Hulu Perak) FR-Belukar Semang FR	87,818.1	79,672.0
PL9	To Link Bintang Hijau Larut Matang FR-Bintang Hijau Kuala Kangsar FR	5,330.1	2,258.8
	Total Cost –Primary Linkages (non-priority)	462,239.2	372,801.5
SL1	To Link Lebir FR-Relai FR-Ulu Temiang FR-Serasa FR-Jentiang FR -Gunung Stong FR	295,960.2	368,427.9
SL3	To Link Bintang Hijau (Hulu Perak) FR-Papulut FR-Piah FR	6,014.9	3,049.0
SL4	To Link Jerangau FR –Pasir Raja Barat FR- Besul Tambahan FR –Besul FR-Bukit Bauk FR	132,077.9	116,100.9
SL5	To Link Pak Kancil FR-Hulu Setiu FR	128,903.9	113,327.6
SL6	To Link Gunong Nabong FR-Chiku FR-Relai FR-Tmn Negara	129,414.5	159,231.0
SL7	To Link Ulu Muda FR-Pedu FR-Chebar FR	95,394.6	53,758.0
SL8	To link Ulu Muda FR-Rimba Teluai FR	9,240.9	3,638.5
SL9	To Link Jeli FR-Sungai Sator FR-Jedok FR-Sokortaku FR	90,424.3	110,697.7
SL10	To Link Temangan FR-Chabang Tongkat FR-Ulu Sat FR	28,534.3	32,957.8
	Total Cost-Secondary Linkages (Non Priority)	915,965.5	961,188.5
	Total Cost	2,151,684.2	1,809,076.8



Table 5.3.12: Economic Analysis of Ecological Linkages

	Year	'Acquisition' of State Forestland	Cost (RM in 000)						Benefits From Carbon Sales @ US\$30/mt (US\$: RM3,543)	Net Economic Benefits (RM'000)
				Infrastructure	Operating	Annual loss of Forest Income	Awareness Campaign	Total Cost		
1	2013	195,180.2		62,113.0	6,404.4	113,596.0	533.3	377,827.0	-	(377,827.0)
2	2014	195,180.2		62,113.0	6,596.6	113,596.0	533.3	378,019.1	-	(378,019.1)
3	2015	195,180.2		62,113.0	6,794.5	113,596.0	533.3	378,217.0	-	(378,217.0)
4	2016	88,333.8		3,834.0	6,998.3	204,263.7	280.0	303,709.8	475,086.8	171,377.0
5	2017	88,333.8		3,384.0	7,208.3	204,263.7	280.0	303,919.7	475,086.8	171,167.0
6	2018	88,333.8		3,384.0	7,424.5	204,263.7	280.0	304,136.0	475,086.8	170,950.8
7	2019	88,333.8		3,834.0	7,647.2	204,263.7	280.0	304,358.7	475,086.8	170,728.0
8	2020	88,333.8		3,384.0	7,876.7	204,263.7	280.0	304,588.1	475,086.8	170,498.6
9	2021	178,824.9	-	4,188.2	8,113.0	432,321.5	180.0	623,627.6	847,888.3	224,260.7
10	2022	178,824.9	-	4,188.2	8,356.4	432,321.5	180.0	623,871.0	847,888.3	224,017.3
11	2023	178,824.9	-	4,188.2	8,607.0	432,321.5	180.0	624,121.7	847,888.3	223,766.6
12	2024	178,824.9	-	4,188.2	8,865.3	432,321.5	180.0	624,379.9	847,888.3	223,508.4
13	2025	178,824.9	-	4,188.2	9,131.2	432,321.5	180.0	624,645.8	847,999.3	223,242.5
14	2026	-	-	-	9,405.1	432,321.5	-	441,726.7	1,809,076.8	1,367,350.1
15	2027	-	-	-	9,687.3	432,321.5	-	442,008.8	1,809,076.8	1,367,068.0
16	2028	-	-	-	9,977.9	432,321.5	-	442,299.5	1,809,076.8	1,366,777.4
17	2029	-	-	-	10,277.3	432,321.5	-	442,598.8	1,809,076.8	1,366,478.0
18	2030	-	-	-	10,585.6	432,321.5	-	442,907.1	1,809,076.8	1,366,169.7
19	2031	-	-	-	10,903.1	432,321.5	-	443,224.7	1,809,076.8	1,365,852.2
20	2032	-	-	-	11,230.2	432,321.5	-	443,551.8	1,809,076.8	1,365,525.1
Residual Land Value									1,289,889.5	
Economic Internal Rate of Return (EIRR)										22%

- Notes:
- (1) mt:metric tonne
 - (2) Carbon storage forest (open forest) @ 115 tC/ha (see Weiss J. (ed), The Economics of Project Appraisal and Environment (1994), for Brown and Pearce, "The Economic Value of Non-Market Benefits of Tropical Forests: Carbon Storage."
 - (3) US\$: RM3.543 (Bank Negara Rate @ November 8 2008. Malaysian Reserve)
 - (4) Price of carbon is assumed at US\$30 per metric tonne.
 - (5) Period of analysis is 20 years.



The sensitivity analyses are carried out to indicate the economic viability of the linkages under more adverse conditions and are shown in **Table 5.3.13**. The first scenario assumes the values of state forestland are relatively high and equivalent to 50% of the market prices of agricultural land in the states. This would push up the cost of land while the carbon price is held constant at US\$30 per metric tonne. The computed EIRR shows a rate of return of 15%, which is still higher than the opportunity cost of capital.

The second and third scenarios assume that trading is likely to be in the voluntary market where prices tend to be lower, such as at US\$20 or US\$15 per metric tonne. The analysis shows that if carbon price per metric tonne averages US\$20, (assuming land value is sustained at 25% of market price) is 14%; the internal rate of return (EIRR) is still relatively high at 14%. However, if carbon price falls further to US\$15 per metric tonne, the analysis finds that EIRR has declined to 6%, drawing closer to the government's opportunity cost of capital of 4.3%.

Table 5.3.13: Sensitivity Analysis

	EIRR %
Base Case (Value of state forestland @ 25% of market price of agricultural land and carbon price is @ US\$30 per metric tonne)	23
Scenario 1 (Value of State Forestland @ 50% of Market Price of Agricultural Land and carbon price is @ US\$30 per metric tonne)	15
Scenario 2 (Value of state forestland @ 25% of market price of agricultural land and carbon price is @ US\$ 20 per metric tonne)	13
Scenario 3 (Value of state forestland @ 25% of market price of agricultural land and carbon price is @ US\$15 per metric tonne)	6



5.3.6 Implementation Time Line

The implementation schedule is guided by (1) a desire to facilitate implementation in the shortest possible time; (2) to provide time for further feasibility studies for linkages that have yet to be studied in details. The implementation time line follows the underlying schedule below and a summarised table in given in **Table 5.3.14:-**

- Priority Linkages to be implemented under 10th Malaysia Plan, and targeted to start at latest from mid-term of the 10th Malaysia Plan.
- Non-Priority Primary Linkages to be implemented under 11th Malaysia Plan.
- Non Priority Secondary Linkages to be implemented under 12th Malaysia Plan.

However, proposals that are policy measures should be introduced under the Tenth Malaysia Plan as a precautionary approach. Such measures involve policy directives on activities within the linkages and they include:-

- Freeze on land alienation,
- Freeze on degazettement of forest reserves in and around selected linkages,
- Restriction on logging activities in forest reserves,
- Non-renewals of TOLs,
- Non-road widening,
- No expansion of agricultural activities,
- No expansion of human settlements in the linkages, and
- Focus on enforcement of laws on poaching and wildlife trade.

Table 5.3.14: Implementation Time Line

List / Name of Linkages by Rank	Implementation Strategy	Phasing																								
		10 th Malaysia Plan					11 th Malaysia Plan					12 th Malaysia Plan														
		2011-2015					2016-2020					2021-2025														
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5										
PL1	To link Sungai Yu FR-Tanum FR-Taman Negara																									
	Forest Reserve and Acquisition of Land.																									
	1. Gazette Tanum FR within the Core Area as Protected Forest under s10 NFA.																									
	2. Gazette all state land forests and within the core as Protected Forest under s10 NFA, and state land forests within the buffer as forest reserve under NFA.																									
	3. Gazette scrub land within the core as Protected Forest under s10 NFA and scrub land within Buffer as forest reserve under NFA.																									
	4. Long term strategy: Extend the boundary of Taman Negara Pahang to include the Core Area.																									
	5. Create riparian reserve of 50 m on either side of the rivers of Sg. Temau, Sg. Tanum and Sg. Yu.																									
	6. Build animal crossings at 1.3km (overpass) and 3km (viaduct) from Sg. Yu Bridge. Prohibit road widening within the linkage.																									



List / Name of Linkages by Rank	Implementation Strategy	Phasing																		
		10 th Malaysia Plan					11 th Malaysia Plan					12 th Malaysia Plan								
		2011-2015					2016-2020					2021-2025								
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5				
	7. Infrastructure development: install road sign postings and impose speed control on roads.																			
	8. Land use Management Control:																			
	• Plantation agencies in the area to adopt RSPO and obtain certification and create wildlife corridors.																			
	• Monitor the animal crossing programme.																			
	• Immediate freeze on land alienation and development in the corridor, plus any TOL land is not allowed to be renewed.																			
	• The wildlife corridor should be promoted as the most accessible part of the premier ecotourism destination of Taman Negara.																			
	• Establish viewing towers.																			
	9. Awareness campaign.																			
PL2	To Link Belum FR-Royal Belum FR-Temenggong FR																			
	1. Extend Belum FR to include Royal Belum Forest & gazette as Protected Forest .																			
	2. Extend Gerik FR & gazette state forest lands and scrub in linkage as Protected Forest.																			
	3. Build wildlife crossings such as viaduct or overpass.																			
	4. Infrastructure development: install road sign postings and impose speed control on roads.																			
	5. Land use Management Control:																			
	• Prohibit expansion of agriculture along the entire stretch of this highway in order to maintain the conservation and ecotourism benefits.																			
	• Acquire cleared land and reforest.																			
	6. Establish checkpoints at various parts of the highway to counter poaching.																			
	7. Long-term monitoring to identify critical elephant crossing sites.																			
	8. Establish wildlife viewing areas within core area and associated tourism facilities within suitable location.																			
	9. Promote this linkage as 'Jumbo Trail" in line with National Ecotourism Master Plan																			
	10. Awareness campaign.																			
PL3	To Link Lojing FR-Sg Brok FR																			
	1. Gazette state forests as forest reserve.																			
	2. Gazette state land under scrub land use as forest reserve.																			
	3. Infrastructure development: install road sign postings and impose speed control on roads.																			
	4. Establish riparian reserve along the rivers.																			
	5. Land use Management Control: linkage to be promoted as ecotourism attraction for Lojing.																			
	6. Awareness campaign.																			
PL4	To Link Padang Chong FR-Sg. Kuak FR- Belukar Semang FR																			
	1. Gazette state land forests as forest reserve.																			
	2. Establish riparian reserve along the rivers.																			
	3. Acquire and reforest all cleared land.																			



List / Name of Linkages by Rank	Implementation Strategy	Phasing																	
		10 th Malaysia Plan					11 th Malaysia Plan					12 th Malaysia Plan							
		2011-2015					2016-2020					2021-2025							
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5			
	4. Infrastructure development: install road sign postings and impose speed control on roads.																		
	5. Land use Management Control:																		
	• Human settlement: No expansion of human settlement within identified linkage.																		
	• Agricultural land: Rubber estates to follow sustainable agricultural practices (SAP) guidelines.																		
	• No expansion of agricultural activities.																		
	6. Awareness campaign.																		
PL5	To Link Ulu Muda FR (Ulu Muda)-Gunung Inas FR (Bintang Hijau)																		
	1. Extend Ulu Muda FR & gazette state land forest as forest reserve.																		
	2. Extend Gunung Inas FR & gazette state land forest as Protected Forest.																		
	3. Infrastructure development: install road sign postings and impose speed control on roads.																		
	4. Land use Management Control: Agricultural land: rubber estates to follow sustainable agricultural practices. Agricultural cultivation (rubber) to follow SAP guidelines.																		
	5. Awareness campaign.																		
PL6	To Link Ulu Jelai FR -Hulu Lemoi FR-Bukit Bujang FR-Bukit Jerut FR																		
	1. Gazette state land forest and scrub land as forest reserves.																		
	2. Acquire and reforest cleared land.																		
	3. Establish riparian reserve along rivers.																		
	4. Infrastructure development: install road sign postings and impose speed control on roads.																		
	5. Land use Management Control:																		
	• Control conversion of land along road in the linkage.																		
	• Agricultural land: Rubber estates to follow SAP guidelines.																		
	• Increase patrol and enforcement around viaducts to discourage poaching.																		
	6. Awareness campaign.																		
PL7	To Link Taman Negara-Lebir FR-Tembat FR (Greater Taman Negara)																		
	1. Gazette Lebir FR as a Protected Forest.																		
	2. Gazette state land forest as forest reserve.																		
	3. Infrastructure development: install road sign postings and impose speed control on roads.																		
	4. Land use Management Control:																		
	• No development activity to be permitted along the dry land forest between Tasik Kenyir's water edge and stretch of border with Kelantan.																		
	• Oil palm and rubber smallholdings to follow SAP guidelines.																		
	• Promote as part of ecotourism destination of Taman Negara Kuala Koh and Kenyir Lake.																		
	5. Awareness campaign.																		



List / Name of Linkages by Rank	Implementation Strategy	Phasing														
		10 th Malaysia Plan					11 th Malaysia Plan					12 th Malaysia Plan				
		2011-2015					2016-2020					2021-2025				
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
PL8	To Link Kenderong FR (Bintang Hijau)-Bintang Hijau (Hulu Perak) FR- Belukar Semang FR															
	1. Gazette state forest land along road and viaducts as forest reserve.															
	2. Reforest areas around viaducts.															
	3. Establish riparian reserve along Sg. Rui.															
	4. Land use Management Control:															
	• Increase patrol and enforcement around the viaduct areas															
	• Develop artificial salt licks and reforest around them.															
	5. Infrastructure development: install road sign postings and impose speed control on roads.															
	6. Enhance park management system through human resource development.															
	7. Awareness campaign.															
PL9	To Link Bintang Hijau Larut Matang FR-Bintang Hijau Kuala Kangsar FR															
	1. Gazette state land forest as forest reserve.															
	2. Gazette state land along road as forest reserve.															
	3. Acquire cleared land and reforest.															
	4. Infrastructure development: install road sign postings and impose speed control on roads.															
	5. Establish riparian reserve.															
	6. Land use Management Control: Relocate Deer Farm.															
	7. Awareness campaign.															



List / Name of Linkages by Rank	Implementation Strategy	Phasing														
		10 th Malaysia Plan					11 th Malaysia Plan					12 th Malaysia Plan				
		2011-2015					2016-2020					2021-2025				
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
SL1	To Link Lebir FR-Relai FR-Ulu Temiang FR-Serasa FR-Jentiang FR-Gunung Stong FR															
	1. Gazette state land forests as forest reserve.															
	2. Gazette scrub land as forest reserve.															
	3. Gazette Gua Ikan (limestone) as part of Serasa FR.															
	4. Establish riparian reserve along the rivers															
	5. Infrastructure development: install road sign postings and impose speed control on roads.															
	6. Land use Management Control:															
	• Agricultural land: Rubber estates to follow SAP guidelines															
	• Human settlements: no expansion of existing settlements within linkage.															
	• Develop Gua Ikan as ecotourism attraction															
	7. Awareness campaign.															
SL2	To Link Krau WR-Som FR –Yong FR –Benchah FR-Kerambit FR-Gunung Benon FR															
	1. Gazette state land forests as forest reserve.															
	2. Gazette scrub land as part of forest reserve.															
	3. Gazette established corridors as part of Krau Wildlife Reserve															
	4. Establish riparian reserves along Sg. Som (entire length); Sg. Kenong, Sg. Darah, Sg. Ceka (Kuala Som to Kuala Rengat). Riparian reserves to have minimum width of 50m on both sides.															
	5. Infrastructure development:															
	• Develop crossings for small animals along road.															
	• Prohibit road widening within corridors.															
	• Install road sign postings and impose speed control on roads.															
	6. Forest Management:															
	• Reforestation and enrichment planting on gazetted riparian reserves and cleared land.															
	• No degazettement of Som FR, Hulu Mas FR, Bukit Taching FR, Jerantut Tambahan FR, Kerambit FR, and Krau FR.															
	7. Land use Management:															
	• Agricultural land: Rubber estates to follow SAP guidelines.															
	• Human Settlements: Establish special management zones to reduce wildlife animal-human conflicts.															
	• Eco-tourism: promote wildlife corridors as an attraction for National Park (Jerantut) and Kenong Rimba Park (Pahang State Park). Construct viewing towers.															
	8. Awareness campaign.															
SL3	To link Bintang Hland ijau (Hulu Perak) FR-Papulut FR-Piah FR															
	1. Gazette state land forests as forest reserve.															



List / Name of Linkages by Rank	Implementation Strategy	Phasing																
		10 th Malaysia Plan					11 th Malaysia Plan					12 th Malaysia Plan						
		2011-2015					2016-2020					2021-2025						
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5		
	2. Establish riparian reserve along river and lakes in the corridors.																	
	3. Infrastructure development: install road sign postings and impose speed control on roads.																	
	4. Land use Management :																	
	• Rubber estates to follow SAP guidelines.																	
	• No expansion of agricultural activities in the corridors																	
	• Human settlements: No expansion of human settlements in the corridors																	
	5. Awareness campaign.																	
SL4	To link Jerangau FR –Pasar Raja Barat FR- Besul Tambahan FR –Besul FR-Bukit Bauk FR																	
	1. Gazette state land forests as forest reserve.																	
	2. Establish riparian reserves along the rivers.																	
	3. Forest Management: Conserve wetlands.																	
	4. Infrastructure development: install road sign postings and impose speed control on roads.																	
	5. Land use Management:																	
	• Agricultural land:																	
	i. Oil palm and rubber smallholdings to follow SAP guidelines.																	
	ii. Paddy lands to adopt SAP guidelines.																	
	iii. No expansion of agricultural activities.																	
	• Human settlements: No expansion of human settlements in the corridors.																	
	6. Awareness campaign.																	
SL5	To link Pak Kancil FR-Hulu Setiu FR																	
	1. Gazette state land forests as forest reserve.																	
	2. Gazette scrub lands as part of forest reserve.																	
	3. Infrastructure development: install road sign postings and impose speed control on roads.																	
	4. Land use Management:																	
	• Agricultural land:																	
	i. Oil palm and rubber smallholdings to follow SAP guidelines.																	
	ii. No expansion of agricultural activities in corridors.																	
	iii. Conserve all wetlands.																	
	5. Awareness campaign.																	
SL6	To link Gunong Nabong FR-Chiku FR-Relai FR-Tmn Negara																	
	1. Gazette state land forests as forest reserve.																	
	2. Gazette scrub lands as part of forest reserve.																	
	3. Establish riparian reserve along river.																	
	4. Infrastructure development: install road sign postings and impose speed control on roads.																	
	5. Land use Management:																	



List / Name of Linkages by Rank	Implementation Strategy	Phasing														
		10 th Malaysia Plan					11 th Malaysia Plan					12 th Malaysia Plan				
		2011-2015					2016-2020					2021-2025				
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	<ul style="list-style-type: none"> Agricultural land: <ol style="list-style-type: none"> Oil palm and rubber smallholdings to follow SAP guidelines. No expansion of agricultural activities in corridors. Human settlements: No expansion of human settlements in the corridors 															
	6. Awareness campaign.															
SL7	To link Ulu Muda FR-Pedu FR-Chebar FR															
	1. Gazette state land forests as forest reserve.															
	2. Gazette scrub lands as part of forest reserve.															
	3. Establish riparian reserve along rivers and lake shores.															
	4. Infrastructure development: install road sign postings and impose speed control on roads.															
	5. Forest Management: Restrict logging in Ulu Muda FR															
	6. Land use Management: <ul style="list-style-type: none"> Prohibition of agricultural activities. Promotion of eco-tourism activities. Protection of watershed management areas. 															
	7. Awareness campaign.															
SL8	To link Ulu Muda FR-Rimba Teluai FR															
	1. Gazette state land forests as forest reserve.															
	2. Infrastructure development: install road sign postings and impose speed control on roads.															
	3. Land use Management: <ul style="list-style-type: none"> Agricultural land: <ol style="list-style-type: none"> Oil palm and rubber smallholdings to follow SAP guidelines. No expansion of agricultural activities in corridors. 															
	4. Awareness campaign.															
SL9	To link Jeli FR-Sungai Sator FR-Jedok FR-Sokortaku FR															
	1. Gazette state land forests as forest reserve.															
	2. Gazette scrub lands as part of forest reserve.															
	3. Establish riparian reserve along river.															
	4. Infrastructure development: install road sign postings and impose speed control on roads.															
	5. Land use Management: <ul style="list-style-type: none"> Agricultural land: Rubber smallholdings to follow SAP guidelines. Human settlements: No expansion of settlements 															
	6. Awareness campaign.															



List / Name of Linkages by Rank	Implementation Strategy	Phasing																
		10 th Malaysia Plan					11 th Malaysia Plan					12 th Malaysia Plan						
		2011-2015					2016-2020					2021-2025						
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5		
SL10	To link Temangan FR-Chabang Tongkat FR-Ulu Sat FR																	
	1. Gazette state land forests as forest reserve.																	
	2. Infrastructure development: install road sign postings and impose speed control on roads.																	
	3. Land use Management:																	
	Agricultural land: Rubber holdings and paddy to follow SAP guidelines.																	
	4. Awareness campaign.																	

Note: FR: Forest Reserve; SAP: Sustainable Agricultural Practices; CSR: Corporate Social Responsibility

Attachment 5.3.1

	Linkage	Cost RM'000	Funding Mechanism	Funding Source
PL1	To link Sungai Yu FR-Tanum FR-Taman Negara			
	1. Gazette state forests	41,502.7	Federal Budget	Federal Revenue
	2. Create riparian reserve -FELCRA Sungai Temau Estate	n.a.	Private Initiative	Private Fund
	3. Build road Infrastructure for animal crossings & sign posts	42,000.0	Federal Budget	Federal Revenue
	4. Install monitoring equipment & maintenance	5,640.0	Federal Budget	Federal Revenue
	5. Install Viewing Towers for ecotourism & car parks	240.0	Federal Budget	Federal Revenue
	Subtotal	89,382.7		
PL2	To Link Belum FR-Royal Belum FR-Temenggor FR			
	1. Gazette state forests	334,297.0	Federal Budget	Federal Revenue
	2. Build road Infrastructure for animal crossings & sign posts	120,990.0	Federal Budget	Federal Revenue
	3. Install monitoring equipment & undertake annual maintenance	14,160.0	Federal Budget	Federal Revenue
	4. Install Viewing Towers for ecotourism & car parks	240.0	Federal Budget	Federal Revenue
	5. Acquire cleared land & reforest	1,270.8		
	Subtotal	470,957.8		
SL2	To Link Krau WR-Som FR –Yong FR –Benchah FR-Kerambit FR-Gunung Benon FR			
	1. Gazette state forests	208,976.9	Federal Budget	Federal Revenue
	2. Establish riparian reserves & reforest	9,798.7	Federal Budget	Federal Revenue
	3. Build road Infrastructure for animal crossings & sign postings	249.0	Federal Budget	Federal Revenue
	4. Acquire cleared land & reforest	5,785.3		
	Subtotal	224,809.9		
	Total Cost – Priority Linkages	785,150.4		
PL3	To Link Lojing FR -Sg Brok FR			
	1. Gazette state forests as forest reserve	63,086.0	Federal Budget/New Mechanism	Federal Revenue/ National Trust



	Linkage	Cost RM'000	Funding Mechanism	Funding Source
	2. Build road Infrastructure for animal crossings & sign postings	48.0	Federal Budget	Federal Revenue
	Subtotal	63,134.0		
PL4	To Link Padang Chong FR-Sg. Kuak FR- Belukar Semang FR			
	1. Gazette state forests as forest reserves	56,123.7	Federal Budget/New Mechanism	Federal Revenue/ National Trust
	2. Build road Infrastructure for animal crossings & sign postings	24.0	Federal Budget	Federal Revenue
	3. Acquire cleared land & reforest	4,955.7	Federal Budget	Federal Revenue
	Subtotal	61,103.4		
PL5	To Link Ulu Muda FR (Ulu Muda)-Gunung Inas FR (Bintang Hijau)			
	1. Gazette state forests as forest reserves	24,120.4	Federal Budget/New Mechanism	Federal Revenue/ National Trust
	2. Build road Infrastructure & sign postings	24.0	Federal Budget	Federal Revenue
	Subtotal	24,144.4		
PL6	To Link Ulu Jelai FR -Hulu Lemoi FR-Bukit Bujang FR-Bukit Jerut FR			
	1. Gazette state forests as forest reserves	201,755.9	Federal Budget/New Mechanism	Federal Revenue/ National Trust
	2. Build road Infrastructure for animal crossings & sign postings	258.0	Federal Budget	Federal Revenue
	3. Acquire cleared land & reforest	1,973.1	Federal Budget	Federal Revenue
	Subtotal	203,987.0		
PL7	To Link Taman Negara-Lebir FR-Tambat FR (Greater Taman Negara)			
	1. Gazette state forest as forest reserve	24,058.3	Federal Budget/New Mechanism	Federal Revenue/ National Trust
	2. Build road Infrastructure for animal crossings & sign postings	144.0	Federal Budget	Federal Revenue
	Subtotal	24,202.3	Federal Budget/ New Mechanism	Federal Revenue/ National Trus
PL8	To Link Kenderong FR (Bintang Hijau)-Bintang Hijau (Hulu Perak) FR- Belukar Semang FR			
	1. Gazette state forests as forest reserves	83,385.5	Federal Budget/New Mechanism	Federal Revenue/ National Trust
	2. Build road Infrastructure for animal crossings & sign postings	108.0	Federal Budget	Federal Revenue
	3. Acquire cleared land & reforest	461.5	Federal Budget	Federal Revenue
	Subtotal	83,955.0		
PL9	To Link Bintang Hijau Larut Matang FR-Bintang Hijau Kuala Kangsar FR			
	1. Gazette state forests as forest reserves	2,406.1	Federal Budget/New Mechanism	Federal Revenue/ National Trust
	2. Acquire cleared land & reforest	6,069.3	Federal Budget/New Mechanism	Federal Revenue/ National Trust
	3. Build road Infrastructure for animal crossings & sign postings	84.0	Federal Budget	Federal Revenue
	Subtotal	8,559.4		
	Total Cost –Primary Linkages (non-priority)	469,085.5		



	Linkage	Cost RM'000	Funding Mechanism	Funding Source
SL1	To Link Lebir FR-Relai FR-Ulu Temiang FR-Serasa FR-Jentiang FR -Gunung Stong FR			
	1. Gazette state forests as forest reserve	310,602.5	Federal Budget/New Mechanism	Federal Revenue/ National Trust
	2. Build road Infrastructure for animal crossings & sign postings	288.0	Federal Budget	Federal Revenue/ Shared Revenue from Concessionaire
	Subtotal	310,889.5		
SL3	To Link Bintang Hijau (Hulu Perak) FR-Papulut FR-Piah FR			
	1. Gazette state forests as forest reserve	9,499.0	Federal Budget/New Mechanism	Federal Revenue/ National Trust
	2. Build road Infrastructure for animal crossings & sign postings	27.0	Federal Budget	Federal Revenue
	Subtotal	9,526.0		
SL4	To Link Jerangau FR –Pasir Raja Barat FR- Besul Tambahan FR –Besul FR-Bukit Bauk FR			
	1. Gazette state forests as forest reserve	129,332.9	Federal Budget/New Mechanism	Federal Revenue/ National Trust
	2. Build road Infrastructure for animal crossings & sign postings	105.0	Federal Budget	Federal Revenue
	Subtotal	129,337.9		
SL5	To Link Pak Kancil FR-Hulu Setiu FR			
	1. Gazette state forests as forest reserve	110,687.8	Federal Budget/New Mechanism	Federal Revenue/ National Trust
	2. Build road Infrastructure for animal crossings & sign postings Build road Infrastructure & sign postings	18.0	Federal Budget/New Mechanism	Federal Revenue/ National Trust
	Subtotal	110,705.8		
SL6	To Link Gunong Nabong FR-Chiku FR-Relai FR-Tmn Negara			
	1. Gazette state forests as forest reserve	114,744.1	Federal Budget/New Mechanism	Federal Revenue/ National Trust
	2. Build road Infrastructure for animal crossings & sign postings	72.0	Federal Budget	Federal Revenue
	Subtotal	114,816.1		
SL7	To Link Ulu Muda FR-Pedu FR-Chebar FR			
	1. Gazette state forests as forest reserve	96,096.1	Federal Budget/New Mechanism	Federal Revenue/ National Trust
	Subtotal	96,096.1		
SL8	To link Ulu Muda FR-Rimba Teluai FR			
	1. Gazette state forests as forest reserve	6,449.9	Federal Budget/New Mechanism	Federal Revenue/ National Trust
	2. Build road Infrastructure for animal crossings & sign postings	51.0	Federal Budget	Federal Revenue
	Subtotal	6,500.9		
SL9	To Link Jeli FR-Sungai Sator FR-Jedok FR-Sokortaku FR			
	1. Gazette state forests as forest reserve	262,696.0	Federal Budget/New Mechanism	Federal Revenue/ National Trust
	2. Build road Infrastructure for animal crossings & sign postings	132.0	Federal Budget	Federal Revenue
	Subtotal	262,828.0		



	Linkage	Cost RM'000	Funding Mechanism	Funding Source
SL10	To Link Temangan FR-Chabang Tongkat FR-Ulu Sat FR			
	1. Gazette state forests as forest reserve	26,473.3	Federal Budget/New Mechanism	Federal Revenue/ National Trust
	2. Build road Infrastructure for animal crossings & sign postings	36.0	Federal Budget	Federal Revenue
	Subtotal	26,509.3		
	Total Cost-Secondary Linkages (Non Priority)	1,067,209.6		
	Total Cost	2,321,445.4		



5.4 REVIEW AND ASSESSMENT

5.4.1 Introduction

It is important to note that this study is a test-bed in pioneering the planning, design and management of ecological corridors in Peninsular Malaysia. As such, it is important that we learn from the corridors established, and to add to the local body of knowledge on ecological corridors (and landscape ecology in general) so that we are able to better plan and manage them in future.

An important step in the planning, design and management of ecological linkages is to measure the effectiveness of the various initiatives implemented against set targets and key performance indicators, and to take appropriate policy decisions and actions to rectify any deviations and constraints faced. For instance, if elephants are deterred from using a viaduct over a road due to excessive vehicle traffic noise, sound barriers can be built to mitigate the adverse sound impact on the viaduct.

Very little research done so far on ecological corridors, or wildlife movement at the landscape level in the country. Thus there is a grave lack of local empirical evidence available to base the planning and design of ecological linkages. Due to this, as well as time and resource constraints of this study, we have designed the ecological linkages based on studies and guidelines from overseas, coupled with local wildlife expert knowledge and intuition as well as conservation biology and landscape ecology theories. It should be noted that the although corridor/linkage guidelines from oversease have been Thus, monitoring, together with more field researches, is crucial to assist the project to produce a more solid scientific-based set of key performance indicators for assessing the design and functionality of ecological corridors.

5.4.2 Baseline Data, Monitoring and Assessment

Monitoring the use of the ecological linkages by target wildlife species in the CFS-1 area is essential to allow for adaptive management. It is also extremely important to pay attention to the population changes in animals, e.g. size and growth rates, after an ecological corridor has been implemented to ensure that there are no harmful side effects, as well as the trends in human wildlife conflicts, e.g. roadkills, elephants raiding plantations, in the vicinity

To enable monitoring and assessment of the effectiveness of each linkage, it is necessary to gather baseline data on the vegetation and fauna, using appropriate survey methods, e.g. camera traps and mark-recapture techniques. The main purpose of monitoring is to address the following questions:-

- Is the location of the ecological corridor effective in facilitating wildlife movement between forest complexes and forest islands in the CFS-1 area?
- Is the layout of the ecological corridor optimal, in terms of width-length, shape, and slope?
- What large mammals, e.g. elephants and tigers, and predators use the ecological corridor?
- Are the type of physical structures and recommended design standards suitable for use by the target animal species?
- What are the constraints to animal movement in these areas?
- Where additional habitat restoration (or other management actions), e.g. reforestation, are required to encourage animal movement?



- Are the land use, development and human activities control and management guidelines adequate and appropriate in reducing human-wild conflicts in the buffer zones as well as in not deterring animals from using the wildlife corridors?
- Can mitigating measures, e.g. electric fences and trenches, be taken in designated ecological corridor areas where human and human activities are already present without having them relocated?

5.4.3 Targets and Key Performance Indicators (KPI)

Two sets of KPI are envisaged, i.e. one set to measure the progress in the establishment of ecological linkages (following the implementation timeline proposed earlier in this chapter), and another set to measure the performance of the linkages (i.e. the linkages’ “functionality”) (See **Table 5.4.1**). It is important to note that with a lack of baseline data at present, no hard targets may be set (e.g. increase elephant numbers to 100 per month). A much more realistic way of assessing effectiveness would be to measure trends, whereby an upward trend in wildlife numbers and species found in the linkage would indicate that the linkage is increasingly used by wildlife.

Table 5.4.1: KPI for Achieving “Functional linkage”

KPI	Criteria*	Survey Method
Focal species population <ul style="list-style-type: none"> • In the linkage • In adjacent habitats 	<ul style="list-style-type: none"> • Population of focal mammal and bird species in the linkage and adjacent habitats. 	<ul style="list-style-type: none"> • Camera trapping programme. • Survey of animal presence.
	<ul style="list-style-type: none"> • General status of biodiversity (species richness and abundance) 	<ul style="list-style-type: none"> • Biodiversity survey.
Usage of the wildlife crossing structures	<ul style="list-style-type: none"> • Recording and monitoring of animals using specific wildlife crossing structure (species diversity and numbers) and time and frequency of usage 	<ul style="list-style-type: none"> • Camera trapping programme. • Survey of animal presence.
Human-wildlife conflict	<ul style="list-style-type: none"> • Number of roadkills in the corridor 	<ul style="list-style-type: none"> • Monitor roadkill trends within the corridor.
	<ul style="list-style-type: none"> • Number of wildlife (e.g. elephants, tigers) causing problems in adjacent plantations and villages 	<ul style="list-style-type: none"> • Monitor human-wildlife conflicts
	<ul style="list-style-type: none"> • Effectiveness of anti-poaching enforcement 	<ul style="list-style-type: none"> • Survey of poaching presence.

* In order to measure changes and trends, initial surveys are required to determine the baseline for all KPI/criteria



5.5 LEGAL IMPLICATIONS

5.5.1 Constitutional Provisions

Malaysia follows a Federal System of government with divided responsibilities for Federal and State Governments. The distribution of executive and legislative powers is spelled out in 9th Schedule of the Constitution. Many of the matters pertaining to natural resources and land development are on the State and Concurrent List rather than the Federal List. Hence, agriculture, forestry, rivers and riparian rights, land improvement and soil conservation fall within State jurisdiction. (**See Table 5.5.1**)

There are some conservation aspects that fall within the Concurrent List (where executive power is normally vested in the State unless otherwise provided by law (Art 80(2))). This includes the protection of wild animals, town and country planning, drainage and irrigation and the preservation of heritage. Most of the communication and transport sector relating to federal roads, railways and bridges, and more recently water supply and tourism comes within the Federal List. Hence it is important to recognize that the State is an important stakeholder in establishing and implementing the ecological linkages.

1) Key Issues

The first issue revolves around Federal-State relationships. Two aspects of this issue are:-

- i) The constitutional delineation of jurisdictions and revenue sources between the two levels of government. The constitutional demarcations of jurisdiction place land under state jurisdiction but there are a host of activities under the concurrent list which are pertinent to the proposed corridors and require both levels of government to work closely to achieve the stated objective.
- ii) The second aspect concerns finances. Most of the state governments are not in a strong financial position, as their revenue sources are generally inelastic and have low base. They are afraid to lose potential income base from land which is needed to support their fiscal position, and which is the only major assets the states have. In many instances, states are very much dependent on federal grants to cover their budgetary deficits so they are hesitant to take up additional responsibilities from the proposed the ecological corridors could demand.

The second issue arises when implementation goes outside of government jurisdiction and brings into play the private sector and the non-governmental organizations (NGOs). Implementation of the corridors encourages direct participation from the private sector and the NGOs. The rationale for doing is, as far as possible, to tap into their financial and human resources. However, this does not displace the government whose role is important as an intermediary to ensure that all players carry out their work effectively towards the creation of the proposed corridors. The interplay of organizations from government, private sector, and the NGOs is critical to the success of some corridors and it demands careful coordination.



Table 5.5.1: Matters Relevant to the Environment & Natural Resources under the Federal, State and Concurrent Lists

List	Item	Matter
Federal	8	Trade, commerce and industry, particularly, Item 8(a), relating to production, supply and distribution of goods, Item 8(l), which is concerned with industries and regulation of industrial undertakings, and Item 8(j) which deals with the development of mineral resources, mines, mining, minerals, mineral ores, oils, oilfields and petroleum products.
	9	Shipping, navigation and fisheries, especially, Item 9(d), pertaining to maritime and estuarine fishing and fisheries.
	10	Communications and transport including Federal Roads, Bridges, Railways
	11	Federal works and power including water supply and distribution, electricity and gas works
	14	Medicine and health
	20	Control of agriculture pests
	25A	Tourism
State	2	Land matters, particularly, Item 2(a) which refers to land improvement and soils conservation, compulsory acquisition of land , Malay Reservation
	3	Agriculture and forestry
	4	Local government
	6	State works and water, rivers and canals but excluding water supply and services, control of silt and riparian rights
	12	Turtles and riverine fishing
Concurrent	3	Protection of wild animals and wild birds, and National Parks
	5	Town and country planning
	7	Public health
	8	Drainage and irrigation
	9	Rehabilitation of mining land and land which has suffered soil erosion
	9E	Preservation of heritage

2) Integrated Framework for Implementation and the legal implications

The following **Table 5.5.2** summarizes the main implementation scenarios in securing the ecological corridors and the legal provisions that apply to the options. It is submitted that the land parcels within the corridors will contain a wide array of land ownership status from alienated land, reserve land, state land, forest reserve and even Malay Reserve Land. Each of these parcels has to be addressed differently.

Option1: Acquisition of private land in the corridors and reserve it for public purpose.

Acquiring or purchasing land for the corridor may be a costly option and should only be resorted to if they exist as small pockets of land interspersed within state land. The principle laws that will apply include the Land

Acquisition Act 1960, National Land Code and State Land Rules. The purpose for which acquisition could be done is wide and is provided under s3 (1) of the Act:-

- i) For any public purpose
- ii) By any person or corporation for any purpose which in the opinion of the State Authority is beneficial for the economic development of Malaysia or any part thereof or to the public generally or any class of the public
- iii) For the purpose of mining, residential, agricultural, commercial, industrial or recreational purposes or any combination of the purposes.

Some of the aspects that need to be noted are:-

- Land acquisition can only be applied all alienated land, land occupied under customary right and land occupied in expectation of title. As such land held under mining certificate or mining lease and state land are not included.
- It should be noted that under the Act only the State Authority is empowered to acquire land compulsorily although it may do so on behalf of any person or corporation.
- The words “public purpose” is not defined in the Act. It is exclusively for the State Authority to decide what is and what is not public purpose. It is submitted that land acquired as an ecological corridor could very well fall within the definition of public purpose. However if the courts adopt a limited definition of public purpose, there may be a need to amend the Act to include conservation as one of the purposes for land acquisition.
- Similarly the land could also be acquired under s 3 (1) b, where the purpose can be anything as long as it is in the opinion of the SA economically beneficial to the country. There may be a need to prepare an environmental economic cost and benefit analysis of the potential corridor and establish the economic benefits to the country
- Once the land is acquired it can be reserved for public purpose under s62 National Land Code (NLC). Reserved lands are normally maintained by the officers of the State or Federal Departments. Hence there will be a need to determine the department that will have control of the reserved land.

Option 2 : Purchase of land / alienation of land as ecological Corridors

Private land may be purchased and assembled to form an ecological corridor. Most of the alienated lands in the corridor are likely to be agricultural lands. In the event the land constitutes estate land its conveyance to two or more persons will also require the consent of the Estate Land Board constituted within the State. If there is state land in the corridor, an application can be made to alienate the land to the project proponent. The effect of the alienation is an issuance of a title. In most cases, the state land is alienated as leasehold land not exceeding 99 years unless there are special circumstances as shown s76(aa) NLC. The principle laws in this respect are the National Land Code and the State Land rules. Some of the aspects that need to be noted are:-



- With the exception of industrial land, non citizens and foreign companies may only purchase land with the approval of the State Authority (s433B). The SA may also impose a levy on such transaction (s433E).
- One of the issues that may arise is the category of landuse to be imposed on the alienated land .Under the circumstances the 'nil' category could be imposed with express conditions that the land is to be used for the purpose of ecological corridors.
- While it may be possible to source external funds to purchase lands, again the practicality of it may be constrained by the amount of funds required to do so. Notwithstanding this it may be possible to use some of the Special Funds in the market to do so.

Option 3: Integrating Road/Railway Crossing with the Ecological Corridors

Integrating roads and railways with the ecological corridors should be given greater attention especially when planning for new highways, pipelines, highways and high speed rail. The Principal Laws are:-

- i) Federal Roads Act 1959
- ii) Road Transport Act 1987
- iii) Highway Authority Malaysia (Incorporation) Act 1980
- iv) Railways Act 1991
- v) Railways (Successor Company) Act 199
- vi) Environmental Quality Act 1974 (The Environmental Quality (Prescribed Activities) Environmental Impact Assessment Order 1987

Generally the consent of the infrastructure agency / authority will be required if any ecological connections are established either under or over the road or railway. Some of the aspects that should be noted are:-

- Ecological connections should be one of the key components to be addressed when planning and designing of highways and expressways. Within the context, the proposed Central Spine Expressway which extends from Segamat to Gua Musang (a new dual-2 carriageway) will have to carefully studied as several ecological corridors have been identified along this route.
- The EIA for such infrastructure should include these guidelines as part of the TOR or scoping of the study.
- The existing KTM service which runs two trains a day from Gemas to Kota Bahru may not be a physical barrier to most animals due to the low train frequency and the absence of fencing barriers normally associated with electric trains. However new graded crossings may be necessary if electric trains are used in this sector in the future. As construction of new railway lines also falls within the Prescribed Order, there may be need to include ecological corridors in the EIA guidelines for New Railway Schemes especially high speed electric trains.

Option 4 : Establishing Ecological Corridors on Private Land

Establishing ecological corridors on private land holds a lot of promise, particularly if they are large plantation lands. This could be seen as part of the Corporate Social Responsibility of these groups in supporting the biodiversity initiative of the government. The current legal mechanisms seem to be Memorandum of Understanding and Agreements between parties. In the long run however concepts such as Conservation Easements could be introduced. Managing the corridor will also require sufficient expertise from NGO's and Environmental Groups. It is also important to have proper training and dissemination of knowledge and training to the surrounding village residents who will be important stakeholders in the exercise. Some of the aspects to be noted are:-

- The easement as provided under the NLC is different from the Conservation Easements that are used in the United States as a means of safeguarding Ecological Corridors. Hence there may be a need to include new provisions for Conservation Easements in the NLC before it could be effectively applied in the country.
- Similarly the NLC also does not create any proprietary rights on the land as a result of covenants and agreements between parties if it does not amount to an easement. The remedy for any breach of such agreements is in contract
- One of the issues that need to be addressed in awarding MOU with conservation groups are contradictions if any with the express or implied conditions of the land. An application may need to be made to include or amend any express conditions should there be any contradictions.

Option 5: Establishing the Corridor as Protection Forests/ Wildlife Reserves/ Heritage Park/ Environmentally Sensitive Areas

The eventual goal is to establish these corridors as permanent protected areas. There are various mechanisms for this including reservation as a forest reserve, a wildlife sanctuary, a heritage site, a constituent component of the National Park Network and even as a State Park. Prior to establishing this it may be prudent to designate the corridors as Environmental Sensitive Areas in the Development Plans (NPP, Structure and Local Plans) of the country.

Some of the aspects that need to be noted are:-

- The State Authority has powers under s7NFA to constitute **any land** as permanent reserve forest (PRF).
- The State Authority has powers under s9 NFA to acquire any land including private land to constitute the PRF and such a declaration shall be deemed to be for public purpose. This would suggest that the SA can use the Land Acquisition Act to acquire private land in the corridor to constitute a PRF.
 - Protection forest which could include:
 - Soil protection forest
 - Soil reclamation forest
 - Flood control forest
 - Water catchment forest



- Forest sanctuary for wildlife
 - Virgin jungle reserve forest
 - Amenity forest
 - Education forest
 - Research forest
 - Forest for federal purpose
- The ecological corridors identified within the plan may be constituted as a PRF and classified as a Forest Sanctuary for Wildlife.
 - There are also several states that have amended the State Forestry Enactments to provide protection to state parks. The states of Kelantan (Stong State Park), Perlis and Selangor have used the provisions of their enactments to gazette their state parks that are found within forest reserves under the control and management of the State Forestry Department instead of a new State Parks Corporation. Some of the enactments also provide for a public enquiry to be held before the state park could be excised
 - The power to designate a wildlife reserve or sanctuary is with the State Authority after consulting the Minister. The SA will also have to designate the controlling officer (PERHILITAN) for the reserve or sanctuary. Any revocation of a wildlife reserve or sanctuary will also require consultation with the Minister
 - Once it is declared a Wildlife Reserve, the removal of timber or vegetation is prohibited (s48 (5)).
 - The Wildlife Act with respect to establishing Wildlife Reserves is not popular with the State Authorities and very few wildlife reserves have been declared since Merdeka.
 - It may also be possible to designate the ecological corridor as a heritage site under the National Heritage Act 2005. The Commissioner of Heritage may designate any site which has natural heritage significance to be a heritage site under s24
 - Once the site is designated as a heritage site, there is a need to prepare a Conservation Management Plan for the heritage site as well as the buffer zone around the site (s45)
 - The Minister may also declare any heritage site as a National Heritage (s67). Once the corridor is gazetted as a Heritage Site it may be possible to draw down expenditure from the Heritage Fund which is established under the Act.
 - The National Parks Act 1980 however does not have popular support from the States which prefer to establish their own state parks under State Enactments or through the modification of the National Forestry Act. To date only the Penang National Park is gazetted under the Act.
 - A number of States have to date established State Enactments to establish and manage State Parks. These include:-
 - National Parks (Johor) Enactment 1989
 - Perak State Parks Corporation Enactment 2001
 - Selangor State Parks Corporation Enactment 2005



- Taman Negara Enactment Kelantan 1938
- Taman Negara Enactment Pahang 1938
- Taman Negara Enactment Terengganu 1938

However the capacity of obtaining federal funding is limited

- One of the key components of Development Plans in recent years is the importance given to Environmentally Sensitive Areas. Areas which are identified as ESA in the development plans would enjoy a certain level of protection especially if they are designated in the Local Plans. As such it is important that the ecological corridors identified in this plan are designated as ESA's in the statutory development plans in the country starting with the NPP, SP and the LP.

Option 6: Establishing Ecological Corridors along Riparian Reserves

The river corridor is an important strip of land not only for flood mitigation purposes but may also serve a useful purpose as an ecological corridor. Most of the rivers in the Peninsular are not particularly large to be an impediment for animals to traverse. In addition to designating river corridors for flood mitigation purposes as required by JPS it may be possible to widen the reserve to accommodate ecological corridors along selected stretches of the rivers. Some aspects to consider are:-

- It may be possible to use the Waters Act 1920 (revised 1989) and the respective state water resources enactment (Pahang Water Resources Enactment 1987) to secure riparian reserves for ecological corridors.
- The current JPS guidelines require an **additional width of 50m from the river reserve to be managed and controlled as a river corridor**. It may be possible to use this enactment to establish proper riparian reserve within the river corridors taking into consideration the need for ecological connectors. This may however require an amendment in the Enactment to provide for this.



Table 5.5.2: Summary of Implementation Mechanisms

	Implementation Scenarios	Related Agencies	Related Laws and Regulations	Implementation Mechanism
1.	Acquisition of private land in the corridor to be reserved for public purpose	<ul style="list-style-type: none"> - State agency - Forestry Department - Wildlife Dept 	<ul style="list-style-type: none"> - National Land Code - Land Acquisition Act 1960 	State acquires land using the Land Acquisition Act 1960. It can also be done on behalf of any person or corporation. Need to be placed under a caretaker agency after acquisition.
	(a) Under a Federal Agency	<ul style="list-style-type: none"> - Wildlife Dept 	<ul style="list-style-type: none"> - Wildlife Act 1972 - National Parks Act 	
	(b) Under a State Agency	<ul style="list-style-type: none"> - State Agency - Forestry Dept 	<ul style="list-style-type: none"> - State land rules - Forestry Act 1984 	
	(c) Acquire on behalf of NGO/corporate body to be developed as an ecological corridor	<ul style="list-style-type: none"> - NGO - Body Corporate 	<ul style="list-style-type: none"> - National Land Code - State land rules 	May need to amend the express conditions of the land title
2.	Purchase land and secure State Land as ecological corridor	<ul style="list-style-type: none"> - State agency - Forestry Dept. - Wildlife Dept - NGO , Body Corporate 	<ul style="list-style-type: none"> - National Land Code; State Land Rules 	<ul style="list-style-type: none"> - Direct purchase of private land - For state land, require alienation and issuance of title. Can be issued to the Federal Government as well.
3.	Integrating roads and railways within ecological crossing	<ul style="list-style-type: none"> - MOT - JKR, Railway Dept/Road Transport Dept/Malaysian Highway Authority 	<ul style="list-style-type: none"> - Federal Roads Act 1959; Federal Roads (Private Management) Act 1984; - Road Transport Act 1987; - Highway Authority Malaysia (Inc.) Act 1980; - Railways Act 1991; - Railways (Successor Company) Act 1991 	Possibility of introducing viaducts, underpass, culvert or overpass to link the separated ecological parks. Either Federal or State Government will need to take the lead to provide the link. This is particularly critical if it is a highway, expressway or high speed electric trains.
4.	Establishing ecological corridors on private land	<ul style="list-style-type: none"> - Private sector - Forestry Dept. - Wildlife Dept 	<ul style="list-style-type: none"> - National Land Code - State Land Rules - Forestry Act 1984 - Wildlife Act 1972 	<p>Land remains under private ownership. Corporate social responsibility becomes the concept to be used to garner greater support from corporate bodies to allow the use of private land for public use. Can be implemented using MOU and agreements with related parties.</p> <p>The management of these corridors may be outsourced to expert organizations or related government agencies such as Perhilitan or Forestry Dept. Conservation easement may have to be included in the National Land Code</p>
5.	Establishing corridors as protected lands	<ul style="list-style-type: none"> - Related Government Agency 	<ul style="list-style-type: none"> - Forestry Act 1984 - Protection of Wildlife Act 1972 - Heritage Act 2005 - Parks Act 1980 	



	Implementation Scenarios	Related Agencies	Related Laws and Regulations	Implementation Mechanism
			<ul style="list-style-type: none"> - State Park Enactments - Town & Country Planning Act 1976 	
	(a) Permanent Reserve Forest, subsequently classifying as Forest Sanctuaries for Wildlife.	<ul style="list-style-type: none"> - State agency - Forestry Dept. 	<ul style="list-style-type: none"> - State Land Rules - Forestry Act 1984 	State Authority reserves the State land as permanent forest reserve. SA amends the State Forest Enactments to provide for State Parks
	(b) Wildlife Reserve or Sanctuary	<ul style="list-style-type: none"> - State agency - Wildlife Dept. 	<ul style="list-style-type: none"> - State Land Rules - Protection of Wildlife Act 1972 	Declare the corridor as a Wildlife Sanctuary
	(c) Heritage site	<ul style="list-style-type: none"> - State agency - Commissioner of Heritage 	<ul style="list-style-type: none"> - State Land Rules - Heritage Act 2005 	Declaration of a site as a national heritage, subsequently to be managed under a Conservation Management Plan
	(d) National Park	<ul style="list-style-type: none"> - State agency - Wildlife Dept. 	<ul style="list-style-type: none"> - State Land Rules - National Parks Act 	Declare the corridors as part of the National Park
	(e) State Park	<ul style="list-style-type: none"> - State Park Corporation - Forestry Department - Wildlife Dept. 	<ul style="list-style-type: none"> - State Park Enactments - National Forestry Act 	Declare the corridor as a State Park under the State Parks Enactment or as a modification under the Forestry Enactments
6.	Establishing ecological corridor along riparian reserves	<ul style="list-style-type: none"> - State government - DID - Wildlife Dept. 	<ul style="list-style-type: none"> - Waters Act 1920 (rev. 1989) - Pahang Water Resources Enactment 2007 - Selangor Water Management Authority Enactment 	Designating the buffer zone on both sides of the river in the forest, to be advised by the DID. JPS guideline – 50m from river reserve.



5.6 AWARENESS, EDUCATION AND COMMUNICATIONS STRATEGY

The purpose of the Communications and Awareness Plan (CAP) is to convey the technical and beneficial aspects of the Central Forest Spine study to all stakeholders.

Raising awareness and understanding of CFS concerns and the importance of establishing key ecological corridors between selected forested landscapes allows local governments, local industries and business and surrounding villages to engage in appropriate ecological linkage and corridor projects.

Benefits accrued from collaborative on-the-ground action by various stakeholders to maintain and enhance Malaysia's biodiversity will serve to bolster local economies and increase awareness among national and international audiences to recognize the country's conservation initiatives and sustainable environmental practices.

5.6.1 CFS Communications and Awareness Approach

The strategic thrust of the communications and awareness plan, in the initial stages, is derived from several key sources of information:

- CFS Masterplan for Ecological Linkages
- Implementation Plan
- General Guidelines
- Detailed Case Studies

The CAP relies on these technical recommendations, general guidelines for corridor management and overall vision for the Central Forest Spine. These key outputs present an overall planning scenario for primary and secondary ecological corridors identified throughout Peninsular Malaysia for immediate and secondary action.

To bolster the effectiveness of the CAP, feedback from selected target groups, including government agencies, local communities, Orang Asli settlements, was solicited to gain insights into concerns and cooperative activities. These dialogue sessions and community participation meetings occurred in both formal meetings and informal site visits.

5.6.2 Engaging Target Groups

The technical recommendations and findings of the CFS study require action and implementation from a variety of government agencies, community groups and industry operations within the ecological linkages or in nearby gateway towns and tourism attractions.

To meet the objectives to engage with all the stakeholders involved in the CFS study area, a series of meetings and on-site visitations were conducted. Consultants met with state level officials from key agencies, industry representatives and tourism operators within corridor zones, headmen from Orang Asli settlements and NGO organizations with on-going activities related to the ecological corridors.



A synopsis of the three main approaches to garner stakeholder information and support include the following:

1) Government Meetings

Technical Working Group meetings prepared the way to engage with government stakeholders and introduce the ecological elements, implementation concerns and community circumstances surrounding linkage sites and corridor activities. Most of the key departments were represented from district offices, forestry, wildlife and national parks and tourism officials.

NGO representatives from WWF Malaysia, the Malaysian Conservation Alliance for Tigers, Wildlife Conservation Society and the Malaysian Nature Society provided biological insights and addressed environmental issues. Others from the business sector, including Tenaga Nasional Berhad and Telekom Malaysia, joined in the discussions to highlight current problems and possible solutions regarding infrastructure design and planning.

Tourism industry representatives (e.g. Pahang Tourism Action Council, Perak State Parks Corporation) also provided insights into planning initiatives and constraints related to increasing visitation rates and revenue potential.

2) Site Visit Field Trips

Study tours and field site visits allowed consultants to preview on-the-ground conditions related to implementing CFS recommendations. Engaging with government officials and NGO representatives at ecological linkage locales and specific corridor crossings helped to clarify the concerns and options for future action.

Each study tour consisted of several stops at selected points of interest along the route of the ecological corridors. These included viewing areas abutting national parks and forest reserves, as well as, verifying plantation, agriculture and infrastructure development within the boundaries of primary and secondary linkages.

NGO representatives from the Malaysian Conservation Alliance for Tigers, WWF Malaysia, and the Wildlife Conservation Society briefed the team on wildlife and habitat studies in the ecological corridors. These insights into animal movements, habitat suitability, hunting pressure and other management concerns provided invaluable inputs for selecting the area for the core corridor zones and identifying animal crossing sites.

Visitation to recreational sites operated by the Department of Forestry (e.g. Sungai Yu Recreational Park) and the Department of Wildlife and National Parks (e.g. Sungai Ketiar Elephant Sanctuary) provided information on visitor use and the potential for future tourism activities.

Visitation to new roadway designs for “eco-bridges” or “wildlife-friendly bridges” along ecological corridor locations (e.g. Simpang Pulai to Kuala Berang; Gerik to Kepang) provided the team with a chance to survey and gain a better understanding of the effectiveness of corridor crossings.



Visitation to Orang Asli communities provided both current and historical knowledge about animal sightings and movements, as well as, crop destruction problems, attitudes about wildlife, natural resource product use and sale, and opportunities to earn revenue from tourism-related activities.

In addition to field study tours, some consultants met separately with district officials to discuss issues related to forestry, wildlife, tourism and community concerns. These visits assisted in verifying current analyses, obtaining additional data and sourcing new information materials.

3) Community Participation Meetings

Reaching out to communities in and around ecological linkage sites is vital for achieving successful implementation of the CFS study. Some of the link locations will encompass several communities, while others may have communities scattered outside the core and buffer boundaries.

Each of these primary and secondary link sites will have different scenarios in regard to human-wildlife conflicts, ecotourism potential, agriculture activities or other social and economic considerations.

Engaging in community participation sessions allows consultants to better understand the views and perspectives of those living in affected areas. The purpose is not only to attain updated information from villagers and local authorities but also to allow parties to raise alternative measures and solutions to problems. Participants include district authorities, local business and industry managers, and village elders from Malay and Orang Asli settlements.

The sessions center on a range of issues that provide insights and concerns for consideration into developing model programmes for other ecological corridors and community outreach projects:-

- Animal movements
- Crop destruction
- Attitudes on conservation
- Role of authorities
- Mitigating measures
- Ecotourism potential
- Environmental education
- Economic impacts
- Role of plantations

In December, a presentation of the recommendations of the CFS study was made for community and business members, as well as local authorities, at one of the critical ecological linkage locations. Jerantut was chosen due to its proximity to both Primary Link 1 (Tanum FR -Sungai Yu FR) and Secondary Link 2 (Krau FR – Som FR – Yong FR). This allowed a greater pool of stakeholders to be involved in gaining feedback on the proposed activities in the area.

[Note: A more detailed report of the community participation meeting is available in appendix section.]



5.6.3 Principal Communications and Awareness Tools

Each of the primary and secondary ecological linkage sites requires the development of a series of targeted communication and awareness measures that cater to the implementation of CFS objectives and recommendations.

The purpose of each of these communication and awareness tools is to select the most appropriate option depending on priority goals and the capacity of multi-agency cooperation to sustain corridor management and activities. These tools serve to capture different target groups from local entrepreneurs to international recognition.

The principal tools seek to reach out to local, national and international groups to provide site-specific information, general awareness and alert different parties to engage in the protection of ecological linkages and corridors. These tools try to make use of current media formats, the Internet and proven models from Malaysia and other countries.

Among the key principal tools recommended to formulate and coordinate effective awareness programmes include the following:-

- 1) *Central Forest Spine Website Portal* – A vital information portal to provide an overview of ecological linkages, details on corridor projects and a means to learn how to engage with key agencies and groups to support biodiversity protection.
- 2) *CFS Information Materials/Package* – Reaching out to a wide spectrum of target audiences necessitates the use of a series of informative materials. These include print media for publicity, promotion and awareness that take into account government managers, industry and business operators, and the general public.
- 3) *Public Relations Campaigns* – To gain momentum with the public and affected government agencies and civic groups, the PR campaign employs a variety of avenues to ‘get the word out’ and showcase project activities and corridor events in the implementation phase.
- 4) *Ecological Corridor Campaigns* – These critical locations serve as the focal points to engage stakeholder activities and increase awareness. Each campaign uses a mixture of roadway signage, information kiosks, outreach projects and special events to instill biodiversity awareness and sustainable management.
- 5) *CFS Interpretative Centre* – Showcasing national efforts to maintain biodiversity with ecological corridors necessitates a facility to bolster public awareness, solicit scientific interests and promote multi-disciplinary environmental projects.

To augment the overall CAP, three case studies were conducted to better understand the communications and awareness scenarios of the primary and secondary linkages and corridors. These selected sites offer a more specific outline on how to engage stakeholders and set priorities for action.

The three sites chosen for more detailed analyses are the following, with specific corridor campaigns presented under the Case Studies section:-

- 1) *Primary Linkage 1 (Tanum FR-Sungai Yu FR)* – Connecting Taman Negara National Park, the largest stronghold of viable populations of endangered species (e.g. tigers, rhinos) in Peninsular Malaysia, to the vast forests of the Main Range secures their long-term survival.
- 2) *Primary Linkage 2 (Belum FR-Temenggor FR)* – To maintain some of the country’s largest mammal populations, including elephants, tigers, and tapirs, and support all ten hornbills and other valuable species, these forests must remain



contiguous with sustainable ecotourism and land use practices.

- 3) *Secondary Linkage 1 (Kuala Krai-Gunung Stong)* – As a stepping stone connection between Taman Negara and the Main Range, multiple crossings ensure the viability and integrity of wildlife movements.

The following principal communications and awareness tools aim to initiate awareness and sustain the effectiveness of the implementation of CFS project activities at each primary linkage and secondary linkages site.

A. JPBD-CFS Website Portal

Information on the Internet usually serves as the primary source for communicating new initiatives. With its national and international outreach, a JPBD-CFS web portal is a dynamic tool to present the overall elements of the CFS study, provide up-to-date information on specific linkage activities and be a one-stop centre for downloadable PDF brochures and reports.

In the early stages of implementation it is important to ensure a reliable source of information for stakeholders that may engage in selected CFS ecological corridors. Without an official presence at each linkage locale, the portal allows for an accessible alternative to increase government agency understanding and gain public support for a new national programme.

Integrating the CFS web portal into the existing JPBD website offers an opportunity for JPBD to maintain a high profile while taking the lead on implementation. At later stages, information can be shared with other government websites to give credit for active participation in CFS projects.

The complexity of the CFS ecological linkages will no doubt confuse some stakeholders on how to play a proper role. The CFS portal offers easy access to information resources and provides a vital means to engage with project proponents. By keeping information current and providing special reports, inclusive of photos and videos, JPBD is to both monitor and showcase progress related to CFS implementation.

Start-up contents for the JPBD-CFS Website Portal should include the following:-

- 1) *CFS Overview and Guidelines* – Presenting the rationale for the CFS study and selection of ecological corridors, together with general guidelines for land use and implementation, serve as an introduction for participation for a national audience.
- 2) *CFS Technical Fact Sheets* – Providing a technical basis for the inclusion of primary and secondary linkage sites bolsters credibility, improves understanding and gives a foundation for engagement. [Option to download PDF version]
- 3) *CFS Sector By Sector Emphasis* – Active participation from different stakeholders is sought through targeted information pertinent to plantations, tourism operations and communities surrounding ecological corridors. [Option to download PDF version]

[Note: A complete outline of a proposed JPBD-CFS Website Portal is included in the CFS Communication and Awareness Materials in the appendix section.]



B. CFS Information Materials

The CFS comprises eight forest complexes, each one with different features and number of primary or secondary linkages and corridors. To garner appropriate interest and participation within each forest complex, information needs to provide direction for possible conservation actions, Corporate Social Responsibility programmes (CSR), and economic opportunities for various groups to pursue.

To promote CFS initiatives and reach target groups, a series of informative publications and on-site media material must address key features and recommendations of the CFS study and highlight the benefits to stakeholders.

The technical results of the CFS Master Plan require being broken down into separate sections for selected target groups. A synthesized version of technical inputs and legal, financial and policy conditions is best presented to each sector on its own or summarized into readable portions along key placements within or nearby ecological corridors.

Three primary types of awareness materials intend to capture audiences online, on-site and within their own sector: technical fact sheets; information kiosks; and brochures.

- 1) *CFS Primary and Secondary Linkage Fact Sheets* – Technical fact sheets lay out the scenario at each primary and secondary linkage location. Each fact sheet incorporates the justification and description, key issues, priority strategies, and expected benefits arising from the CFS study. These are invaluable primers for understanding both the biological dilemmas and effective measures required to sustain ecological corridors.
- 2) *CFS Information Kiosks* – Placed at strategic tourism and rest area locations within ecological linkage zones, information kiosks provide visitors with interesting facts, photos and maps of each corridor initiative. Easy to set up at gateway towns and along linkage highways, kiosks enable project proponents to keep the public aware and advertise special events.
- 3) *CFS Sectoral Brochures* – Implementation of the technical recommendations of the CFS study depend on various sectors to participate in conservation action. Each of these is approached in a target-oriented brochure to convey key issues concerning each group and ways to engage in protecting ecological corridors.

[Note: A sample of sectoral brochures is included in the CFS Communication and Awareness Materials in the appendix section.]

C. CFS Public Relations Campaign

To gain interest by the public and ‘kick-off’ the CFS implementation phase, a public relations campaign requires thorough planning to create awareness, reach stakeholders and meet project objectives.

The overall PR strategy foundation is derived from the CFS Master Plan; whereby each ecological linkage location merits a tactical programme built on site-specific issues, objectives and capacity. It is important to clarify the objective, develop a strategy and then employ various tactics to advance the campaign.

The challenge at each ecological corridor is to choose the best tactics to meet the objectives. This depends on the types of tools available, lead agency direction, budgets, timeframes and other campaign factors. Creativity is always paramount; it can provide a lasting impression that carries beyond the PR exercise.



Initial PR campaigns rely on using tools and tactics that provide substantial publicity without being too costly. With the direction and leadership at each ecological linkage location to be determined later, JPBD is in the best position to handle PR duties.

Supported by the JPBD-CFS Website Portal, the PR campaign should include the following tools to introduce the CFS project to a national and international audience:

- 1) *CFS Press Releases* – At the outset the entire CFS project is newsworthy information due to its innovative approach, biodiversity angle and conservation objectives. Press releases provide announcements from key stakeholders on the importance of project activities and achievements and connect the public to its mission.
- 2) *CFS Print and Web Media Articles* – Getting CFS proponents to write informative and entertaining articles and feed them to print and web media sources secures a constant flow of good publicity. The biodiversity, wildlife and community aspects of each ecological corridor translate to a steady supply of exposure via article submissions from different agencies, NGOs, corporate CSR programmes and others.
- 3) *CFS Media Tours* – With more action on-the-ground occurring in the implementation phase, media tours at selected ecological linkage or corridor sites offer exposure in print and web media. Bringing collaborative parties together to engage with journalists, bloggers and web writers bolsters the public image of Malaysia's conservation efforts.
- 4) *CFS Newsletter Updates* – As the lead agency in implementation coordination, JPBD can keep CFS proponents and the general public informed on project activities, accomplishments and events. These regular updates can be thematic in presentation and available for download on the JPBD-CFS Web Portal.

The following is a list of key local media with interest in promoting environmental projects, issues and actions related to conservation:-

New Straits Times	MNS Naturalist
The Star Newspaper	www.wildasia.net
Chinese Dailies	www.mns.org.my
Malay Dailies	www.virtualmalaysia.com
Going Places Magazine	www.nature-escapes.com
Virtual Malaysia Magazine	

D. CFS Corridor Campaigns

The key to sustaining involvement of the various stakeholders in the Central Forest Spine is to make each ecological corridor a hub for action. Every primary and secondary linkage has the potential to be distinctive and serve as a platform to educate people and integrate activities that evolve local participation, protect biodiversity and enhance the nation's awareness.

Ecological corridor campaigns seek to champion the efforts of CFS proponents and gain participation from a wide spectrum



of stakeholders. As the focal locations for wildlife crossings and conservation activities, the linkage boundaries and corridor zones become the main points of interest for the public.

Corridor campaigns must capitalize on showcasing the nation's tremendous wildlife biodiversity and actions of the CFS project to safeguard their long-term survival.

Roadside signs and information kiosks provide first level awareness for tourists visiting national parks and forest recreation areas or travelers passing through corridor destinations. Joint projects with NGOs, school and civic groups create an active means for participation with CFS project implementers. And special events take advantage of wildlife sightings, natural phenomena and local community activities to organize groups for festivals, day-trips or weeklong excursions.

All of these campaign tools provide ample opportunities for creative use of ecological corridors to increase publicity, solicit participation and improve understanding of the value of CFS action plans.

1. *CFS Roadside Signage Zones* – Each ecological linkage area is of special interest due to wildlife species, forest habitats or other natural attractions. Demarcating these special zones with striking entry signs ensures visitors pay attention and start recognizing the CFS project.

If administrative zones (e.g. district) merit boundary signs, then certainly highlighting key areas vital to sustaining biodiversity and alerting the public to be aware is of national importance and pride.

A Model Approach: Entry and Exit Signs for Forests, Rivers & Parkways

U.S. National Park Service & U.S. Forest Service

Entry and exit signs mark the boundaries of America's national forests, scenic rivers and scenic roadways. These handsome signs allow travelers to easily recognize landscape habitats and view different types of protected areas. Not only showcasing the country's natural beauty, these signs serve to remind people to prevent forest fires, pollution and littering.



Another option is to designate key stretches of some of the ecological linkage roads as scenic passageways due to wildlife or other natural attributes. This provides an introduction to establishing CFS in the minds of travelers. It also serves as a way to incorporate safety signs and information to protect crossing animals and reduce vehicle incidents.

A creative approach to naming these scenic vistas and wildlife corridors can be done by public competition or a selection of CFS proponent agencies. It is advisable to convene a special working group with key agencies to

deal with the safety and promotional aspects of formulating a “Wild Malaysia” signage campaign. As a national project, advertising agencies can be solicited to participate as a CSR initiative.

A Model Approach: National Scenic Byways Program
U.S. Department of Transportation

The National Scenic Byways Program recognizes certain roads based on their archaeological, cultural, historic, natural, recreational, and scenic qualities. Promoted as America's Byways, the vision of the program is to create a distinctive collection of American roads, their stories and treasured places. Resources are provided to the byway community to create unique travel experiences and enhance efforts to preserve, protect, and interpret the intrinsic qualities of designated byways.



2. *CFS Information Kiosks* – Placed at strategic tourism destinations, highway rest areas and gateway town locations within ecological linkage zones, information kiosks provide visitors with interesting facts, photos and maps of corridor activities and special events.

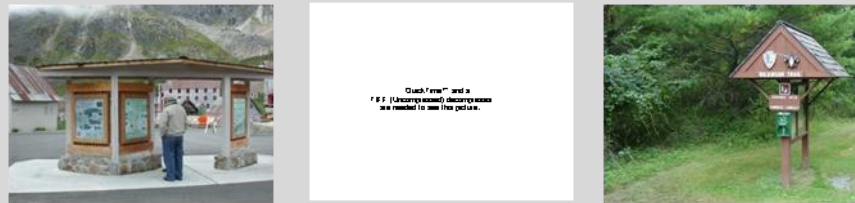
An added benefit of building information kiosks is to hire local artisans to craft them using traditional styles and skills. The kiosks enable project proponents to keep the public aware of wildlife concerns and promote special events. Corporate and civic group support for sponsorship and maintenance of kiosks is also a viable option.

For ecological linkages and corridors, the kiosks could highlight the natural heritage of the area and present information thematically. For example, a schedule of biodiversity themes, including mammals, birds, reptiles, insects and plant life, could rotate every six months. Using outdoor enthusiasts or university groups to assist in providing attractive materials lessens the burden on government agencies. MNS has several Special Interest Groups that could develop awareness materials for kiosks and run special events to enhance the publicity.

A Model Approach: Information Kiosks for Parks, Trails and Visitor Centres

U.S. National Park Service

Information kiosks are a primary means of public awareness in many national parks with isolated trails or roadside attractions. They provide interpretation on natural history, keep visitors abreast of improvements and hazards and give guidance on how to enjoy the unique features of a park. Kiosks are especially useful to minimize staff requirements and provide an easy way for visitors to be updated on activities and projects.



3. *CFS Outreach Projects* – Outreach projects engage both stakeholders and sponsors to combine resources to increase awareness, education and opportunities; while trying to alleviate local problems to improve community conditions.

Community residents gain through consultative solutions to existing conflicts with wildlife or environmental hazards. Sponsors from the corporate sector gain by ensuring that CSR programmes address real issues with on-the-ground benefits, rather than just public relations exercises.

In essence, ecological linkages and wildlife corridors are outdoor environmental learning centres. Utilizing these venues to bring together science professionals with interested civic groups goes a long way towards conservation awareness.

A participatory approach to engaging target groups through on-site projects is done within the objectives and capacity of lead agencies at each corridor location. It is not necessary to build facilities, but rather develop in-the-field studies to assist obtaining data from surveys or other beneficial projects.

For example, initiate corporate CSR programmes to promote and maintain certain cultural aspects of nearby communities, support arts and craft development or even provide equipment for individual species monitoring needs.

**A Model Approach: DiGi's Amazing Malaysians**

DiGi Telecommunications Sdn. Bhd.

DiGi's Amazing Malaysians is a corporate social responsibility programme initiated in January 2005. It aims to support the preservation of Malaysia's heritage by identifying individuals and engaging them in projects with youth or children living mainly in rural areas.

The programme has identified five broad heritage areas to focus on, namely natural, cultural, art, built and social heritage. Via individual projects, DiGi hopes to contribute in a real and meaningful way to strengthening the knowledge, skills and craft that link Malaysia's past to its present and future.



Ecological corridors involve wildlife. And wildlife is a big draw factor for dealing with the public. Civic, business and school groups can pull together to help out with littering or pollution problems associated with corridor zones. If viable, groups could clean-up adopted highway sections and even survey the area for animal signs and tracks as a monitoring exercise. These simple outdoor projects could be done every two months to promote community involvement and increase awareness.

A Model Approach: Adopt A Highway – Don't Mess With Texas

U.S. State Highway Anti-Littering Campaigns

The Adopt-a-Highway program, also known as Sponsor-a-Highway is a promotional campaign undertaken by U.S. states to encourage volunteers to keep a section of a highway free from litter. In exchange for regular litter removal an organization (e.g. School or Business Groups) is allowed to have their name posted on a sign in the section of the highways they maintain.



FINAL REPORT

Every generation learns about the environment in a different way. Today, the Internet is not only an encyclopedia but also a conversation tool to engage in discussions and find new ideas with a global audience of like-minded people. Young Malaysians already understand this.

Tapping into the worldwide web and sharing your experiences with others is a motivating factor to interest kids and teenagers to participate. One way to merge cyberspace with the real world is through environmental education projects within ecological corridors.

For example, different school groups could set up monitoring activities or conduct simple surveys and share this information online with other school groups in other primary corridor locations. Using inexpensive blogs or existing online forums would also allow students to discuss environmental and wildlife issues.

If feasible, a special school forum could be added to the JPBD-CFS Web Portal to facilitate data gathering and discussions.

A Model Approach: Roots and Shoots – The Power of Youth Is Global
The Jane Goodall Institute

Roots & Shoots provides kids with an online framework for organizing and achieving meaningful projects that connect their minds, hearts and hands as they promote care and concern for animals, people and the planet. Youth are empowered through knowledge, compassion and action that teaches them they are capable of improving the status quo. Given the overwhelming global crises we face, this contextual framework and genuine youth empowerment is crucial for youth to develop a constructive, participatory and hopeful worldview.



Reaching out to local communities depends on the whether or not tourism services and/or local products are viable for business ventures. Some natural attributes of ecological linkages merit establishing new operations compatible with CFS objectives or promoting and enhancing existing tourist hotspots.

Key considerations for animal and human safety require appropriate planning for visitor capacity and infrastructure costs. However, wildlife observation towers and guided day or night tours are ways to enhance suitable use of corridor crossings and instill awareness among visitors.

FINAL REPORT

The potential exists for Orang Asli communities to craft value-added products from non-timber forest products for sale to tourists and travelers. At present, many of these communities only collect raw materials to be bought at low prices from middlemen. Reviving traditional crafts and assisting in product marketing improves their revenue earnings and highlights the plant diversity of natural forests within ecological linkages.

A Model Approach: Gerai OA (Orang Asal/Asli)
Malaysian NGO

The Gerai OA is a Kuala Lumpur-based mobile, non-profit store carrying crafts for sale from 17 different Orang Asli (indigenous) groups from Peninsular Malaysia and Sabah & Sarawak. The crafts are mostly sourced directly from the craftspeople in the villages with 100% of the sale proceeds going back to the craftspeople and the community. Gerai OA also offers craft training workshops and advice on business marketing.



4. *CFS Special Events* – For most of the year, ecological linkage and corridor site activities function well without fanfare. However, at certain times it is important to remind the public of the invaluable role these habitat zones play in protecting biodiversity.

Special events take advantage of nature, global environmental awareness days, site-specific issues and other happenstances that coincide with achieving the objectives at each primary and secondary linkage location.

Nature provides scenic attributes, seasonal animal migrations, unusual wildlife sightings, and different habitats to explore for use in setting up outdoor educational events or wildlife observation tours. Any of these activities could be centered around important environmental days on the calendar:

World Environment Day	June 5
World Biodiversity Day	May 22
World Wetlands Day	February 2
World Water Day	March 22
Earth Day	April 22

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A Model Approach: Raptor Watch Week Malaysian Nature Society

Raptor Watch Week (RWW) is an annual event organised in partnership with the Malacca State Government. It's a festival to celebrate the return of the migratory birds of prey, known collectively as raptors, on their journey back to their breeding grounds in the northern hemisphere. RWW is a public event for birders, novices, and even kids that is meant to raise awareness on the conservation of raptors and their habitats.



Another alternative is to schedule special events around village festivals or cultural activities with a tie to the environment. Sometimes this may include awareness programmes to teach locals about the illegal wildlife trade or wild animal consumption. However, it is easy to balance the seemingly negative tone of these events with others that use nature guides to teach about mammal, bird, reptile and wildlife species behaviour and conservation.

Using NGO organizations to help deliver the message to schools and other target groups is preferable since they are well seasoned with these conservation activities. Combining the technical expertise of government agencies and personnel (e.g. Department of Forestry; Perhilitan) with NGO educational programmes (e.g. WWF Malaysia; MYCAT) creates a more effective use of staff and experience for greater outreach.

A Model Approach: MYCAT Kahang Outreach Programme Malaysian Conservation Alliance for Tigers

Held in Kahang, Johor as the "Sehari Mengenal Harimau," the event was part of the campaign to reduce local wild meat trade and consumption. Aimed at enhancing local appreciation for wildlife in the Endau-Rompin National Park, the daylong event focused on activities for 300 primary students with specially trained wildlife volunteers. Students joined with parents and 200 other younger students in the school hall to learn about the importance of tigers in their culture and the threats presented by traditional medicines.



Effective use of a mixture of these principal communication and awareness tools depends on the priorities determined for each ecological linkage location. This means states can either emphasize corridors collectively in a national programme or pick and choose the most appropriate action for each primary or secondary link.

The Case Studies section includes a more detailed analysis of communication and awareness tools for priority action. These enabling initiatives determine what can be done to successfully establish implementation of the CFS study.



E. CFS Interpretative Centre

As a national biodiversity programme, the CFS merits a showcase facility to promote its national identity. An interpretative centre, located at a premier primary linkage site, serves three key purposes:

CFS National Awareness – Highlights from conservation and other projects affiliated with CFS programmes can be concentrated at a single repository to aid in information collection and in promoting awareness. This arrangement allows media, scientists, students and tourists to benefit from a national focal point that addresses matters related to CFS objectives.

Environmental Education Initiatives – Each ecological corridor offers opportunities for engaging various stakeholders in outreach programmes. Seminars and workshops held at an interpretative centre bring together multi-disciplinary teams to develop pilot projects based on progress to date.

Ecotourism Incentives – As a tourist attraction, the interpretative centre provides additional revenue to the state. Capitalizing on ecological corridor attributes, other ecotourism ventures are viable with local businesses, Orang Asli communities and other selected groups.

A Model Approach: Rainforest Discovery Centre

Sabah Forestry Department – Environmental Education Unit

The Rainforest Discovery Centre promotes environmental education on a 107-hectare site next to the Orang-utan Rehabilitation Centre at Sepilok. Its primary function is to create public awareness and appreciation of the importance and sustainable use of conserving forests. Managed by the EE Unit of the Sabah Forestry Department, the centre is a popular resource for teachers and students and is intended to help boost tourism in the district.





5.6.4 Promoting Ecological Linkages and Corridors: Natural Heritage, National Pride

The Central Forest Spine ecological corridors represent the best opportunity to enhance awareness and appreciation for Malaysia's wild places and diverse species. A national initiative to integrate effective promotion, to install appropriate signage, display interesting information and coordinate special events and projects raises the biodiversity profile to a new level.

Promoting CFS linkages and corridors through both active (e.g. interpretative centre, campaigns, events) and passive (e.g. road signs, kiosks, website) measures contributes to national awareness on wildlife species and their movements and the critical importance of connected habitats.

Underscoring the importance of Malaysia's biological diversity for the nation, the Biodiversity and Biotechnology Council decided to set up a Natural History Museum. Besides being the premier national depository for biological resources, the museum will showcase the country's natural heritage and fascinating flora and fauna to a global audience.

Coupled with scientific research, the museum will be a centerpiece to promote conservation and highlight the diversity of animal and plant life protected by national parks, forest reserves and other areas, such as ecological corridors. This bodes well for collaborative research among national and international institutions. The Natural History Museum will undoubtedly become the primary centre for communication, education and public awareness on biodiversity conservation in Malaysia.

The timely construction of the Natural History Museum is the perfect opportunity to promote the CFS ecological corridors. The museum is an indoor attraction to teach awareness and solicit interest in science and the full range of birds, mammals, reptiles, amphibians and other animal and plant groups.

The CFS ecological corridors need to capitalize on this indoor nature education with an outdoor conservation message. Interest gained from museum activities will easily translate into complementary programmes - whether for schools, tourists, or CSR - associated in and around primary and secondary linkage locales.

Malaysia is well known as a centre for tropical biodiversity. It is now the right time to promote our natural heritage and bolster our national pride at every gateway town, every roadside corridor entry and every rest stop traversing the country's forested landscape. (Refer to Annex 1 for CFS Brochure outline).

Part II

Introduction for 3 case studies



Primary Link 1 (PI 1):
Tanum FR (Greater Taman Negara)
- Sg. Yu FR Main Range **6**

Primary Linkages 2 (PI 2):
Temenggor Forest Reserve
– Royal Belum State Park **7**

Secondary Linkages 2 (SI 2):
Krau Wildlife Reserve – Bencah Forest Reserve
– Som Forest Reserve – Yong Forest Reserve **8**

Environmental Cost And Benefits **9**



PART II INTRODUCTION FOR 3 CASE STUDIES

INTRODUCTION

Three case studies are included in the CFS1 study, whereby additional detail is provided to the description of the existing environment, as well as strategies to establish the corridors. Two PLs and one SL were selected as case studies. The reasons for selecting these linkages are as follows:

PL1 (Tanum – Sg. Yu)

- The most important linkage in CFS1, as it is the last remaining area where it is still viable to establish a primary linkage between the Greater Taman Negara Forest Island (the largest forest island) and the Main Range Forest Complex.
- Critical to establish as soon as possible, before further expansion of settlements, agriculture and highways.

PL2 (Belum - Temenggor)

- Highly important linkage to maintain, as it connects the Greater Belum Forest Island (including protected areas in Thailand) to Temenggor Forest Reserve to the south, and subsequently to the rest of the Main Range Forest Complex.
- Many development proposals along the East-West Highway have been previously mooted here (all of which threaten to further isolate Royal Belum), including oil palm plantations, a petroleum pipeline, and herb garden.
- Herds of elephants are already common along the East-West highway. Crossing points for elephants and other large mammals needs to be integrated into development planning in order to minimize the potential for human-elephant conflict, including elephants destroying agriculture crops, motor vehicle accidents etc.

SL1 (Krau – Som – Taman Negara)

- An SL was selected to provide an example of a riparian corridor / stepping stone matrix for small animals and birds.
- Krau – Som – Taman Negara was originally connected but presently appears fragmented in terms of large mammals such as elephants that can no longer move between the various forest islands.

06

Primary Link 1 (PL1) : Tanum FR (Greater Taman Negara) – Sg. Yu FR (Main Range)

Introduction
Objective, Targets and Key Performance Indicator (KPI)
Corridor Profile
Threats, Opportunities and Constraints
Linkages Strategy
Enabling Initiatives



6.0 PRIMARY LINK 1 (PL1): TANUM FR (GREATER TAMAN NEGARA) - SG. YU FR (MAIN RANGE)

6.1 INTRODUCTION

Greater Taman Negara (including adjacent forest reserves) is almost completely cut off from the Main Range Forest Complex in the west, and is increasingly becoming a “habitat island”. The clearing of forest cover along the north and western fringes of the park over the past 15 years created an ecological bottleneck that hinders movement of wild animals, especially predators (e.g. tigers) and their prey species (e.g. deer) between Taman Negara and the Main Range.

Tanum Forest Reserve (on the Taman Negara side) is bisected from the Ulu Jelai Forest Reserve & Sungai Yu Forest Reserve (on the Main Range side) by the Kuala Lipis – Gua Musang trunk road and railway. The forest reserves are separated by approximately 400 m of stateland forest, scrub and grassland.

The least developed section of this road/railway is at the narrowest point (north and south of the bridge over Sungai Yu), where the forest is only separated by the road and the railway. **Figure 6.1.1** show the existing land cover for the PL1 corridor.

6.2 OBJECTIVE, TARGETS AND KEY PERFORMANCE INDICATOR (KPI)

6.2.1 Objective

- To establish and maintain a wide, protected, forested corridor between Taman Negara and the Main Range.
- To ensure the safe passage of wild animals across this corridor.

6.2.2 Targets

The general target is to maintain and further enhance the functionality aspects of the corridor, i.e. in terms of its use by wildlife. The targets are therefore:-

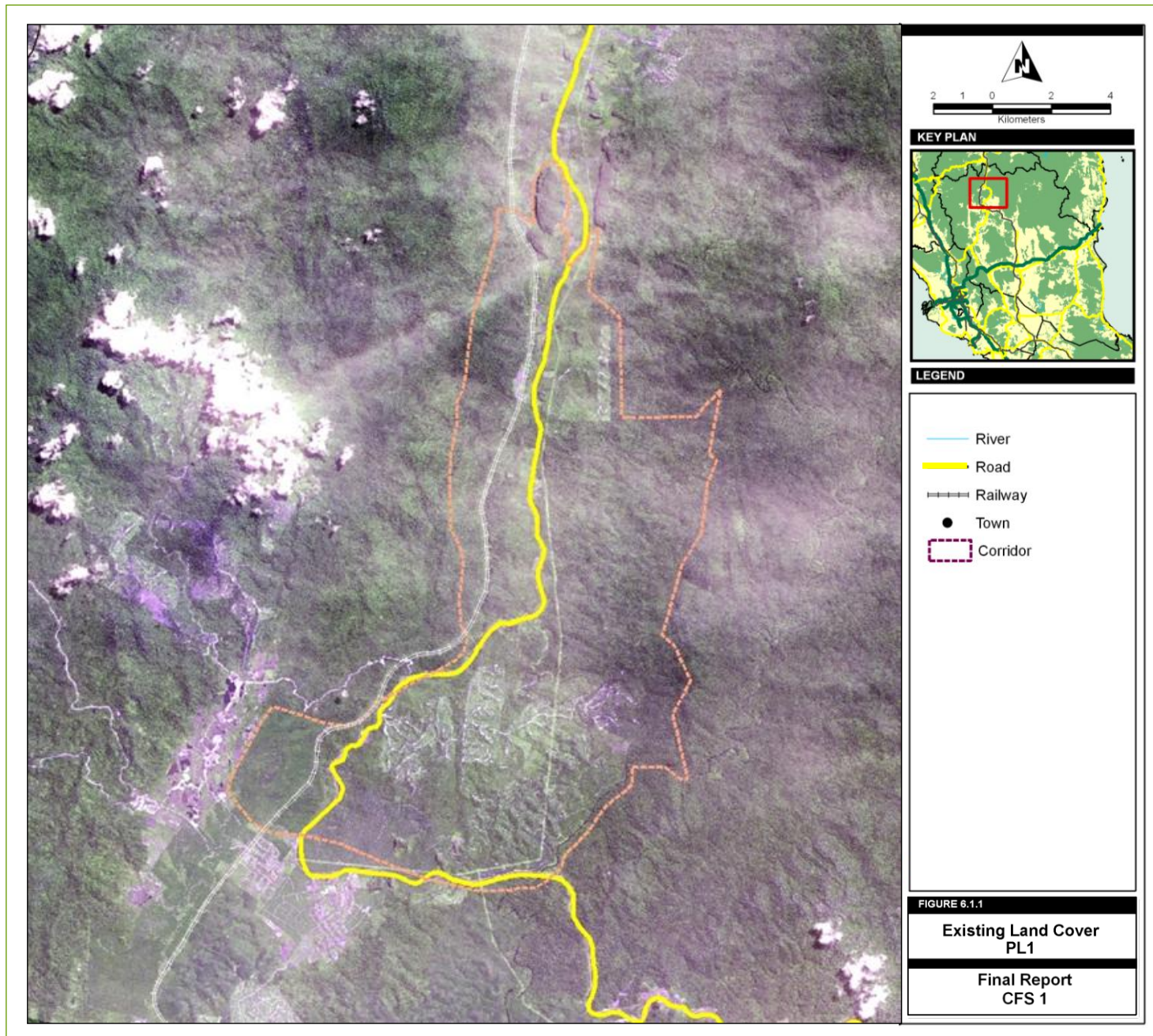
- Increase in use of corridor by wild animals.
- Decrease in mortality rates of wild animals (due to poaching and road accidents).

6.2.3 Key Performance Indicators (KPI)

Key Performance Indicators (KPI) are used to measure the effectiveness of the linkage in meeting the targets. This involves biological criteria relating to species populations within the linkages as well as in the adjacent habitats, and the safe passage of species across of the corridor (in particular across the specific wildlife crossings). (**Table 6.2.1**)



Figure 6.1.1: Existing Land Cover PL1





In order to measure changes and trends, initial surveys are required to determine the baseline for all KPI.

Table 6.2.1: KPI for achieving “Functional linkage”

KPI	Criteria*	Survey Method
Focal species population a. In the linkage b. In adjacent habitats (Taman Negara and Main Range)	<ul style="list-style-type: none"> Population of focal mammal (elephant, tiger, primates) and bird species (hornbills, raptors) in the linkage and adjacent habitats. 	<ul style="list-style-type: none"> Camera trapping programme. Survey of animal presence. Bird Census and monitoring programme
	<ul style="list-style-type: none"> General status of biodiversity (species richness and abundance) 	<ul style="list-style-type: none"> Biodiversity survey.
Usage of the wildlife crossing structures	<ul style="list-style-type: none"> Recording and monitoring of animals using specific wildlife crossing structure (species diversity and numbers) and time and frequency of usage 	<ul style="list-style-type: none"> Camera trapping programme. Survey of animal presence.
Human-wildlife conflict	<ul style="list-style-type: none"> Number of roadkills in the corridor 	<ul style="list-style-type: none"> Monitor roadkill trends within the corridor.
	<ul style="list-style-type: none"> Number of elephants trespassing into adjacent plantations and villages 	<ul style="list-style-type: none"> Monitor human-elephant conflicts
	<ul style="list-style-type: none"> Effectiveness of anti-poaching enforcement 	<ul style="list-style-type: none"> Survey of poaching presence.

Note : * In order to measure changes and trends, initial surveys are required to determine the baseline for all KPI/criteria



6.3 CORRIDOR PROFILE PL1: TANUM FR (GREATER TAMAN NEGARA) – SG YU FR

6.3.1 Physical and Land Use

This Section provides the physical and land use background information of the PL1: Tanum – Sungai Yu (PL1) and its surrounding region (Lipis District) for assisting in the designation of ecological linkages, particularly the location and type of wildlife crossing physical structure and necessary mitigating measures, to connect the forest islands identified. It will set out the ecological linkage physical profile in terms of location and size, terrain, soil, rivers and land uses.

6.3.1.1 Location and Size

The PL1: Tanum – Sungai Yu Ecological Corridor is 12 km long and 9 km wide of predominantly forested land. It covers a relatively small area of approximately 4,233 hectares.

It is located within the Mukim Batu Yon at the left edge of Taman Negara, about 45 minutes drive from the Kuala Lipis town. With the Sg. Yu Recreation Park at roughly the central position of the corridor, it straddles along the Federal Route 8 linking the towns of Kuala Lipis and Gua Musang (**Figure 6.3.1**). On the left side are the Sg. Yu Forest Reserve and Ulu Jelai Forest Reserve, which are an integral part of the Main Range; and on the right side is the Tanum Forest Reserve adjacent to Taman Negara. These natural forested habitats support a vast diversity of mammals and bird species. It has been observed that many large mammals, particularly elephants and tigers, have been using this stretch of road as a vital linkage corridor for moving between the Main Range and Taman Negara. However, the Federal Route 8, together with to a lesser extent the existing railway running parallel to it, have acted as a barrier to wildlife movement as evident by numerous animal sightings and road kill recordings.

6.3.1.2 Terrain

Most of the PL1 Corridor and its surrounding region are characterised by hill land and highlands with steep slopes in many areas. Their elevations vary from 150m to 1,250 meter above sea level (**Figure 6.3.2**). Topographically, the PL1 Corridor comprises 100 percent lowland (lower than 150m) as shown in **Table 6.3.1**. The proposed wildlife and ecological linkages need to be located in both the lowland and hill lands to cater for the needs of as many species of flora and fauna as possible.

Table 6.3.1: Area and Percentage of Terrain in PL1: Tanum – Sungai Yu

Elevation	Description	Hectare	km ²	%
0m - 150m	Low Land	4,387.07	43.87	100.00

In terms of land slope, a large portion of the PL1 Corridor is dominated by a land slope of less than 20° as shown in **Table 6.3.2**. PL1 Corridor highlighting locations of slope with varying steepness. These areas are more suitable to be proposed for ecological linkages as these less steep slope areas are suitable for wildlife movement.

Figure 6.3.1: Location Plan

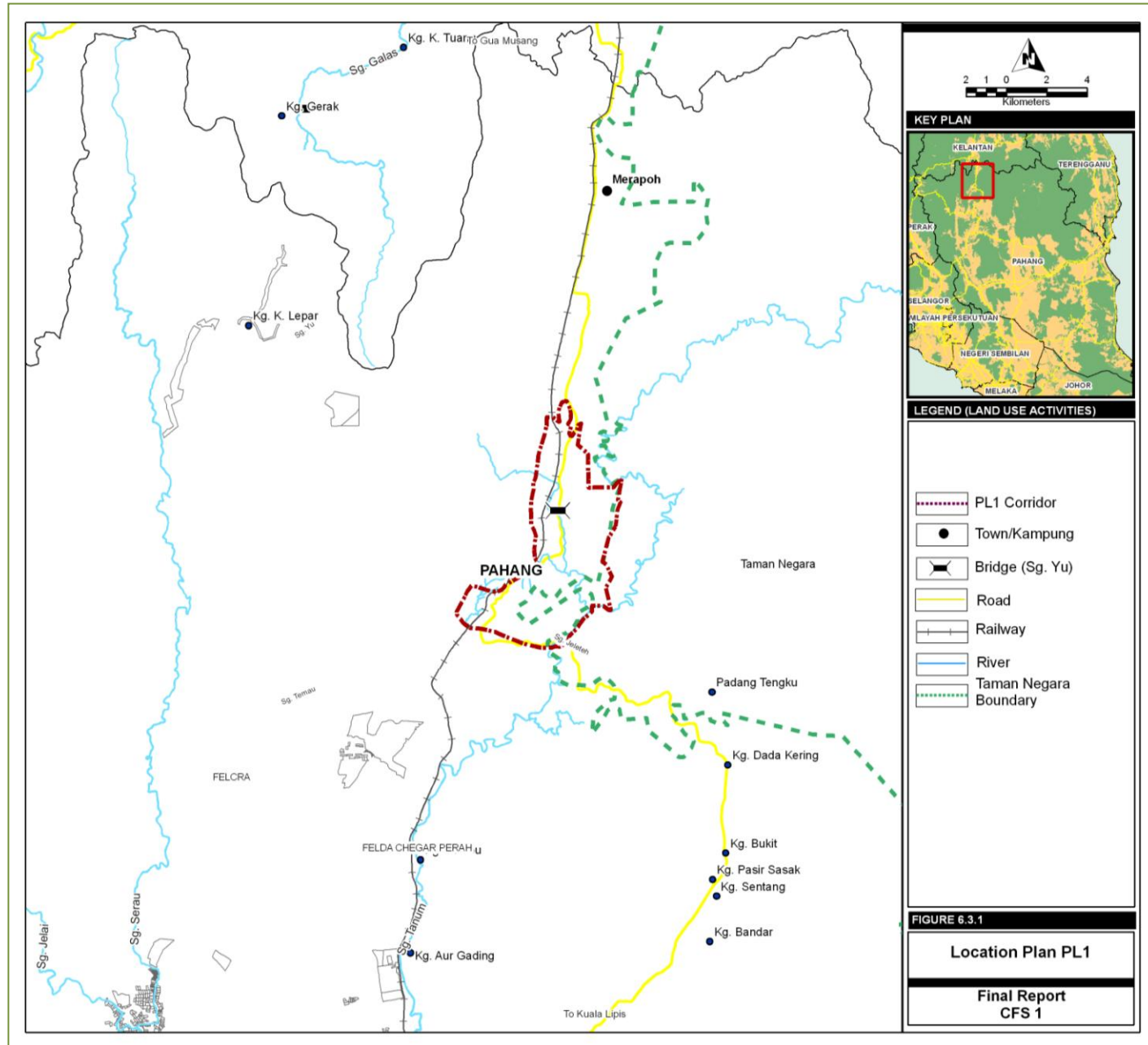




Figure 6.3.2: Terrain

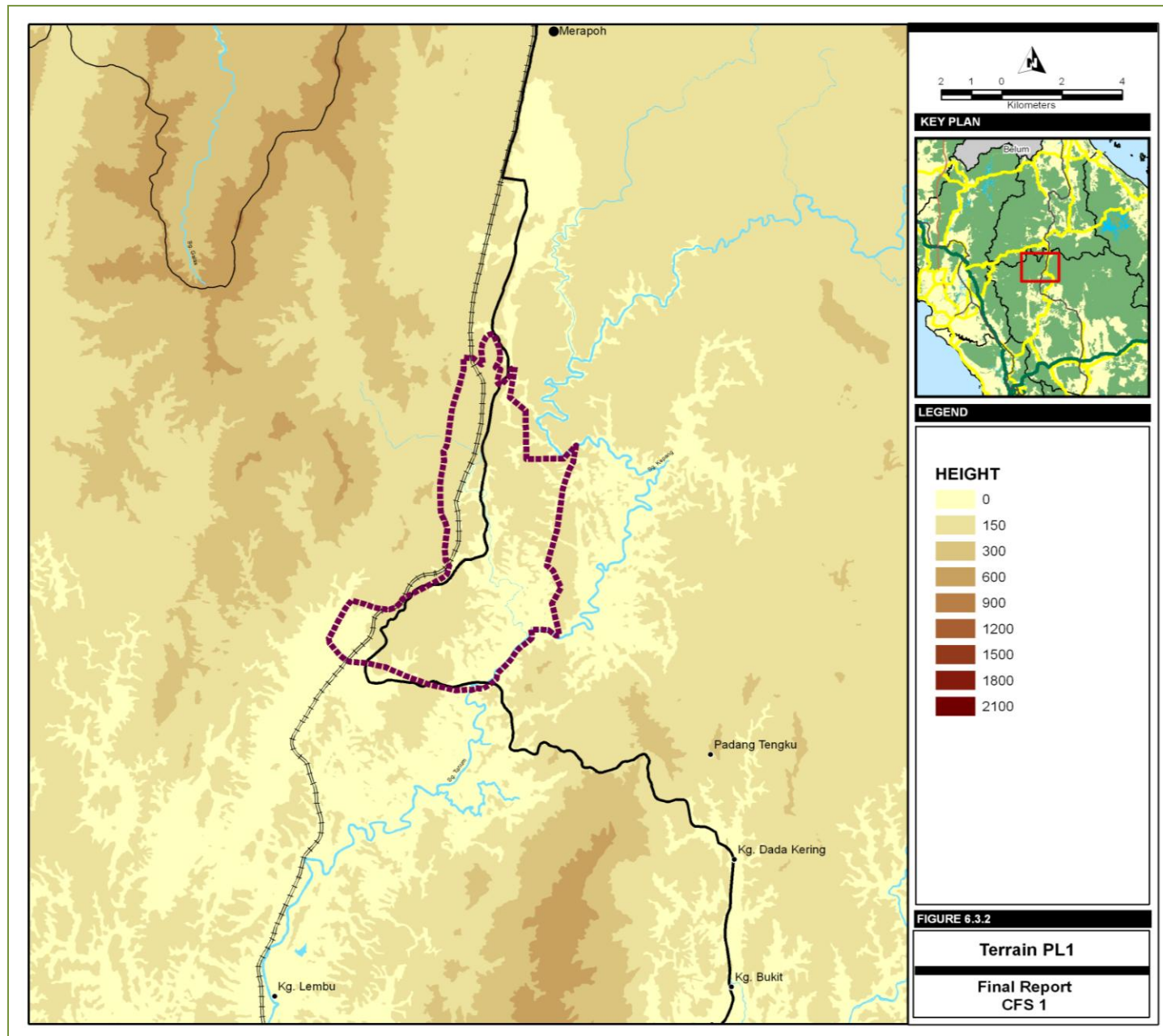


Table 6.3.2: Area and Percentage of Slope in PL1: Tanum – Sungai Yu

No.	Slope Category (Degrees)	Area (ha)	Percentage (%)
1	0 to 11.9	3,145.36	71.70
2	12 to 19.9	1,209.67	27.57
3	20 to 24.9	9.88	0.23
4	Above 25	22.15	0.50
TOTAL		4,387.06	100.00

6.3.1.3 Soil Suitability Classification

Soils provide the physical base for land development. Knowledge of the potentials and limitations of soil types is therefore necessary to evaluate crop production capabilities or when considering construction of buildings, infrastructure, or even the acquisition of the land for reforestation and wildlife corridor purposes. Agriculture activities are not suitable on soils which are characterized by poor filtration, slow percolation, flooding/ponding, wetness, steep slope and subsidence. These areas that are deemed as unproductive for agricultural crop production may be reclaimed and restored as forested w corridors that function as wildlife crossings and as ecological linkages. **Table 6.3.3** and **Figure 6.3.3** show the soil type at PL1 corridor.

Table 6.3.3: Area of Soil Suitability Class in PL1 Corridor

Class	Area (ha)	%
II	1,111.35	25.33
IV	1,006.66	22.95
V	2,269.04	51.72
Total	4,387.05	100.00

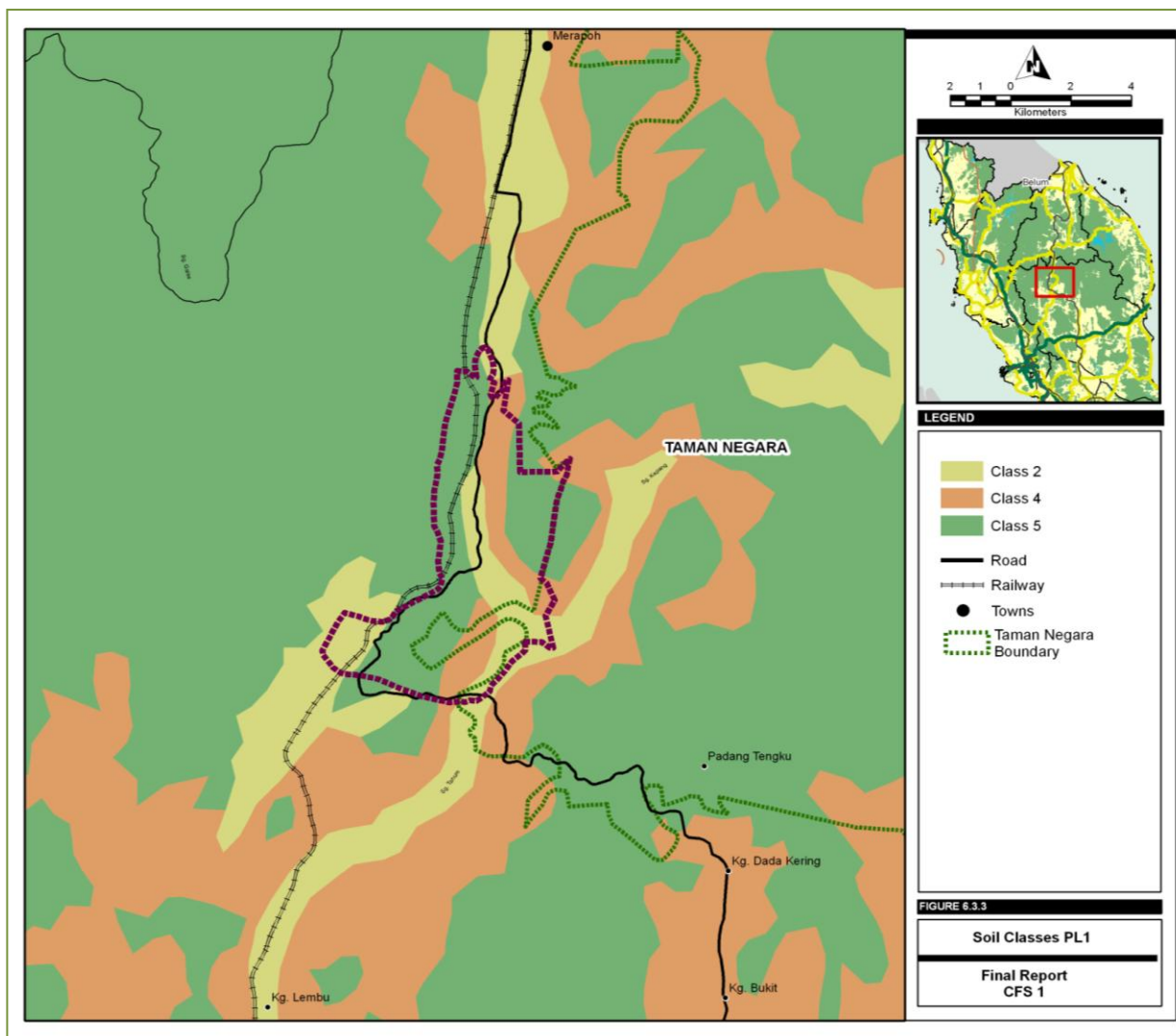
Notes:

- Class I Soils with no limitations to agricultural development.
- Class II Soils with few minor limitations to agricultural development. It can support a wide range of crops.
- Class III Soils with one serious limitation to agricultural development. It supports a limited range of crops.
- Class IV Soils with more than one serious limitation to agricultural development. It is only marginally suitable for crops.
- Class v Soils with more than one very serious limitation to agricultural development. This group is not recommended for any crops.



The soil class analysis indicates the land suitability for agricultural development. Most of soil (51.72 %) in PL1 is Class V which are not recommended for crops. A significant proportion of soil (22.95%) is in Class IV which is only marginally suitable for crops. This is due largely to the steep slope, high terrain and type of soil. Only the narrow strips of alluvial along the river banks are suitable for a limited range of crops. This implies that the PL1 Corridor area is best conserved as forested areas which can serve as animal habitats.

Figure 6.3.3: Soil





6.3.1.4 Rivers

The major river draining this area is Sg. Tanum from Gunung Tahan to the south along the eastern border of the PL1 Corridor (**Figure 6.3.4**). Three short tributaries, .i.e. Sg. Yu, Sg. Jeleteh and Sg. Temau, flowing from west to east join the Sg.Tanum.

The Kuala Lipis – Gua Musang road crosses the Sg.Yu River that runs below the road, approximately in the middle of the PL1 Corridor area. In this respect, it offers a high potential area to create an ecological linkage with a riparian environment for animals to move from the Main Range to Taman Negara. Not only riparian river corridors serve effectively as natural pathways for wildlife movement, it also does not involve the construction of expensive physical crossing structures, e.g. viaducts.

Areas still have viable riparian environment for wildlife usage. On the other hand, if a certain connection point is deemed very critical to create a contiguous forest area, then further analysis needs to be conducted to ensure that the riparian area can be rehabilitated. For example, the newly constructed Gua Musang – Kuala Berang highway that separates Taman Negara and Tembat Forest Reserve, provides three viaducts over existing streams to protect the vital riparian areas for wildlife crossings ranging from small mammals to tapir and elephants.

6.3.1.5 Land Use

Except for a few isolated houses and 4 small villages along the Kuala Lipis – Gua Musang road, very little development has occurred in and around the proposed PL1 Corridor. This is due largely to its remote and rural location and weak economic base. It is situated far away from the mainstream Central Growth Corridor (i.e. Klang Valley-Kuantan Corridor along the East Coast Expressway Phase I) and is dependent mainly on low value-added resource and agriculture-based economic activities (i.e. agriculture, ecotourism and logging).

Within the PL1 corridor, the predominant land use is forest which makes up about 58.08% of land as depicted in **Figure 6.3.5** and **Table 6.3.4**. The forests are bisected by the Federal Route 8 with about 400 meters of Stateland forest, scrub and grassland running along it on both sides. Scrub areas consist of 13.80% of the area and may be able to reclaim as forest area for connectivity purposes. There are some rubber and oil palm agriculture plantations owned by FELDA and FELCRA along both sides of the road at the southern tip. It is important to note that the whole PL1 Corridor is defined as ESA Rank 1 except for the agriculture areas.

**Table 6.3.4: Existing Land Use 2006 for PL1 Corridor**

Landuse	Hectare	km ²	%
Built-up Area	10.54	0.11	0.25
Forest	2,458.94	24.59	58.08
Grassland	144.98	1.45	3.42
Oil Palm	762.01	7.62	18.00
Others Agriculture	10.66	0.11	0.25
Rubber	233.01	2.33	5.50
Scrub	584.19	5.84	13.80
Water Bodies	29.58	0.30	0.70
TOTAL	4,233.91	42.34	100.00

Source: RFN

The nearest towns from PL1 Corridor are Merapoh located 6 km to the north, and Kuala Lipis with a population of 12,145 people situated 35 km to the south. There are 4 villages in the area, i.e. Kg. Persek, Kg Kubang Rusa, Kg. Telok Gunong and Kg. Cecah Kelubi (about 145 Orang Asli). Built-up areas consist of small villages that take up about 10.54 hectares or 0.25 % of the area. While the built-up area covers a very small portion of the PL1 area, it is concentrated in the centre of the area, and therefore will impact on the location and type of wildlife crossing and mitigating measures to be taken to protect the safety of the residents.

The Pahang State Structure Plan has not indicated any major development proposal in and around the PL1 area. Unfortunately, the current Local Plan does not cover this PL1 area, and the new District Local Plan inclusive of the PL1 area is under preparation. In view of this, it is envisaged that Kuala Pilah and Merapoh towns are unlikely to experience significant urban growth and residential population increase in the near future. Therefore, there is no development pressure on the PL1 and surrounding area. However, the District office informed that there is a recent proposal to build a large National Service Training camp behind the Sg. Yu Recreation Park.

Figure 6.3.4: Hydrology

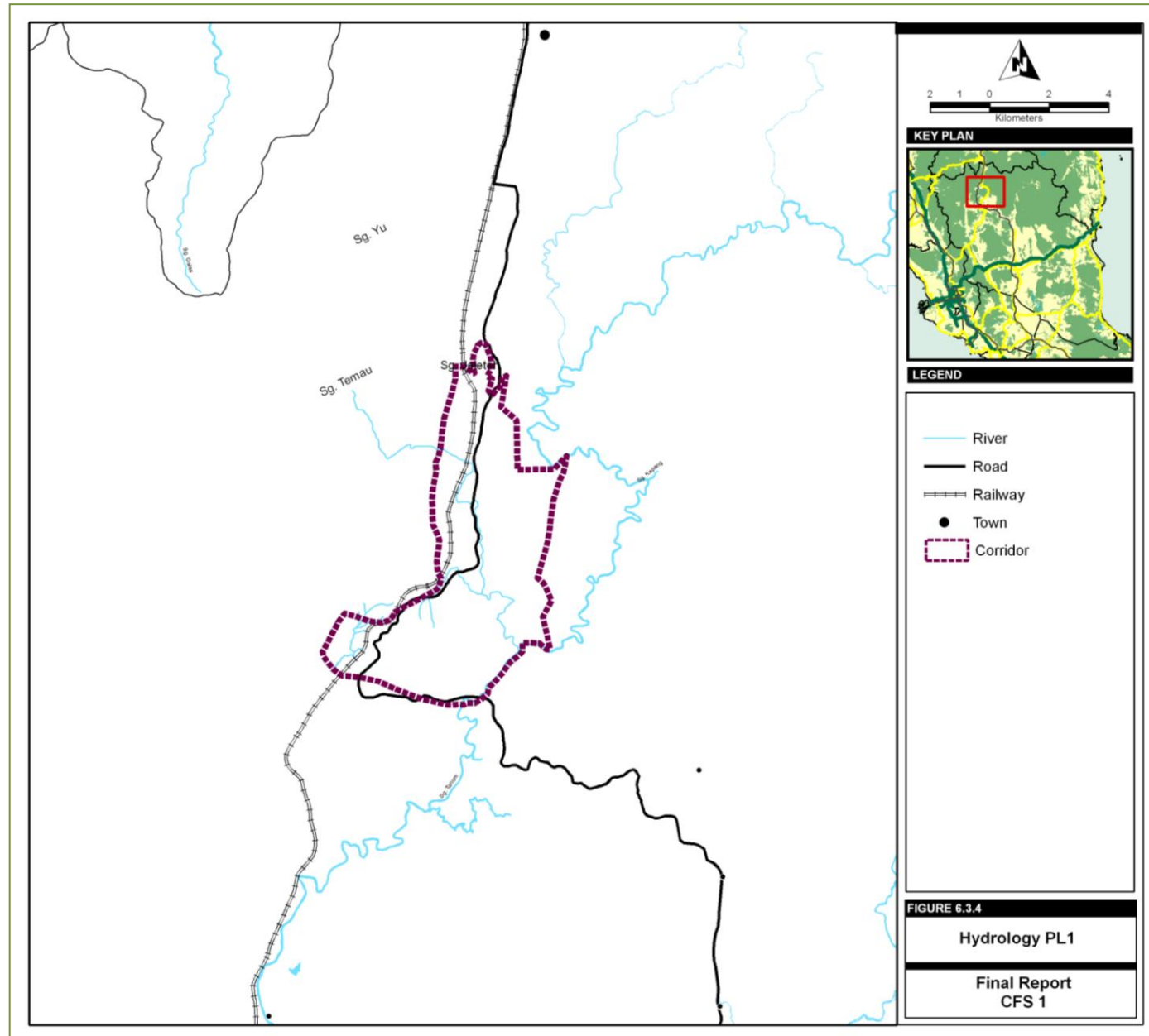
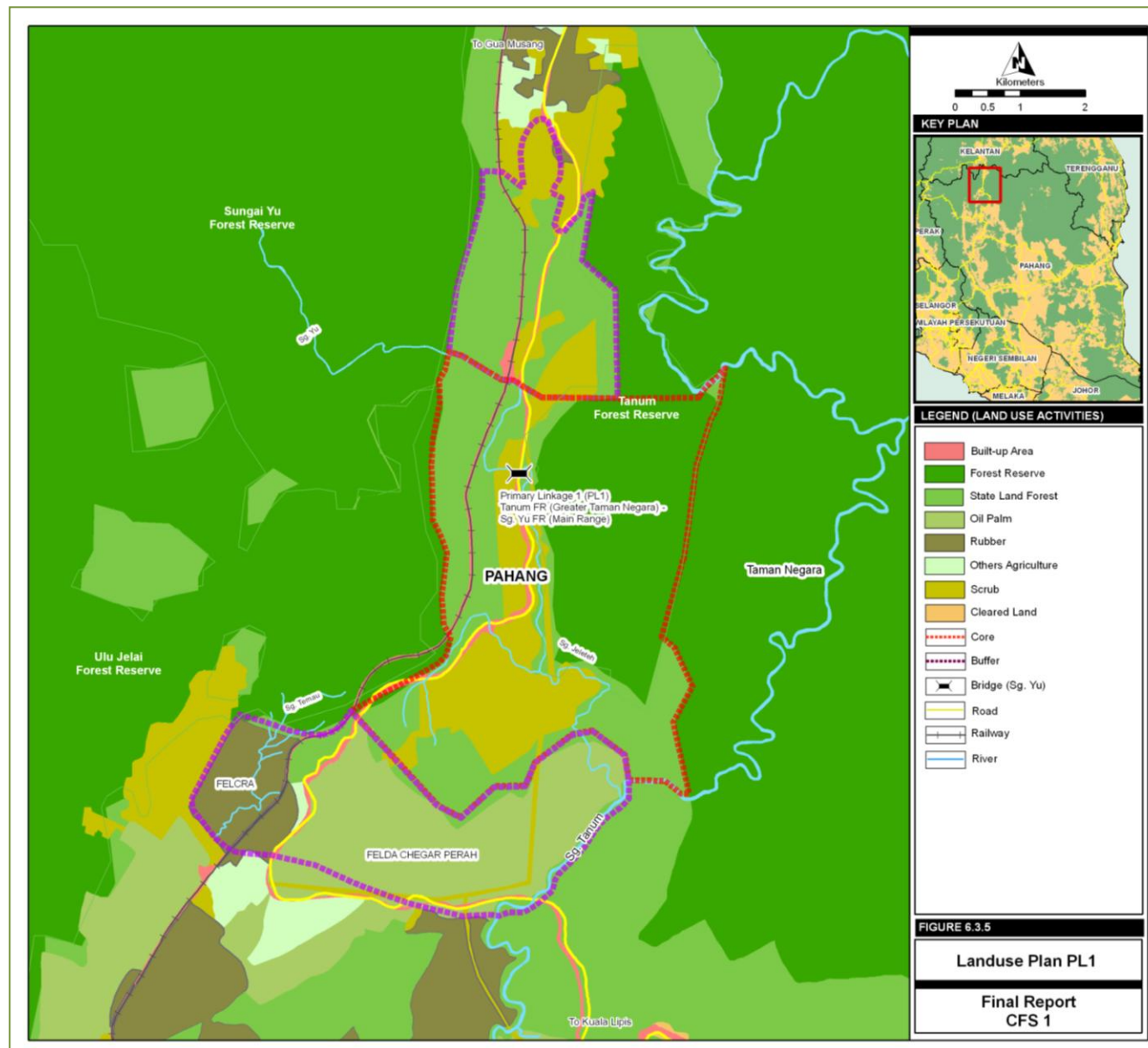




Figure 6.3.5: Landuse (PL1)





6.3.2 Biological

1) High Conservation Value Forest

This linkage is of high conservation value for a number of reasons. In addition to its critical importance as a landscape-level linkage, its proximity to Taman Negara makes it important as a buffer zone. Any activities in this area will have an impact on the large mammals of Taman Negara whose natural range spreads beyond the boundaries of the park. (Refer Figure 6.3.6)

2) Wildlife Habitat

Taman Negara National Park, a 434,000ha tract of protected primary forest is centrally placed in Peninsular Malaysia and topographically varied. As a result of which it supports a rich flora and fauna. Many endangered or threaten species of Southeast Asia and some endemic species of Malaysia are found in Taman Negara. For example, within its limits, as far as mammal is concerned, about 60 percent of the specialized Malesian regional endemics occur, including all the more characteristic and biologically important mammals. It is considered to be a stronghold of viable populations of many endangered species in Peninsular Malaysia.

Taman Negara and its fauna, however, are not totally immune from the adverse effects of isolation. There are concerns that it may be cut off from the rest of the forested landscape in the north (around Kenyir Lake) and in the west (around Sungai Yu), and increasingly becomes a “habitat island”. The clearing of forest cover along a highway to the west of the park and the expansion of oil palm estates to the north have for the past 15 years created an ecological bottleneck that hinders movement of wild animals, especially predators and their prey species between Taman Negara and the Main Range. Conversion of even a small state-land forest to non-forest landuse at critical conservation areas, such as near protected areas poses a serious threat to landscape species such as tigers and elephants. Their movement patterns are disrupted and the overall size and therefore viability of the population will decline as a result of habitat fragmentation.

In such a large and topographically varied tract of forest, wildlife species are not distributed evenly. To conserve adequately the fauna of the area, it is necessary to retain sufficient areas of forest at all elevations. This makes the connection of Taman Negara (mostly lowland forest) with the Main Range important. (refer Figure 6.3.7 for wildlife habitat)

Furthermore, wildlife biologists remark that the long-term viability of the wildlife populations within Taman Negara needs to be evaluated as part of an integrated ecosystem, consisting the surrounding forests collectively known as the Greater Taman Negara Landscape.

PL1 is the last critical linkage between the Greater Taman Negara and Main Range Landscapes. Maintaining and enhancing connectivity across the landscape will ensure a self-sustaining population of wildlife, assuming that they are protected from over-exploitation. With hunting under control, the key to the long term viability of wildlife in Malaysia would be their capability to disperse across the landscapes.



Figure 6.3.6: Existing Forestry Condition

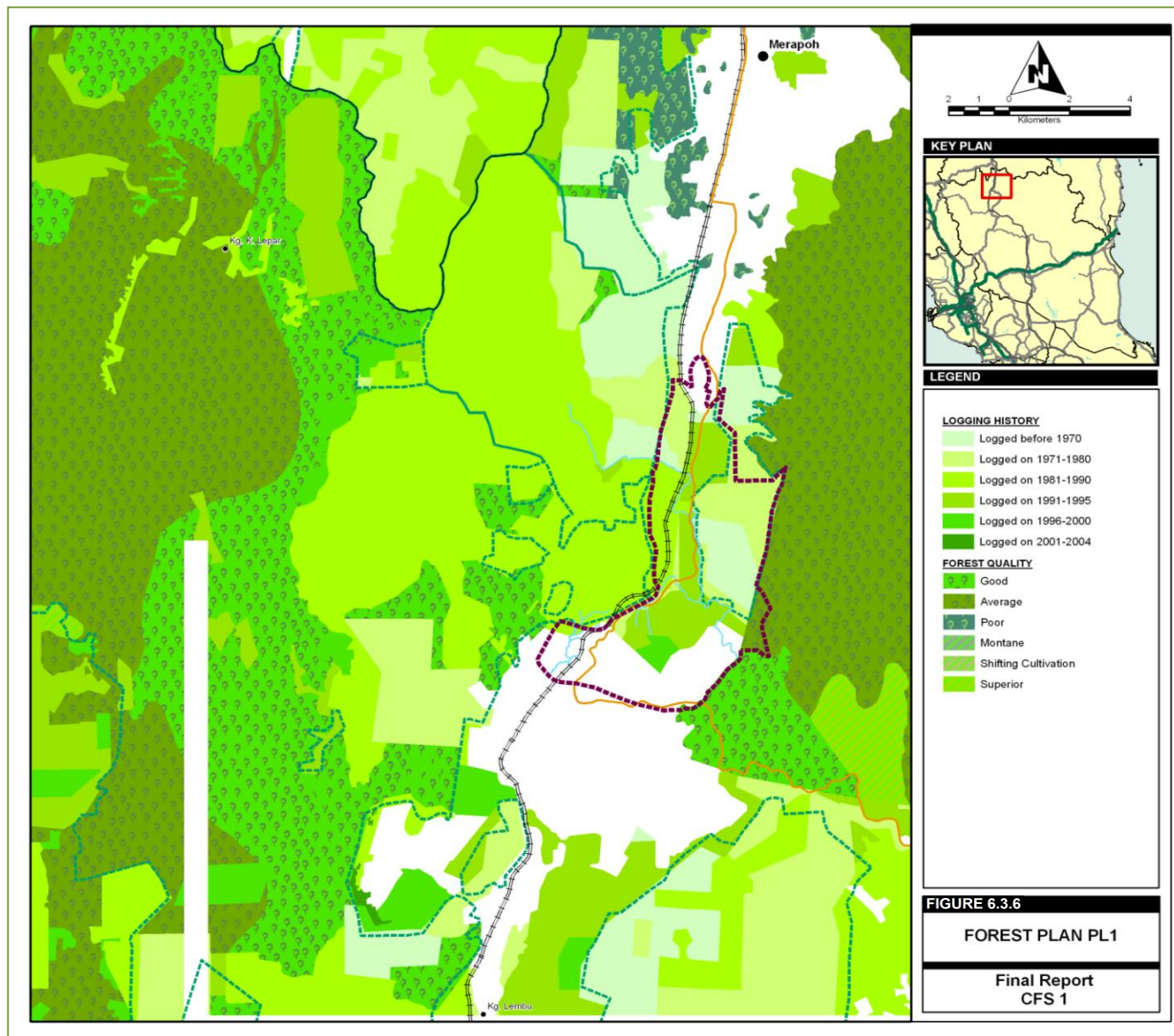
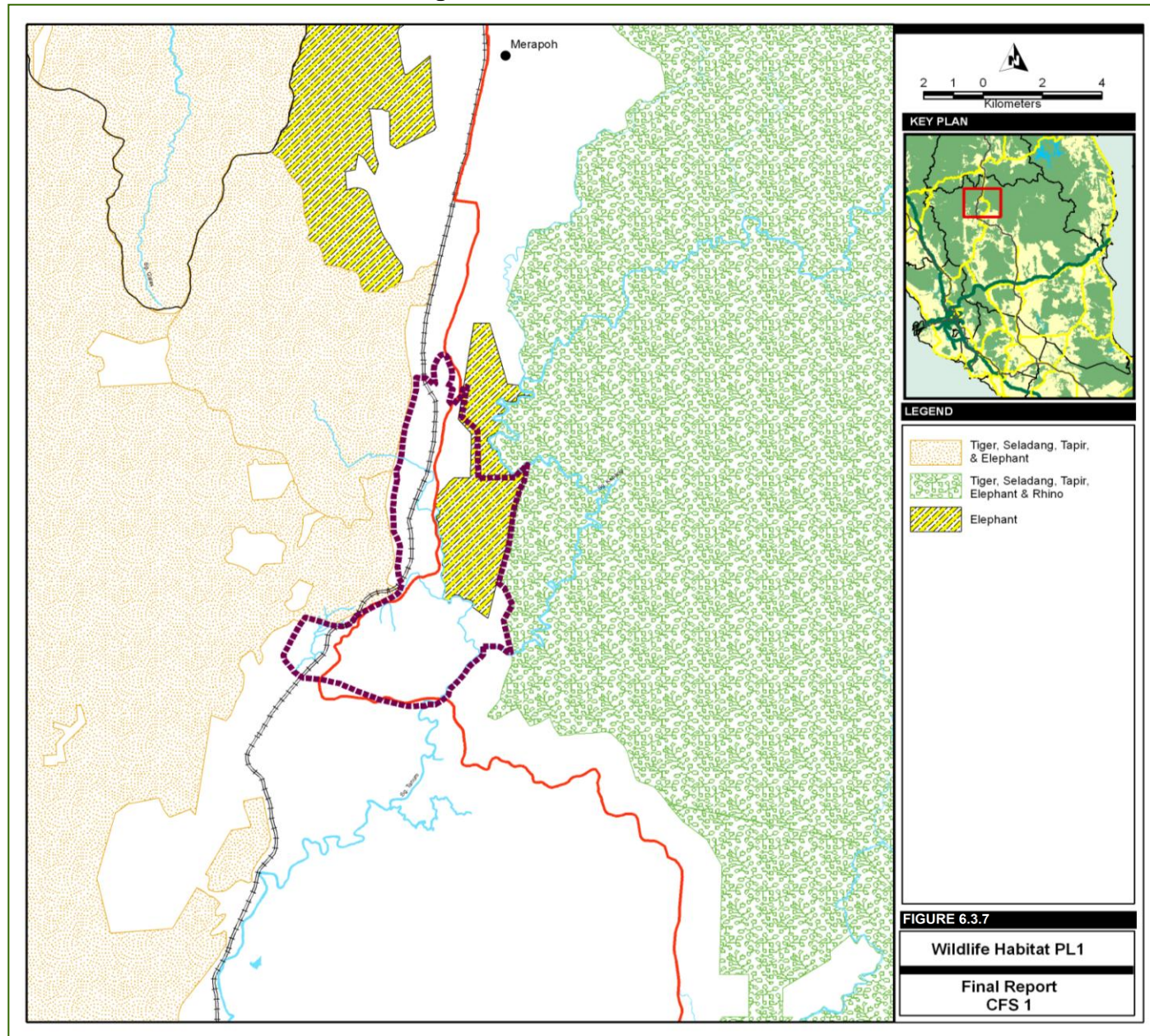


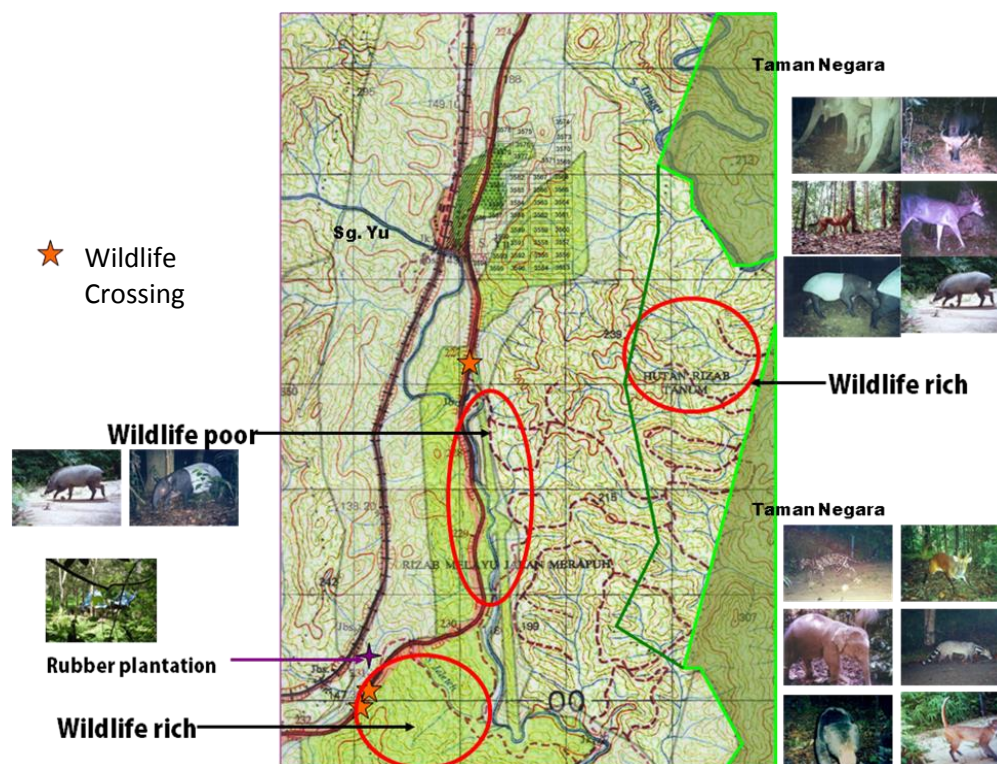
Figure 6.3.7: Wildlife Habitat





Taman Negara, which is on the east of the corridor PL1, has rich wildlife such as Tapirs, deer, elephants etc. According to Dr. Kae, a research working carrying out studies at Taman Negara-Sg. Yu area, there is rich wildlife in the PL1 and animals are crossing the road from Taman Negara to Sg. Yu Forest Reserve. **Figure 6.3.8** shows the locations of poor wildlife, rich wildlife and wildlife crossing point. As such, this corridor is critical and should be conserved as wildlife corridor with a good wildlife management.

Figure 6.3.8: Wildlife Status at PL1



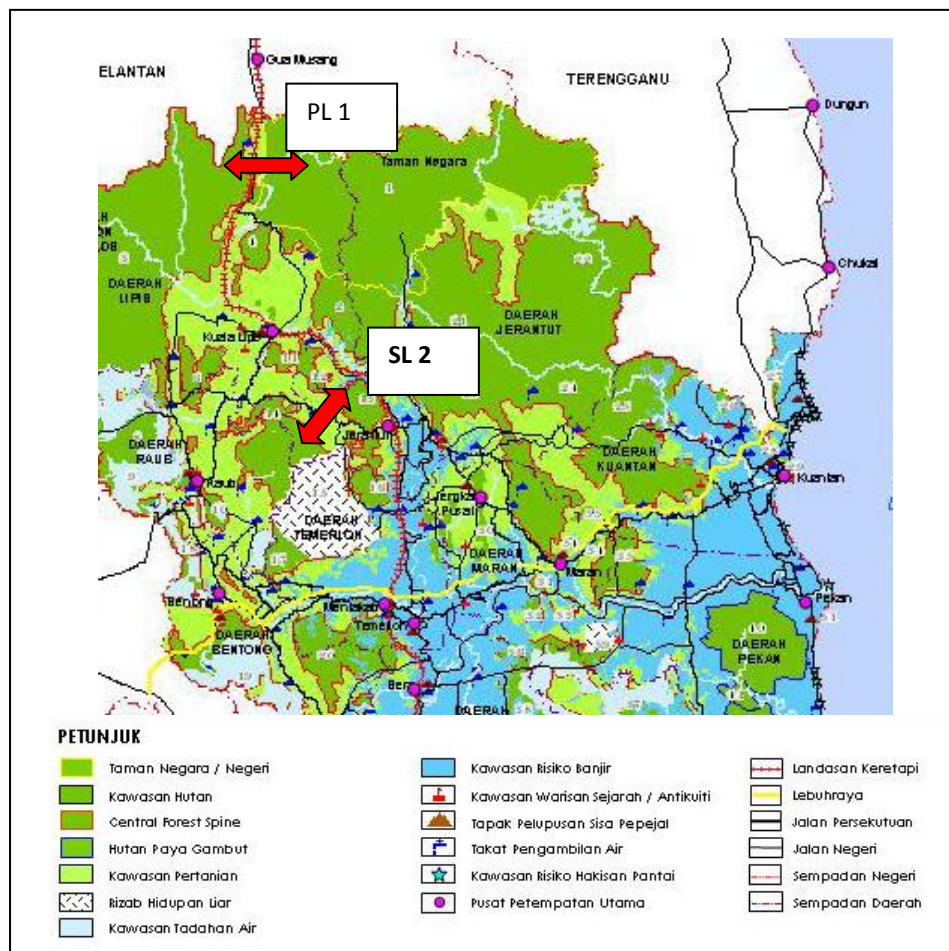
3) Environmental Sensitive Areas

NPP 18 of the National Physical Plan (NPP) states that Environmentally Sensitive Areas (ESA) shall be integrated in the planning and management of land use and natural resources to ensure sustainable development.

The ESAs are further refined, expanded and delineated at the Structure Plan and Local Plan levels. The application of ESAs at the NPP, Structure Plan and Local Plan levels are given in **Table 6.3.5**. **Figure 6.3.9** shows the ESA plan for Pahang state and **Figure 6.3.10** shows ESA plan for PL1 corridor.

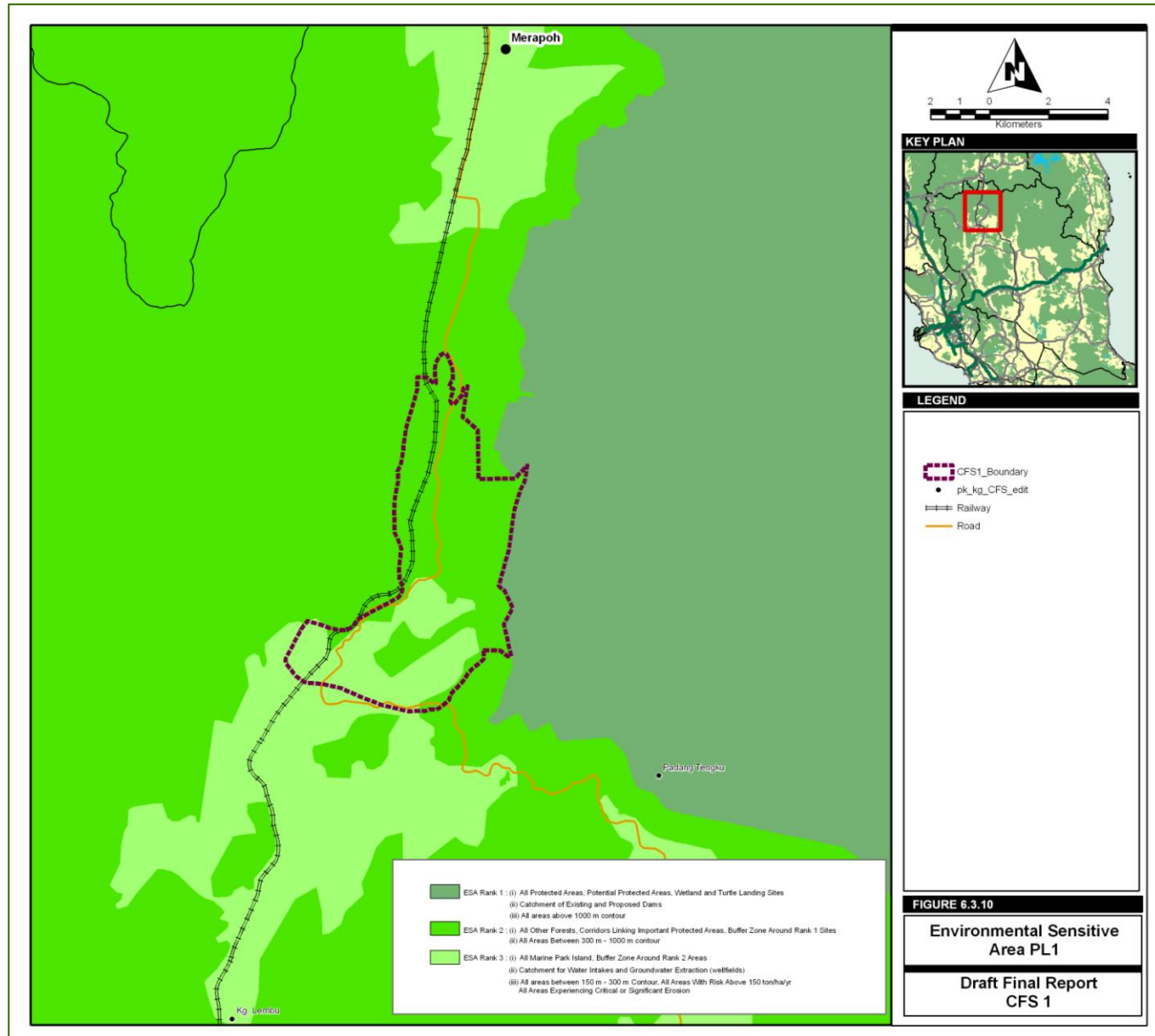
Table 6.3.5: Application of ESAs for PL1

Spatial Plan Level	ESA Ranking	Notes
National Physical Plan	ESA Rank 2	Based on Figure IP8 in the NPP, Tanum Forest Reserve is within ESA Rank 1 and 2, while Sungai Yu Forest Reserve to the west is within ESA Rank 2. The criteria for ESA Rank 2 in the NPP include forests corridors linking important Protected Areas, and all areas between 300m – 1,000m contour. In this case, PL1 connects Taman Negara and The Main Range, which are both ESA Rank 1.
Pahang Structure Plan 2002-2020	N/A	<p>The Pahang Structure Plan 2002-2020 does not rank ESAs, but delineates a number of ESA categories. There is a category called “Central Forest Spine”, of which all of the existing forest reserves in both PL1 and SL2 are included.</p> <p>The plan outlined six policies for environmental conservation. In particular, the second policy called for the sustainable and integrated development of the ESAs in the state which were identified in the National Physical Plan.</p> <p>The structure plan lists three steps for implementation, which include:</p> <ul style="list-style-type: none"> Formulating a management plan for sustainable development of the ESAs by the State Economic Planning Unit Approval for development in ESAs can only be obtained through the State Planning Committee with advise from the National Physical Planning Council Continuous monitoring of ESAs by relevant departments <p>The sixth policy states that the conservation and integrated management of forest with neighbouring states is crucial to ensure the formation of “Central Forest Spine” is realized. In order to achieve this, the conservation and management of Taman Negara requires cooperation from Kelantan, Terengganu and Perak to ensure that the natural ecosystem is not disrupted. Opening up of new agricultural land at the borders should take into account the development at neighbouring states e.g. between Cameron Highlands and Dataran Tinggi Kinta, Perak and Cameron Highlands and Tanah Tinggi Lojing, Kelantan.</p>
Local Plan		The Kuala Lipis Local Plan is currently being drafted and is not available for review.

**Figure 6.3.9: Environmental Sensitive Areas within Pahang State**

Source : Pahang Structure Plan 2002-2020

Figure 6.3.10: Environmental Plan - PL1





6.3.3 Socio Economics

6.3.3.1 Population and Socio Economic Profile

As mention under the introduction, there are 4 main villages around this corridor which are Kg. Persek, Kg. Kubang Rusa, Kg. Telok Gunung and Kg. Cecah Kelubi. The population of Kg. Kubang Rusa is 400 people, 35-45 households, Kg. Cecah Kelubi (Orang asli) 145 people, 30 households. Mostly the residents there work at the farm or small business such as retail shop, restaurants and etc.

6.3.3.2 Socio Perception to Ecological Corridors-

The Tanum – Sungai Yu ecological corridor is important for tiger movement between Taman Negara and the Main Range. It is identified in the DWNP's National Tiger Action Plan as a critical link for conservation. Elephants also move from areas around Sungai Tanum across to the FELDA scheme at Sungai Temau.

Human activity in the core and buffer zones consists primarily of oil palm and rubber plantation agriculture. A federal road and railway runs through the corridor that necessitates some concern for public safety, despite few incidences of human-wildlife conflicts. Several communities, including one in the buffer zone and one Orang Asli settlement, were interviewed by DWNP staff to gain insights into problems and animal sightings in and around the corridor zone.

The main points of concern from villagers from the survey revealed a number of issues that play a part on how to manage the corridor zones:-

- i) **Threats to Livestock** – Leopards, and some tigers, are responsible for the predation of livestock, mostly cows and calves, in the villages. On average about 10 calves per year are consumed. More animals are taken nearby the forests closer to Merapoh as many villagers stay away from forested areas. Tiger sightings are relatively rare, although some are seen during durian season.
- ii) **Wild Animal Disturbance** – Elephants tend to be a nuisance in rubber plantations; while, wild pigs frequently occur in oil palm plantations. In some villages pigs are more problematic than elephants. However to ward off elephants, villagers burn tires and light bonfires.
- iii) **Poaching Problems** – Due to the close access to Taman Negara, poaching has a long history in the region. Orang Siam (Thais) are known to hunt sambar deer, barking deer, mouse deer and small cats and also seek gaharu and elephant tusks. Chinese hunters come from outside to hunt pigs. And some visitors even request pangolins. Tigers seem to be more feared than hunted as hunters ask villagers about sightings to avoid them.

A few RELA members given guns to protect village food gardens hunted instead. Licensed hunters usually come with a large party of unlicensed hunters. People take advantage of slow response times by officials. Illegal snares are found in Taman Negara with deer and pig captured. However, the presence of the army, coupled with DWNP raids, has chased away many of the Orang Siam.



- i) **Community Safety** – Elephants do not seem to be threatening as most problems relate to disturbances in rubber plantations. Today tigers are rarely seen, but in 1985 a villager was killed in Kampong Persek.
- ii) **Public Safety** – Tigers and elephants are not seen crossing the roads. Most of the road kill tends to be pangolins and pigs, the latter coming out during rain at Kampong Kubang Rusa. Surveys made by DWNP suggest tigers use Sungai Yu to cross underneath the bridge at the recreational area. Although encounters with tigers are extremely rare, the potential exists for human-wildlife conflicts.
- iii) **Tourism Opportunities** – Communities are not engaged too much in tourism activities. A few villagers serve as guides to Gunung Tahan. The potential exists to use several major attractions - Taman Negara, Sungai Yu Recreational Area and Sungai Tanum – to promote more local ecotourism development.

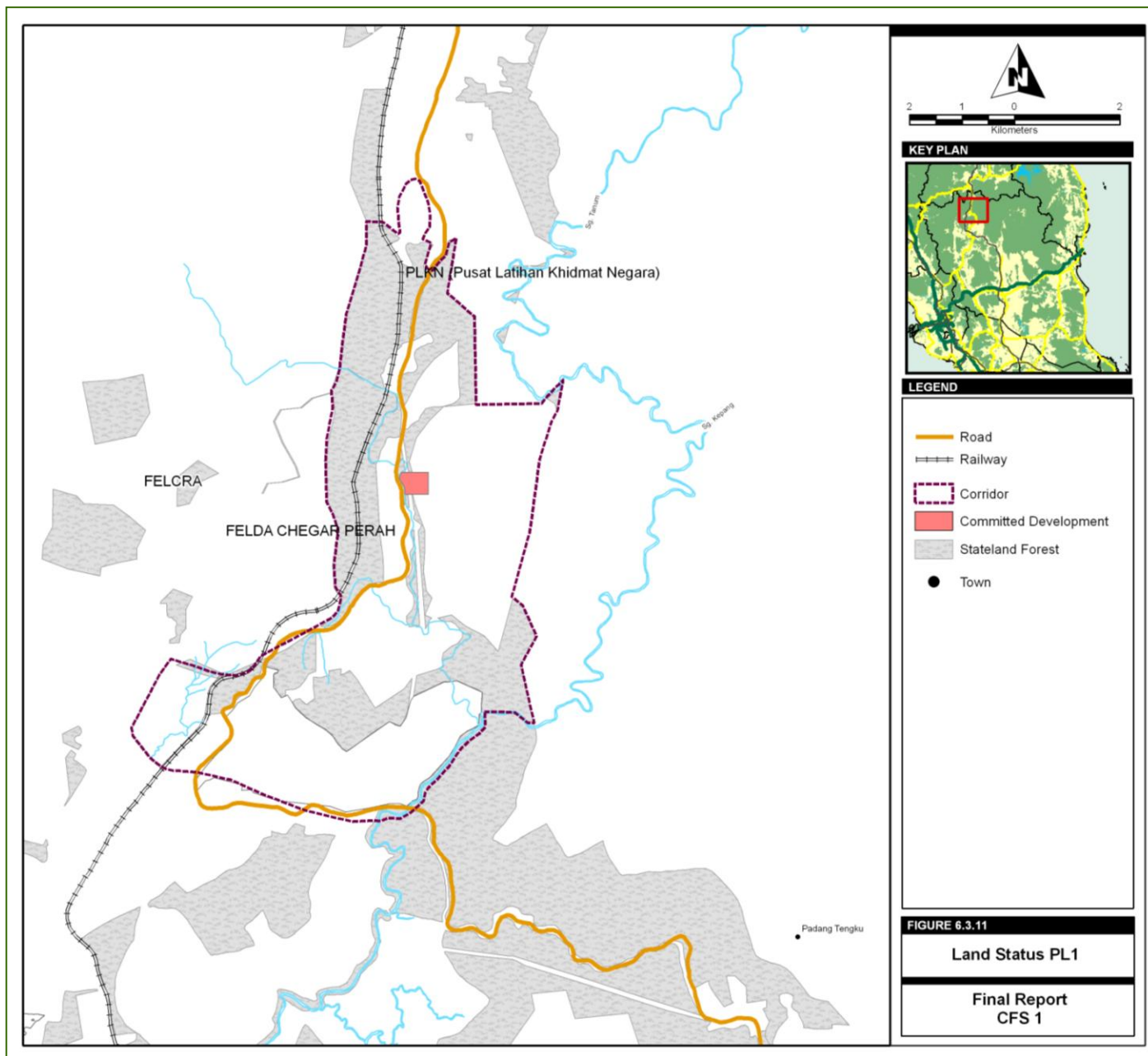
The Tanum-Sungai Yu ecological corridor is a critical area for wildlife protection. The activities of the CFS should focus on assisting villagers to deal with livestock predation, wildlife disturbances, and poaching. Providing training for local communities on how to manage wildlife conflicts, together with measures to reduce poaching, creates direct benefits for villagers and helps develop a sense of ownership to protect the corridor.

6.3.3.3 Land Status

As shown on **the Figure 6.3.11**, in the core area of the PL1 corridor, there is no lot and land belongs to the state. But the buffer area at the north of core area, there are some alienated lands which for agriculture use. However to the south of the core area, there are oil palm and rubber plantation which belongs to Felcra and Felda. Scrub lands also found within the corridor. 80% of the land at the PL1 corridor is state land.



Figure 6.3.11: Land Status



6.3.3.4 Agriculture Activities

1) Soils and Land-Use

The core area consists predominantly of steep land under forest reserves. The predominant soil types found in the area are Langkawi, Gajah Mati – Munchong - Melaka in the north, and Durian – Munchong - Bungor series in the south. Langkawi and Gajah Mati – Munchong - Melaka soil series are normally associated with steep land. These soils in general are shallow, lateritic and juvenile and not suitable for agriculture. They are chiefly derived from granites, sandstones, quartzite and shale. These types of soils are normally found in forest reserves. The Durian – Munchong - Bungor series in the south however are better mineral soils suitable for rubber and oil palm. (Refer Figure 6.3.12 for agriculture landuse plan)

The major portion of the core zone is still under forest cover although small patches of scrubland and grassland are found.

In the southern tip of the corridor however are located four plantations developed by FELCRA and FELDA i.e. FELCRA Sg. Temau (429 ha oil palm and 513 ha rubber), FELDA Chegar Perah1 (655 ha rubber), FELDA Chegar Perah 2 (2,631 ha oil palm) and FELDA Telang 1 Estate (1,884 ha oil palm). Part of these plantations extends into the southern buffer zone.

2) Disturbance and Threats

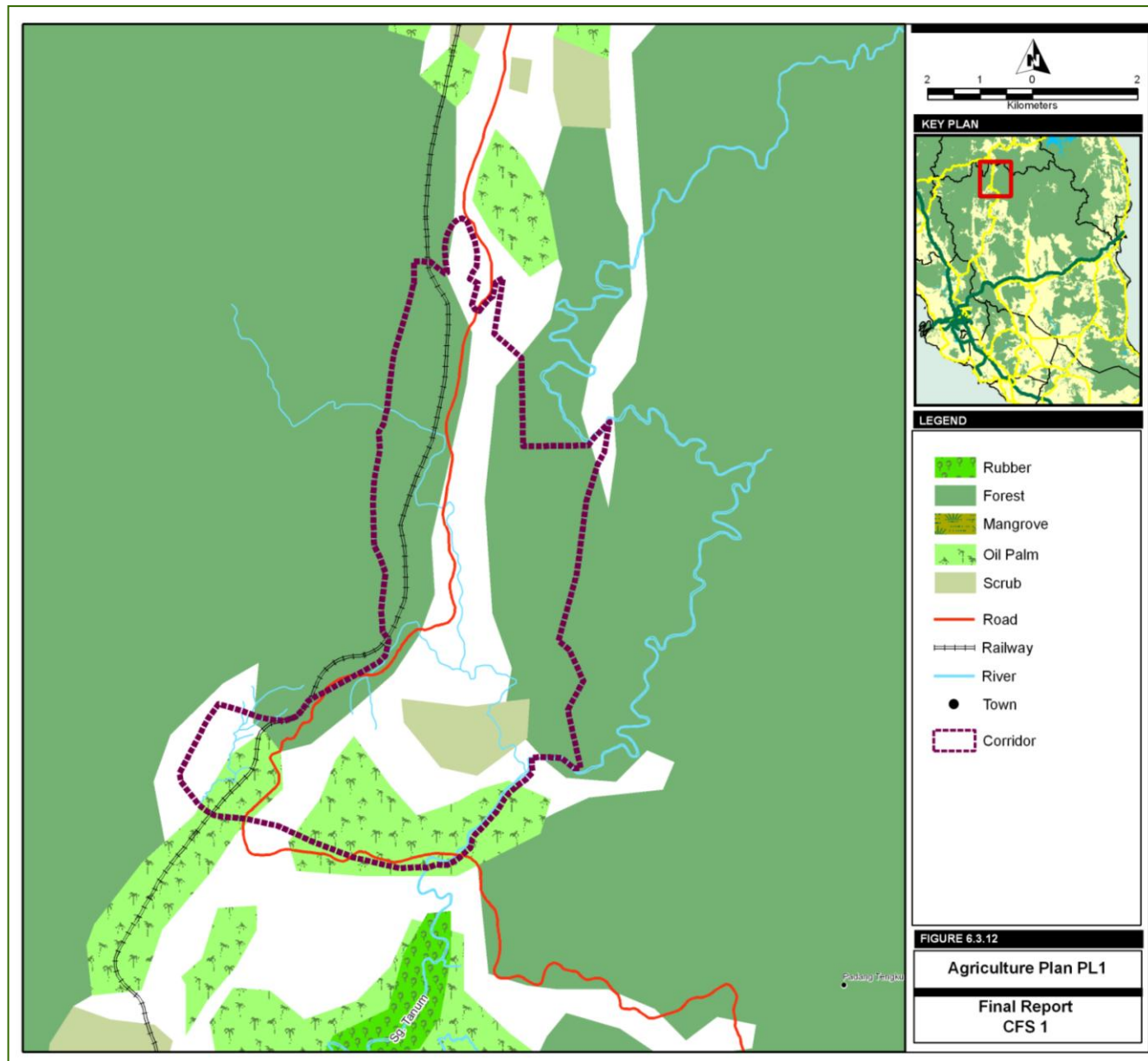
The principal threat in the corridor is the conversion of state land forest along the road to agriculture and settlements. The clearing of forest cover in some of the core areas may lead to some illegal cultivation of crops especially rubber and fruit trees in the region.

3) Issues

The corridor falls within the environment sensitive areas due to its steep topography, and best left undeveloped as clearing of the steep land for development would likely lead to not only severe soil erosion but also involve very high development and maintenance costs.



Figure 6.3.12: Agriculture



6.3.3.5 Tourism Activities

1) Tourism Activities

Sg Yu-Main Range Linkage located within 10 kilometres radius from Taman Negara entry point of Merapoh, and within less than 2 kilometres from Taman Negara boundary. The park leads Pahang ecotourism destination and acts as the main national product in its international tourism promotions.

Among other tourism attractions located within 10 kilometres from the proposed wild life corridor are:

- Sungai Yu Recreational Forest
- Tanum Forest Reserves
- Panjang Cave
- Jenut Kumbang
- Jenut Atai
- Tanum River
- Kuala Yu
- Kuala Toh
- Bukit Tujuh
- Merapoh Limestone
- Chegar Perah Agrotourism

Within the next 20 kilometres from Sg. Yu proposed linkage, other tourism attractions found are mainly of those situated within Taman Negara Merapoh, as follows:

- Yu Forest Reserves
- Pahang National Park Interpretation Centre
- Gajah Cave
- Peringat Cave
- Jenut Cheruai
- Jenut Renkin
- Telok Gong Orang Asli Settlement Centre
- Rimau Cave
- Jeram Kela
- Gunung Tahan

With most ecotourism products offered, Gua Musang – Kuala Lipis region mainly attracts international and domestic eco-tourists. Many prefer to travel by train from Kota Bharu, Kuala Lumpur or Johor Bahru and adjourn at Merapoh station and directly enter Taman Negara. Some will travel by road transport in groups and choose to stay in the above gateway towns or in hostels provided by Taman Negara at Kuala Juram.

For Sg. Yu recreational area, the product is a frequent stop by travellers along Federal Route 3 traverse from south to Kelantan. Visitors are mainly from of daily visitors, domestic family/group tourists and lorry drivers.



2) Tourism Facilities

Tourists to tourism products within Sg. Yu proposed linkage are currently being served by two gateway towns i.e. Gua Musang (Kelantan) and Kuala Lipis (Pahang) which are located within 50 kilometres from the above towns. Both towns provide an approximately 548 numbers of rooms to accommodate tourists to the region. There is a rest house also available in Merapoh. For those visiting Taman Negara Merapoh, a dormitory and a camp site are available in the Perhilitan Complex and Kuala Juram.

Nature guides services are also available particularly for Taman Negara and caving activities within the region. There are about 20 numbers of nature guides offering their services within Merapoh-Gua Musang area.

Jalan Kuala Lipis – Gua Musang (FR3) acts as main access to the area, while tourist by rail from Kelantan to south and vice versa may adjourn at Merapoh station, located in approximately 20 kilometres north from the linkage proposed.

Located within an active wildlife ground, tourism facilities provided in Sg. Yu recreational area frequently being attacked by wild animals, mainly by the elephants at night. **(Refer Figure 6.3.13 for the tourism product plan)**

3) Local Participation in Tourism

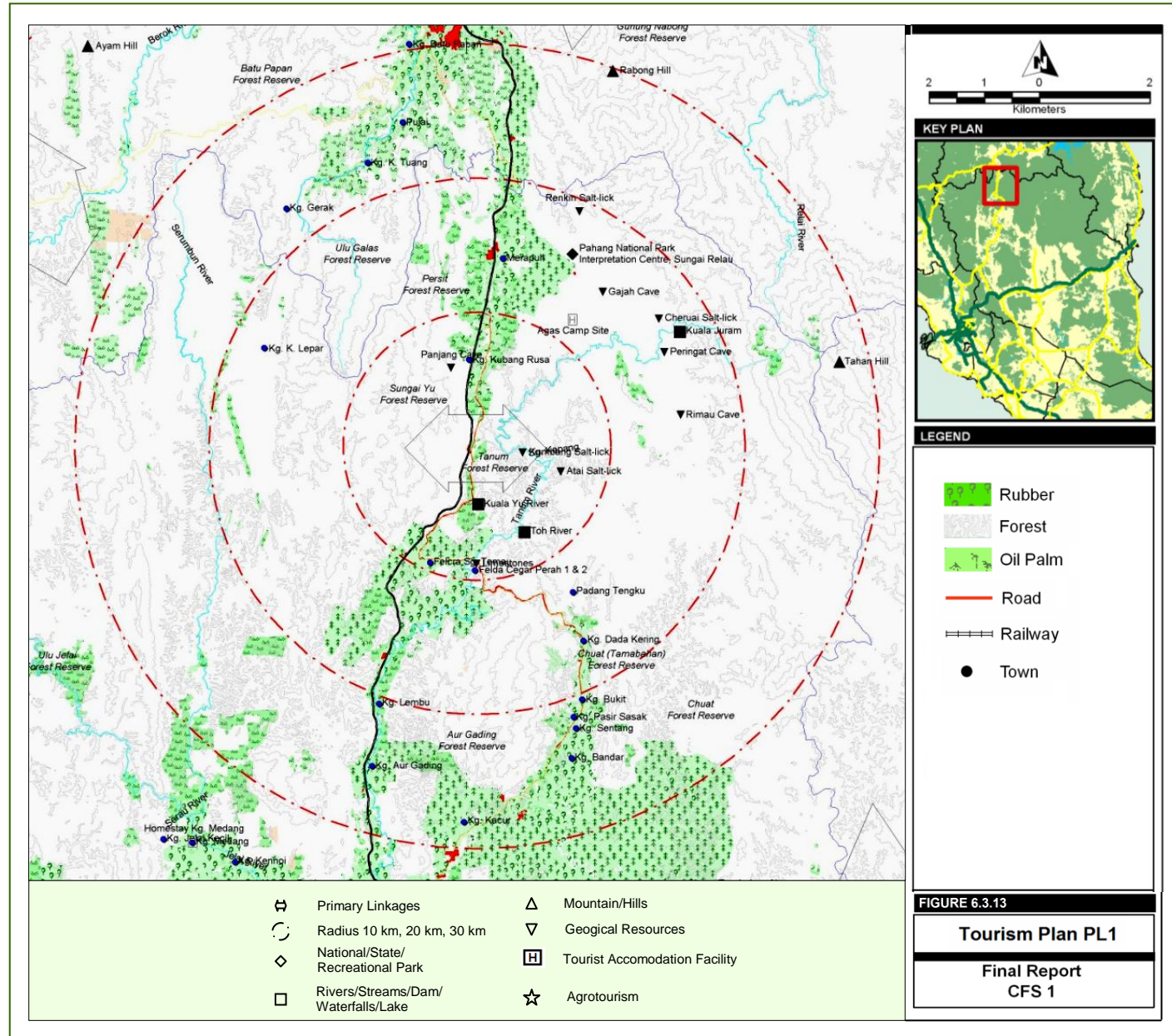
Most tourism products within this region are provided and managed by government agencies, with PERHILITAN being the major player. DID and Forestry Department are also involved in some product development within their function and jurisdictions. Apart from those serving the said departments and involved in the product development and management, other current local participation are mainly as tourist nature guides, tourist accommodation operators and petty traders.

Current local participation in support facilities in Sg. Yu recreational area are mainly petty traders from Kg. Kubang Rusa and FELCRA Temau, operating from the stalls provided by DID. Agro-tourism activities in FELCRA Temau and FELCRA Cegar Perah 1 & 2 are also participated by locals.

6.3.3.6 Forestry Activities / Logging

While the forest reserves in this area have been logged in the past, they are generally considered to be well regenerating and still serve most of their ecological functions. Logging in the immediate vicinity of the linkage should be avoided in future in order to enhance the role of the areas as a wildlife corridor.

Figure 6.3.13: Tourism





6.4 THREATS, OPPORTUNITIES AND CONSTRAINTS

6.4.1 Physical and Land Use

The evaluation of the physical, socio-economic and biological characteristics of the Tanum FR – Sg. Yu FR area will indicate the potential barriers hindering the wildlife movement between the Main Range and Taman Negara as well as enable to identify opportunities in encouraging and facilitating movement of species and ecological processes.

More specifically, the assessment will provide us the basis to select the precise location and appropriate type of physical structure required, e.g. underpass or overpass, to ensure the viability and functionality of the ecological corridor identified. It will also help in identifying the very limited number of wildlife-friendly uses that may be allowed within the core area of the ecological corridor and any conditions attached for such uses. In addition, it will allow us to define those compatible land uses and development that can be normally permitted in the adjacent buffer zone without compromising the biodiversity conservation objectives, e.g. minimal disturbance to the animal species and safety of the residents. Mitigating measures, e.g. electric fencing, may need to be taken to protect the security of the existing residents and property damage from wildlife attacks if relocation is not feasible.

6.4.1.1 Constraints

In identifying the location, extent and type of ecological corridor, particularly the physical structure, the following constraints must be taken into account, viz:-

- Kuala Lipis – Gua Musang Federal Route 8 cutting through the forest habitat, and thus posing a dangerous and difficult barrier to wildlife movement;
- Four small villages, i.e. Kg. Persek, Kg. Kubang Rusa, Kg. Telok Gunong and Kg. Cecah Kelubi (about 145 Orang Asli), and some scattered individual houses along the Kuala Lipis – Gua Musang road, and thus creating potential wildlife-human conflicts as well as deterring animal crossing;
- Some agricultural smallholdings along the road as well as FELDA and FELCRA rubber and oil palm plantations at the northern and southern tips of the proposed ecological corridor, and therefore threaten the safety of workers, and damaging crops and properties;
- Recent alienation of stateland forest for agriculture purpose (about 50 lots at an average size of 4 hectares per lot) that are yet to be developed; and
- A relatively small Sg. Yu Recreation Park beside the road at the centre of the proposed ecological corridor.

6.4.1.2 Opportunities

The following available opportunities should be fully exploited to ensure the creation of a viable and functional ecological corridor, namely:-

- The Main Range and Taman Negara are rich in biodiversity but fragmented by the Kuala Lipis – Gua Musang Federal Route 8. However, the forest cover is closest along this stretch of the road, thus causing minimum social dislocation and requiring minimum land acquisition to establish a wildlife habitat linkage;
- Evidence of wildlife presence and animal movement, particularly elephants and tigers, between the Main Range and Taman Negara along this stretch of the road corridor will ensure the use of the ecological corridor for wildlife crossing. Evidence includes sightings by local residents, roadkills from recordings of JKR and Jabatan Perhilitan, and ground signs of usage, e.g. elephant footprints and droppings, by fieldwork / studies undertaken;
- Existing low level of human presence and human development / activities in the area, particularly few small settlements, low population and low level of economic activities will reduce animal disturbances and threats to human safety;
- No development pressure in the near future as the area is zoned as an Environment Sensitive Area Rank 1 in the National Physical Plan; there is no major development proposals contained in the State Structure Plan; and this area is remote and rural in character;
- Availability of a narrow strip of Stateland forest along both sides of the road offer opportunities to establish the ecological corridor for public benefit; and
- Presence of rivers under the existing road will provide opportunity to create a cost-effective river riparian corridor, and at the same time will offer potential for eco-tourism development.

6.4.1.3 Threats

The following threats must be considered in drawing up the ecological corridor, namely:

- The proposal to expand / upgrade / realign the existing Kuala Lipis – Gua Musang Federal Route, will be insensitive and unsympathetic to wildlife movement and crossing unless wildlife crossing structure, e.g. underpass, can be incorporated into the road design and appropriate mitigating measures are taken;
- The possibility of upgrading the existing railway system to an electrified high speed train mode will likely result in an increase of train frequency, speed of the train, double track and fencing of the railway line, and thus impeding wildlife crossing;
- The narrow strip of Stateland forest earmarked for setting up the ecological corridor is not gazetted as protected land, and therefore can be alienated for non-forest development; and
- Proposal to build a large National Service Training Camp in the proposed core area of the ecological corridor is incompatible to wildlife habitat and movement.



6.5 LINKAGE STRATEGY

6.5.1 Strategic Thrusts

To develop the PL1 corridor, several strategies has been identified to create the safe crossing for animal to cross from Tanum Forest Reserve to Yu Forest reserve and vice versa. There are 4 categories of the strategy, which are; gazette forest reserve and acquisition of land, establish wildlife crossing, create riparian reserve and land use management control. Under land use management control, tourism management, agriculture management and human settlement management will be discussed. The detail strategies are as follows:-

1) **Gazetted forest reserve and acquisition of land**

- Immediate freeze on land alienation and development in the corridor, plus any TOL land is not allowed to be renewed.
- Gazette Tanum FR within the Core Area as Protected Forest under s10 NFA (wildlife sanctuary)
- Gazette all state land forests / scrub land within the Core as protected forest under s10 NFA
- Gazette state land forests within the Buffer as Forest Reserve under NFA
- Long term strategy : Extend the boundary of Taman Negara Pahang to include the Core Area

2) **Establish wildlife crossing**

Components of Stage 1

- Additional signages (gantry type) and advisory signs
- Speed control limited to 60km/hr over 5 km stretch
- Wildlife monitoring program.
- Confirmation of wildlife crossing from monitoring program

Components of Stage 2

- Underpass (viaduct) at 3.5 km south of Sg. Yu bridge
- Overpass (vehicular box culvert) at 1.5 km south of Sg. Yu bridge
- Remove 60km/hr speed limit. Road reverts to 90km/hr after crossing structures are in place
- Provide barriers and escape structures for wildlife crossing as necessary

3) **Create riparian corridor**

- Create a riparian corridor to allow elephants to continue to pass through the oil palm estate (FELCRA Sungai Temau) along the Tanum river.
- For rivers located within the core area no riparian reserve required (Sg. Yu and Sg. Jeleteh)
- For rivers within the buffer area riparian reserve is required for Sg. Temau and Sg. Tanum.
- Riparian reserve is an additional 50 m to the river reserve .

4) **Landuse management control**

- Carry out a monitoring programme.
- FELCRA Sg Temau (942 ha), FELDA Chegar Perah 1(655 ha rubber) and FELDA Chegar Perah 1 (2,631 ha oil

palm) encouraged to practice sustainable plantation management as outlined in 'Guidelines for Sustainable Agricultural Management of Plantations' and RSPO guidelines.

- No further development of agricultural areas should be allowed in the core areas of the ecological corridor.
- The wildlife corridor should be promoted as the most accessible part of the premier ecotourism destination of Taman Negara.
- Poaching must be controlled. Unused logging roads should be closed with gates, which would inevitably obstruct Perhilitan's patrolling vehicles, thus necessitating full collaboration between the Forestry and Wildlife Departments.

6.5.2 Land Use Zoning and Control Plan

1) Future Agriculture Zone and Activities

The corridor areas, both the core and buffer areas, are inextricably associated with surrounding agricultural development in the south. Consequently, interactions between the corridor system and surrounding land uses are important to reduce the negative impacts of agricultural practices in plantations to the environment, in particular, in the ecosystems in and around ecological corridors. As such the managers of these plantations are encouraged to practice sustainable management of their plantations in line with the 'Guidelines for Sustainable Agricultural Management of Plantations'. These guidelines are based on the following principles:-

- Use of appropriate best practices management that minimise and control erosion and degradation of soils
- Use of appropriate practices that maintain the quality and availability of surface and ground water.
- Effective management of pests, diseases, weeds and invasive introduced species using appropriate Integrated Pest Management (IPM) techniques.
- Use of Agrochemicals in a way that does not endanger health, the environment and wild life.
- Environmental responsibility and conservation of natural resources and biodiversity in the plantations
- Maintaining the status of rare, threatened or endangered species and high conservation value habitats
- Disposal of waste in an environmentally and socially responsible manner.
- Increasing biodiversity by providing a habitat for indigenous flora and fauna through a combination of forest and riverine conservation areas within the plantations.

Besides,

- Acacia trees should not be planted in wildlife corridors unless the purpose is to deter the wildlife use.

In the mean time, no further development of agricultural areas should be allowed in the core areas of the ecological corridor.

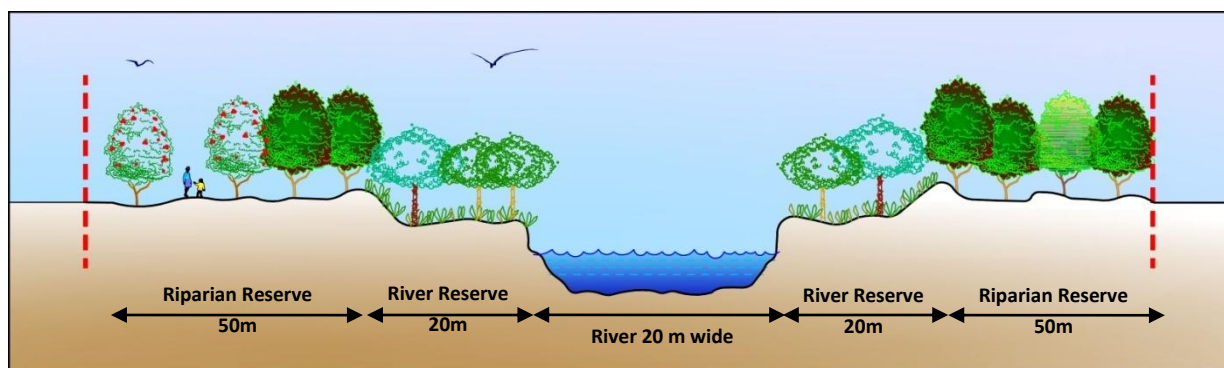


2) Village Boundary Limits

As shown in the generic guideline, human settlements are not allowed in the core area. For the buffer area, no human settlements expansion is allowed. If there is any existing human settlement, village boundary limits has to be identified and fencing or bunds have to be constructed as barriers to stop animals entering the village. For the PL1 study area, within the core area, there is no any human settlement. While at the buffer zone, especially the north of the crossing, there are several land that have been alienated to the private owners for agriculture use. Along the road within the corridor, there are some settlements under the Temporary Occupation Licence (TOL for agriculture activities. Therefore with the core area in PL1, there are no human settlements. However, for the buffer area, all the TOL will not be renewed and no further human settlement expansion be permitted. Bunds and drainage scheme is designed for the village boundary as mentioned in Chapter 4. The development of the barriers could reduce the human wildlife conflicts.

3) River and Riparian Corridors

There are several rivers within the PL1 corridor. The rivers which are located within the core area are Sg. Yu and Sg. Jeleteh. Since these two rivers are located within the core area, no riparian reserve is required. However for the rivers within the buffer area, riparian reserves are required. Sg. Temau and Sg. Tanum is the river within the buffer zone and plantation area. These rivers have to reserve for riparian reserve depends on the width of the river. Riparian reserve is an additional 50 m to the river reserve



4) Buffer Zones

Within the corridor, buffer and core area have been identified. Within the core area, viaducts will be developed and no human and agriculture activities are allowed (refer Figure 6.5.3 for the location of viaduct). Within the buffer area there will be no further expansion of human settlement, but agriculture activities are allowed. River Corridors within the buffer zones are required to be gazetted as riparian reserves.

6.5.3 Establishing Wildlife Crossing (Key Initiatives)

1) Infrastructure description

There are two linear infrastructures within this linkage:-

- i) The main railway line – Kuala Lumpur – Gemas – Kota Bharu
- ii) Federal Route No. 8 – Kuala Lipis – Gua Musang – Kota Bharu

The railway line services the East Coast of Peninsular Malaysia. The frequency of service is low; 2 passenger trains traverses the line each direction per day. Due to the low frequency of trains, the railway is not currently considered a major obstacle to wildlife crossing.

Federal Route No. 8 is a major road connecting Kuala Lumpur to Kota Bharu. The road is a dual lane highway. Traffic volume and projected growth along the road is based on the “Road Traffic Volume Malaysia 2005” published by the Highway Planning Unit, Ministry of Works. **Table 6.5.1** below shows the traffic data for the Federal Route No. 8. Station No. DR 901 in the Gua Musang District is the survey station closest to the site, located between Merapoh and Gua Musang.

Table 6.5.1: Traffic Volumes and Composition along FR 08, (Oct. 2005)

District	Station No.	Route	16 Hours	Car & Taxi %	Van & Utility %	Lorries %	Heavy Lor %	Busses %	Motor cyc %
Kota Bahru	DR203	8	25,623	64.57	8.05	3.92	0.99	1.30	21.16
Kota Bahru	DR204	8	40,138	63.72	6.77	4.39	1.36	1.02	22.74
Machang	DR301	8	20,607	66.50	7.82	6.99	1.78	1.18	15.72
Machang	DR302	8	14,020	65.77	8.85	9.67	3.56	0.55	11.60
Kuala Krai	DR801	8	7,362	58.57	16.69	4.50	2.42	1.49	16.33
Kuala Krai	DR802	8	14,894	58.33	15.69	7.94	2.79	1.14	14.19
Gua Musang	DR901	8	4,564	46.47	20.99	10.17	7.65	1.36	13.37
Gua Musang	DR902	8	7,012	45.27	20.68	12.95	7.56	2.07	11.48

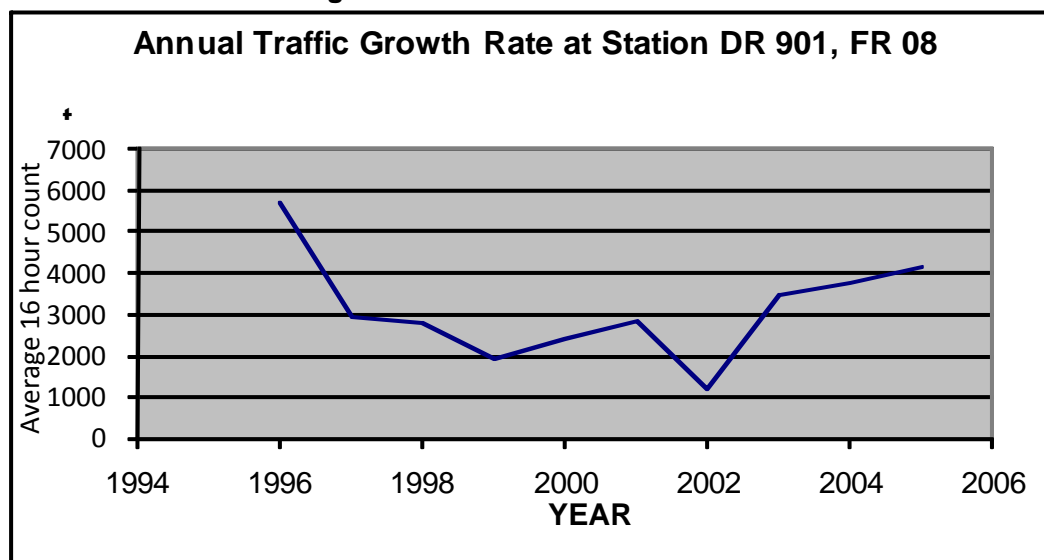
Source: Highway Planning Unit 2005

From the above table it can be seen that for DR 901 the 16 hour count is 4,564 vehicles. Along FR No. 8, the traffic volume is the lowest at DR 901. However in terms of traffic composition, DR 901 has the 2nd highest percentage of medium sized lorries, heavy lorries, van and utilities vehicles compared to other station along FR 08 in Kelantan.

Traffic growth data is shown **Figure 6.5.1**. While traffic growth at DR 901 based on Figure 6.5.1 do not seem to increase substantially, the road remains an important connection between Kuala Lumpur – Kota Bharu and serves the hinterland of Kelantan.



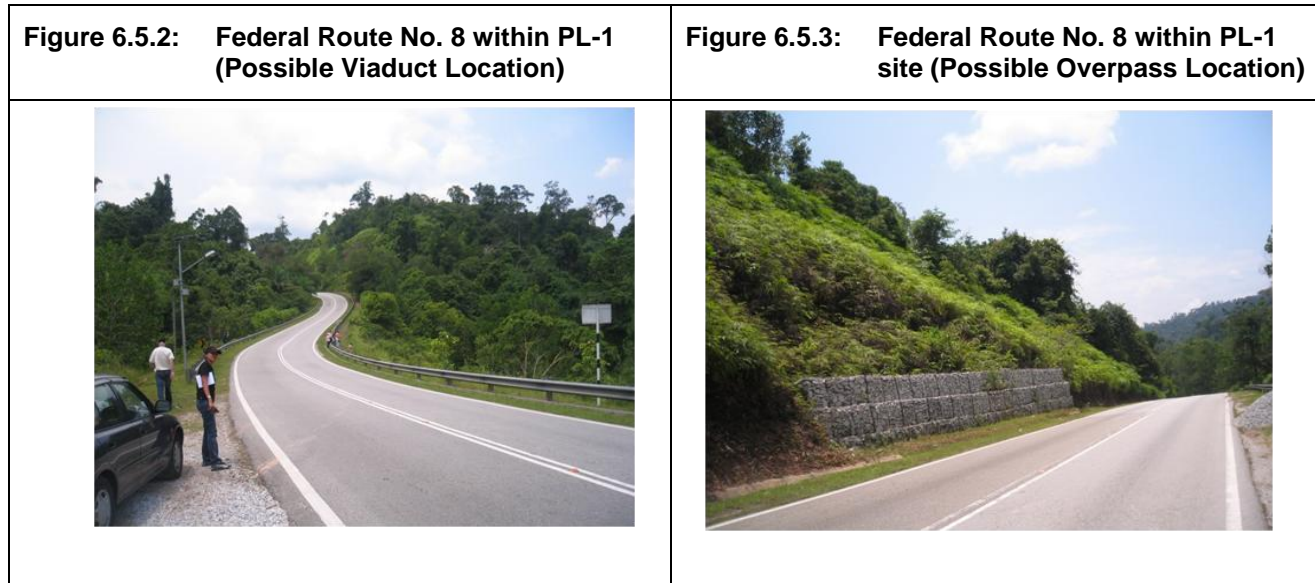
Figure 6.5.1: Annual Traffic Growth



2) Other road details with PL – 2

- The speed limit is 90 km/h
- There is an existing bridge across Sg. Yu, however headroom below the bridge is too low to allow passage of large mammals
- The road shoulder is not paved.
- Lane width is approximately 3.25 meters
- JKR has plans to upgrade this road to R5 standard in the near future.
- In the future, there is a plan to construct a new highway along this alignment. Wildlife crossings will need to be implemented for the new highway.

Figure 6.5.2 and Figure 6.5.3 show the road within the PL-1 core area.



i) Flow chart

Refer to Appendix 1 of the Guidelines. The road is within a primary linkage and therefore requires consideration for wildlife crossings.

ii) Type of wildlife

Refer to Section 2.1 of the Guidelines. Wildlife under consideration are large mammals (elephants and possibly tigers).

iii) Location of Crossings

Refer to Section 2-2 of guidelines. There is no detailed wildlife crossings study available. Propose an “at grade crossing” with monitoring initially and underpass/overpass option upgrade in the future.

iv) Form of wild crossing

Refer to Chapter 4 of the Guidelines. Wildlife under consideration are elephants and tigers (large mammals) and the road is a major road. Therefore suitable forms of crossing are:-

- Underpass (viaduct or bridge approximately 500m long)
- Overpass (30m wide)



Due to lack of detailed study, these are to be constructed in the future.

3) Summary of Recommendation

An “at grade crossing” with monitoring is recommended initially as traffic volumes is still relatively low (stage 1) and there is no detailed wildlife study available. Refer to Appendix 2 of the Guidelines for at grade crossing components.

Underpass and overpass to be considered once monitoring is carried out (stage 2) **Figure 6.5.4** below shows the recommended crossings. An overpass 30m wide is proposed and a viaduct 500m long has been proposed south of the existing Sg. Yu Bridge. **Figure 6.5.5** shows a typical overpass. A cover will be constructed on top of the existing road and backfilled with earth. This type of construction is also called a cut and cover tunnel or a vehicular box culvert.

Figure 6.5.4 : Proposed Locations of Wildlife Crossings in PL1

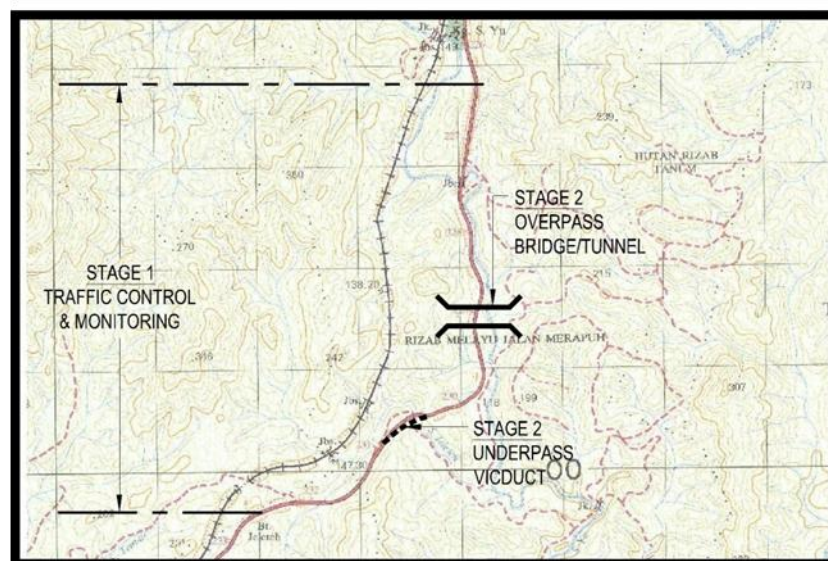
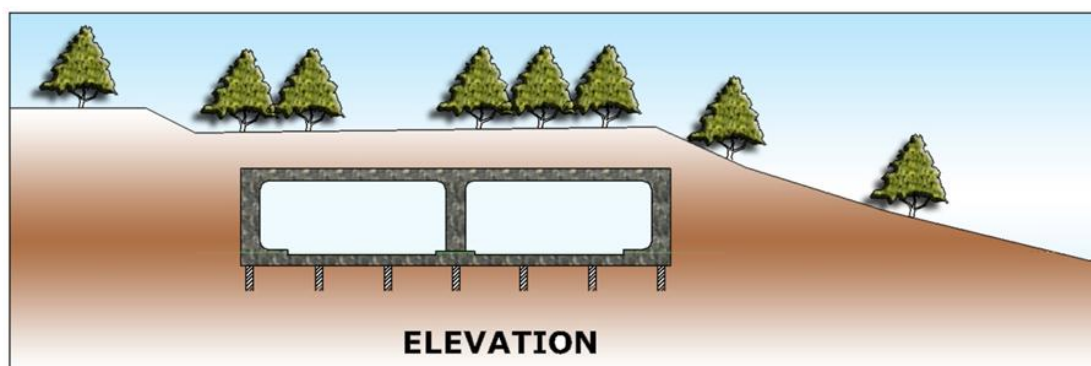


Figure 6.5.5: Proposed Overpass in PL-1



Components of Stage I

- Additional signages (gantry type) and advisory signs
- Speed control limited to 60km/hr over 5 km stretch
- Wildlife monitoring program.
- Confirmation of wildlife crossing from monitoring program

Components of Stage 2

- Underpass (viaduct) at 3.5 km south of Sg. Yu bridge
- Overpass (vehicular box culvert) at 1.5 km south of Sg. Yu bridge
- Remove 60km/hr speed limit. Road reverts to 90km/hr after crossing structures are in place
- Provide barriers and escape structures for wildlife crossing as necessary

Estimated Costs

Estimated costs for Stage I and Stage II are shown in **Table 6.5.2** and **Table 6.5.3** :-

Table 6.5.2: Estimated Cost for Stage I

Item	Unit Cost RM	Quantity	Costs RM
1. Gantry at entrance and Exit of Linkage	100,000	2 nos	200,000
2. Advisory wildlife signs at every 500m	2,500	10 nos	25,000
3. Monitoring/Remote Cameras along 5km of road	500,000	5 km	2,500,000
4. Maintenance of monitoring cameras and other costs	100,000	5 years	500,000
Sub Total			3,250,000
Contingency (20%)			650,000
Total			3,900,000



Table 6.5.3: Estimated Costs for Stage 2

Item	Unit Cost RM	Qty.	Costs RM
A. VIADUCTS			
1. Viaduct Structure approximately 500m long	5,000	5000m ²	25,000,000
2. Realignment of approach roads	500	1,000m	500,000
3. Removal of existing earth fill & existing road	Lump sum	-	200,000
4. Landscaping below viaduct (100m on each side)	5	50,000 m ²	250,000
5. Drainage works	Lump sum	-	250,000
Sub total			26,200,000
B. OVERPASS			
1. Overpass structure 30m wide by 15m long (cut and cover box culvert)	15,000	450m ²	6,750,000
2. Earthworks say average 10m deep fill over an area of 15,000 m ²	10	150,000 m ³	1,500,000
3. Landscaping works	5	15,000 m ²	75,000
4. Drainage works	Lump sum	-	250,000
Sub total			8,575,000
C. MONITORING			
1. Cameras under the viaduct	200,000	3 nos	600,000
2. Cameras along the overpass	200,000	3 nos	600,000
3. Maintenance and Reporting	100,000	5 yrs	500,000
Sub total			1,700,000
Total (A+B+C)			36,475,000
Contingency 20%			7,295,000
TOTAL			43,770,000

6.5.4 Strengthening Ecotourism Capacities (Key Initiatives)

- 1) Develop the wildlife corridor as one of the ecotourism attraction within Merapoh – Kuala Lipis region by including it into the Pahang (Merapoh) National Park. This can be done by extending the existing boundary of the national park to include the linkage.
- 2) Relevant authorities/NGO to carry out a detailed inventory to identify wildlife species that use the corridor. Findings will be useful in product creation and promotion. Tourist market segment suited for the proposed linkage are extended to Taman Negara ecotourists, international and domestic travelers along FR3 and students.
- 3) Develop treks and natural access to existing salt lakes (Jenut Kumbang and Jenut Atai) located along Tanum River and to connect them to the tourist area provided. New salt lakes can be created along the river and within the proposed linkage to enhance the possible chances of safe animal encounter by tourists.
- 4) Develop the ecotourism infrastructure and facilities within close vicinity or in the wildlife corridor according to its suitability such as :
 - Tourist Centre including tourist parking area, tourist rest area, tourism information panels/boards and visiting schedules to designated wildlife potential viewing area
 - Access from the wildlife corridor to the gateway town
 - Jungle treks from the tourist centre to observation decks.
 - Observation decks and hideaway can be proposed at a distance of 200 to 250 meter from the salt lakes and the possible crossings.
 - Canopy Walkway
- 5) Tourism products within 50 kilometres suitable to be packaged together are as follows:-
 - Sungai Yu Recreational Forest
 - Gajah Cave and Panjang Cave
 - Sg. Tanum
 - Gunung Tahan
 - Agrotourism Kechau
 - Jaleh Dam
 - Nenggiri River
 - Kuala Betis
 - Rabong Hill
 - Tahan National Park
 - Bama Cave
 - Kg. Relung Homestay
 - Kg. Medang Homestay
 - Jeram Panggung Lalat
 - Terenggun Recreational Forest



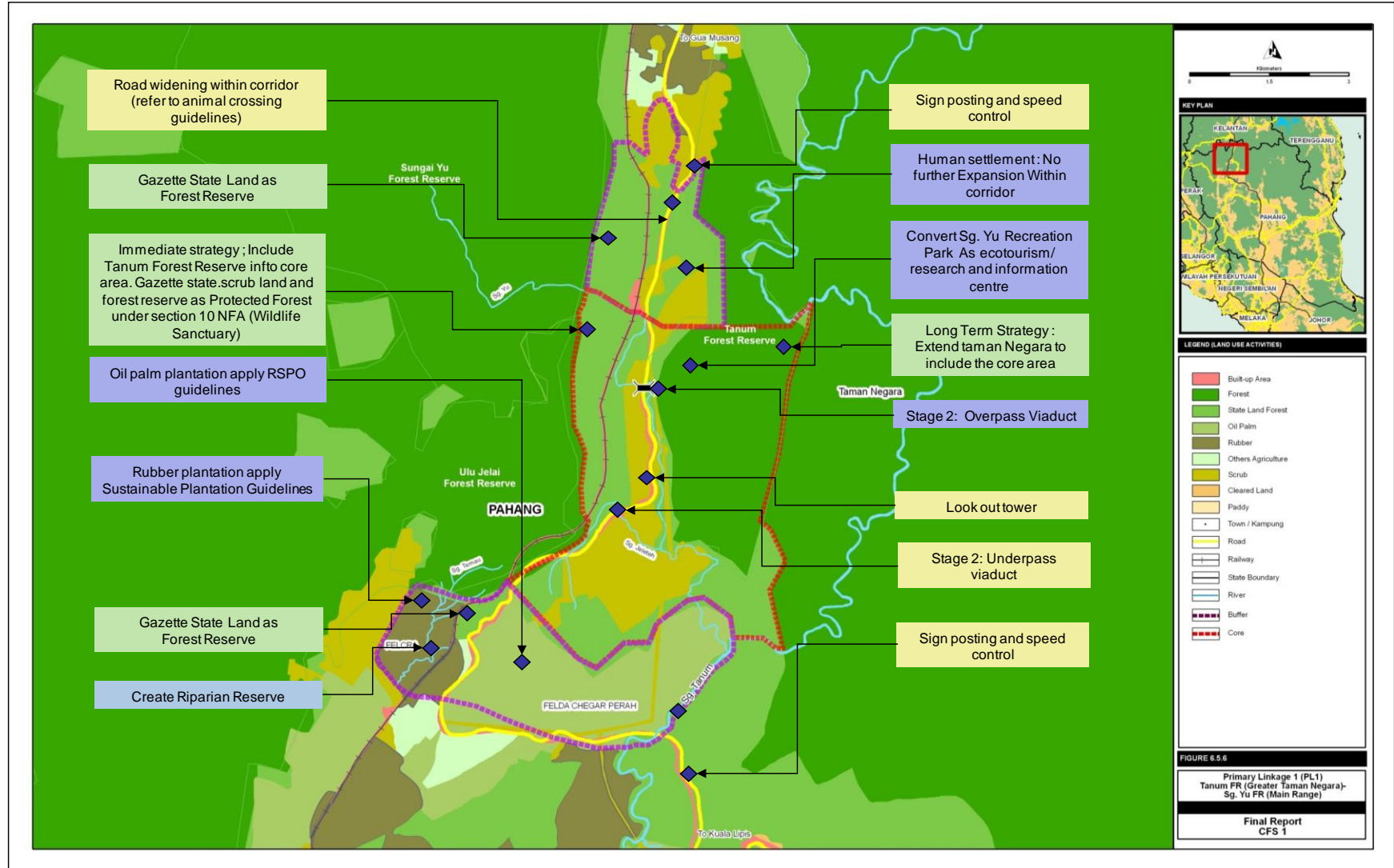
- Kenong Rimba Park
- 6) Locals residing within 20 kilometer radius from the proposed linkage should be encouraged to take advantage in business creation, such as developing ecolodges and homestay facilities. The nearest agro-tourism activities from the linkage are Agro-tourism Cegar Perah and Sg. Temau. Other villages within close vicinity to the proposed linkage are Kg. Kubang Rusa (approximately 40 households) and FELCRA Sg. Temau and FELDA Cegar Perah Satu & Dua.
 - 7) Majlis Daerah Lipis and Majlis Daerah Gua Musang need to encourage local participation in all ranges of tourism related business, including tourist accommodation, transport, travel agents, licensed tourist guides, food and beverages, souvenirs and takeaways within Merapoh, Kuala Lipis and Gua Musang Town.
 - 8) Encourage conservation, responsible tourism awareness and education, interpretation and guide trainings among locals and interested parties. Awareness signs such as with caption *“Take Nothing but Photographs; Leave Nothing but Footprints”* and *“Wildlife Crossings – Slow Down”* should be provided along Federal Route 3 and at the tourist centre. *“Slow Down – You Are Entering the Wildlife Zone”* should also be provided along the railway track to slow down trains and to increase awareness among the rail users and tourists.
 - 9) Outline visitors’ code of ethics, role and responsibilities, and monitor tourist activities within the wildlife corridor.

Figure 6.5.6 show the overall corridor development plan for PL1.

6.5.5 Forestry (Including Reforestation) (Key Initiatives)

While production forestry can continue outside of the immediate vicinity of the linkage, all tree-felling activities inside PL1 should be confined to activities consistent with the general guidelines for PIs. No significant tree planting is required although specific crossing points can be encouraged through the planting of fruit trees at strategic locations.

Figure 6.5.6: Overall Corridor Development





6.6 ENABLING INITIATIVES

Institutional, legislative support, enforcement and monitoring, cost and funding and awareness, education and communication strategy will be discussed under this chapter for the Case Study PL1. The development cost, the implementation agencies, the awareness program will be shown in detail under each sub-chapter.

6.6.1 Costs and Funding

1) Costs

Direct costs are incurred on proposed infrastructure works for PL1. They comprise road and drainage works, structural works, landscape, road signs, monitoring costs, and viewing towers.

Indirect costs arise from imputed costs of lands. Cost of lands is imputed from the average market price of agricultural lands sourced from the Property Market Report (2007). The underlying assumption is state forest lands can be put into alternative use through alienation. As market prices of agricultural land reflect location, level of maturity of crops, and types of crops, the imputed value of forest land is assumed to be lower, that is, at 25% lower.

The costs of lands include all state forestlands, scrub and grasslands, all of which are in the proposed linkage and ideally, are to be conserved to facilitate wildlife crossings. The estimated area of state forestland (1515 hectares) and scrub and grasslands (584 hectares) totalled 2,099 hectares.

Total cost of development is estimated at RM87, 703.8million (**Table 6.6.1**).

Table 6.6.1: Total Cost of PL1

Category	Cost Items	RM
Infrastructure	Road & Drainage Works	2,700,000
	Structural Works	31,950,000
	Landscaping	325,000
	Road signs	25,000
	Monitoring Devices & Maintenances	4,700,000
	Viewing Towers	300,000
	Contingency	7940000
	Sub-total	47,940,000
Awareness campaign		200,000
Imputed Cost of State Land Area: 2,200 ha	Cost of State Forests (Core & Buffer)	39,563,758
	Total Development Cost	89,643,000

Notes: (1) Average market price of land: RM75,385/ha. Property Market Report 2007 & 2006

(2) Infrastructure costs are extracted from Section 6.5

(3) Imputed annual loss in state income of RM4.8 million is not included in development cost.

2) Benefits and Potential Revenue

A major benefit from this linkage is the provision of safe passage for wildlife, allowing them to access the larger forest complexes, hence, creating the enabling environment for their sustained existence. This adds to the overall conservation of biodiversity in the country. An estimate is made to gauge the potential of the linkage as a carbon sink, based on the area that will be converted to forest reserve. The approximate area of 2,099 hectares is expected to store about 241,420 tonnes of carbon (based on 115 metric tonne of carbon stored per hectare)¹.

The current market value of carbon credits traded under the EU carbon market averages US\$50 per metric tonne. At an exchange rate of RM3.543 (Bank Negara November 2008) to one US dollar, the potential annual income raised from carbon trading could be RM42.8 million. However, it is cautious to consider a lower market price, given that there are risks and constraints in obtaining certification, coupled with the current global financial crisis that would make trading in the immediate future difficult and generate uncertainties and fluctuations in carbon prices. Based on a conservative market price of US\$30 per metric tonne, the forest reserves in the linkage could potentially raise an annual revenue of RM25.7 million. The overall development cost of RM87.7 million could be paid for from the estimated annual revenue of RM25.7 million over a relatively short period of 3 to 4 years, assuming that the carbon stored is certifiable and is able to access the carbon market.

3) Sources of Finance

The proposed key source of finance is the Federal development budget through the creation of an ecological development programme under the Federal government's multi-state development fund.

6.6.2 Institutional Support, Legislative Aspects and Enforcement

1) Institutional arrangement

At the policy level, the Sg Yu Ecological corridor will have to be approved by both the National Physical Planning Council (NPPC) and the National Biodiversity and Biotechnology Council as an important EC for large mammals especially the Malayan Tiger and Elephants. The EC should be designated in the National Physical Plan as an Ecological Corridor and an Environmental Sensitive Area. The designation should be adopted in the Structure Plan for Pahang and the Local Plan for Kuala Lipis

It may be necessary to prepare a Detail Management and Implementation plan for the EC. This could be undertaken by JPBD in association with the Forestry Department and the ECERDC. This is one of the highest ranking Ecological Corridors and is of significance to the International Community and may be used as a National Demonstration Project to show Malaysia's commitment to the International Bio- D Convention (CBD). It is possible that such an initiative may also be supported by the East Coast Economic Region Development Council (ECERDC) utilising the Councils Biodiversity Trust Fund. Other key implementing agencies will include the Forestry Department, Wildlife Department, JKR, KTM, Director of Lands and Mines and the Plantation companies in the vicinity especially Felcra Sg Tanum and

¹Weiss, J. (ed), (1994), The Economics of Project Appraisal and Environment, "Brown and Pearce, "The Economic Value of Non-Market Benefits of Tropical Forests: Carbon Storage."



Felda Chegar Perah. As a strategy forward it is also possible to prepare the Detail Plan as a Special Area Plan (Management and conservation type) under s16BTCPA

The immediate implementation strategy for this corridor is to gazette the state land forest and scrubland within the Core Area as Protected Forest (Forest Sanctuary for Wildlife) under the Forest Enactment of Pahang. The Long term strategy outlined is to include the Core Area as part of the Taman Negara. The various institutional arrangements with respect to this corridor is shown in the **Table 6.6.2**.

Table 6.6.2: Institutional Arrangements with Respect to the Sg Yu Ecological Corridor

Preparation of a Detail Plan which should include both a Physical Development Plan and a Management and Implementation Plan	JPBD in association with key conservation agencies such as Forestry Department, ECERDC, Wildlife Department and NGO's especially MYCAT and WWF This could be done as a Special Area Plan under s16B TCPA
Key Implementing Agencies	<ol style="list-style-type: none"> 1. Forestry Department 2. Wildlife Department 3. Local Planning Authority of Kuala Lipis 4. State Director of Town and Country Planning (JPBD) 5. JKR 6. KTM 7. JPS 8. Director of Land and Mines 9. Ministry of Plantation and Commodities 10. Plantation Agencies especially Felda Chegar Perah and Felcra Sg Tanum
Formulation of Rules and Regulations	<ol style="list-style-type: none"> 1. Forestry Department 2. Director of Lands and Mines 3. JPBD 4. Local Authority
Monitoring and Surveillance	<ol style="list-style-type: none"> 1. Wildlife Department 2. Forestry Department 3. NGOs including MYCAT, WWF
Education , Research and Publicity	<ol style="list-style-type: none"> 1. NRE, JPBD, Wildlife Department , Universities , NGO's 2. State Tourism Action Council

CSR initiatives should also be initiated with the plantations in the vicinity including Felda Chegar Perah and Felcra Sg Tanum to adopt sustainable plantation guidelines including the RSPO guidelines on Criterion 5.2 relating to endangered wildlife species.

Community participation and awareness raising programmes are important for the success of this corridor especially among the local village community and the Orang Asli Community in the area

2) Legislative Implications

The primary legislation used will be the National Forestry Act, the Pahang Forest Enactments, the National Land Code and Pahang Water Resources Enactment. Most of the strategies can be implemented without the need for introducing any new legislation. It is intended that by designating the core area as a protected forest (sanctuary for wildlife), the land remains a forest reserve under state jurisdiction. Expert advice may be sought from the DWNP on the management of the EC particularly with respect to animal habitats and behaviour.

The long term strategy however calls for the expansion of Taman Negara to include the Core Area of the EC. An application to this effect has to be made by the Trustees of Taman Negara to the State Authority as provided under the Taman Negara National Park (Pahang) Enactment 1939. This EC is next to the Taman Negara and by including it will provide visibility and prominence to the National Park.

Riparian reserves on existing rivers in the EC may be secured by using provisions of the Pahang Water Resources Enactment 1997. Alternatively the “riparian reserve” can also be secured under the s62 NLC in situations where the land abutting the river is State land. However in areas where the stretches of the river passes through plantation area, the riparian reserve may be have secured through a MOU with the respective plantation owners as part of the CSR initiative

Key strategies	Relevant Laws to be applied
Gazette all state land forest and scrubland within the Core area as protection forest (Sanctuary for wildlife)	S10 NFA , Pahang Forest Enactment
No further land alienation for development purpose (agriculture, building or settlement) within the corridor	National Land Code
Convert the Sg Yu Recreational forest to a different category i.e. Forest Sanctuary for Wildlife	S10 NFA
Long term strategy (Expand the boundaries of Taman Negara to include the Core Area of the EC). The application must be made by the Trustees of the National Park by resolution to the State Authority	Taman Negara National Park (Pahang) Enactment 1939
Establishing Riparian Reserve	Pahang Water Resources Enactment 2007 , National Land Code

3) Enforcement and monitoring

Enforcement and monitoring will be carried by the key agencies that have enabling laws to do so. This will include the Forestry Department. Director of Lands and Mines, and the Local Planning Authority for the Area. Although the EC is not a gazetted wildlife reserve or sanctuary, the DWNP has powers under the Wildlife Act to act against the hunting and poaching of endangered species of animals.



6.6.3 Awareness, Education and Communication

Although all primary linkage locations are invaluable for maintaining connectivity between major forest islands, not all locations are spectacular in presentation. Such is the case in Tanum-Sungai Yu. Designated as a vital link that encourages wildlife movement between the Main Range and the Taman Negara National Park, it is important to widen the ecological bottleneck that occurs here.

The key concerns regard clearing of forests on the fringes of Taman Negara and closing off the movement of animals, both predators and prey species, and the expansion of plantations to reduce habitat. To underscore its importance, the area has already been identified in the National Tiger Action Plan as a critical corridor for Malayan tigers.

The implementation strategy targets maintaining and enhancing forest habitats, ensuring plantations assist in environmental improvements and the use of existing tourism attractions to enhance biodiversity awareness and promote ecotourism activities. The priority messages to communicate to key stakeholders include:

- As a critical ecological corridor for endangered tigers, government agencies must understand the implications of land alienation and further development within a narrow band of habitats.
- Engaging the Department of Forestry is vital to maintain the integrity of core zone habitats by extending forest reserve boundaries.
- The plantation sector needs to assist in promoting sustainable practices to enhance habitats for wildlife movement and curtail expansion plans to support biodiversity protection and adhere to RSPO criteria.
- Local tourism attractions in the core zone provide an opportunity to engage in public awareness efforts and propose suitable ecotourism-related projects that do not interfere with large mammals or threaten public safety.

The following communications and awareness tools are necessary to reach out to selected stakeholders:

- 1) **JPBD-CFS Web Portal** – Implementation of CFS recommendations requires multiple agencies and organizations to be informed and engaged. The web portal serves as the primary source of information to communicate the objectives, goals and roles of all parties towards pursuing positive action. Case studies, fact sheets, corridor maps and downloadable brochures for different sectors (i.e. plantation, tourism) all aid to increase awareness among potential participants.
- 2) **Information Kiosks** – Engaging with the public directly at linkage areas is a first step for understanding the concepts of ecological corridors and their functions. Information kiosks located at Sungai Yu Recreation Area can highlight current and future activities at this high use facility. To increase awareness among the local community, other suitable sites for placement, including local caves and rest areas, need to be considered as well.
- 3) **Wildlife Safety Signs** – Ensuring safety for animals and motorists travelling on corridor roads is usually a priority. An effective safety sign awareness programme instils three key messages:-
 - A sense of importance for the surrounding habitats;
 - A sense of concern for wildlife crossings; and
 - An awareness to avoid animal conflicts and reminder to use appropriate behaviour and safe speeds.

Even with limited large mammals crossing the road, the real value is to introduce signage as a means to promote corridors and sensitise travellers to be aware of road hazards and reduced speeds.

- 4) **Ecotourism Initiatives** – Reaching out to the tourism sector requires targeted information to encourage them to offer more activities at the Sungai Yu corridor and beyond to Taman Negara National Park. Establishing appropriate walks, talks, night safaris and other non-intrusive recreational programmes enhances the overall value of the ecological core and buffer zones.
- 5) **Plantation Initiatives** – Engaging with the oil palm plantation sector (i.e. FELCRA) requires them to understand the aims of CFS to increase the integrity of ecological connections for all animals. By adhering to RSPO principles and developing management plans to protect wildlife habitats, they can play a positive role in maintaining biodiversity. For example, Wild Asia's *Stepwise Support Programme* serves to increase RSPO awareness that leads to proper planning, while its *Natural Corridor Initiative* helps rehabilitate rivers for improved wildlife passage in plantations.
- 6) **Corridor Campaign** – Special projects and special events are necessary to maintain local awareness and feature encompassing natural attributes of the Tanum-Sungai Yu linkage area:-
 - **Corridor Launch** – Primary link sites require a promotional event to kick-off conservation efforts and energize stakeholders to play an active role. Using the key corridor of Sungai Yu Recreational Area offers a chance to highlight the CFS project in Pahang and gain interest from a local and national audience.
 - **Project Cooperation** – Academic institutions are active in conducting plant and animal surveys and other work to increase scientific knowledge at local sites. In cooperation with implementing agencies, these projects stand to increase biodiversity awareness, increase local knowledge and promote CFS corridors to a broader audience.
 - **Media Tours** – Getting the media active early on requires organizing media tours to highlight CFS conservation objectives, to visit critical corridor passage sites and increase public awareness on their role to avoid human-wildlife conflicts and appreciate the efforts of project proponents.
 - **Community Outreach** – Illegal wildlife trade, poaching and wild meat consumption are problems associated with communities in and around the location. Organizing special events with school and other civic groups (e.g. MYCAT and WCS *Teachers for Tigers* Programme) addresses target groups directly.
 - **NGO Programmes** – NGOs provide a wealth of experience in promoting environmental awareness with special events. For example, MNS Special Interest Groups organize outings to see birds, reptiles, and flora and bring awareness on all aspects of biodiversity. It is advisable to use these groups to explore corridor habitats and provide information and images for public display.

07

Primary Linkages 2 (PL2) : Temenggor Forest Reserve – Royal Belum State Park

Introduction
Objective, Targets And Key Performance Indicator (KPI)
Corridor Profile
Threats, Opportunities And Constraints
Linkages Strategy
Enabling Initiatives





7.0 PRIMARY LINKAGES 2 (PL2) : TEMENGGOR FOREST RESERVE - ROYAL BELUM STATE PARK

7.1 INTRODUCTION

The Royal Belum and the Belum and Temenggor Forest Reserves comprise an ecologically integrated landscape of great biological richness, extending across the Thai border. It is well known for its spectacular large mammals and birds. It is unique with a mixture of Thai-Burma and Malaysian forest types that is not found anywhere else in the Peninsular. The Belum area is recognized internationally as an Important Bird Area (IBA). The study area has been designated as a national premier ecotourism destination.

The forest Island, which consists of Royal Belum State Park and Gerik Forest Reserve (and contiguous with Bang Lang National Park and Hala Bala Wildlife Sanctuary in Thailand) is fragmented from the rest of the Main Range forest complex by the East-West Highway. At present, there have been limited developments along the highway in Perak, between Banding Island and the Perak-Kelantan border. As such, animals are still able to move between Belum and the Main Range forest complex. An indication of this is that herds of elephants are frequently seen walking along/crossing the highway, attracted by the herbaceous vegetation growing in the cleared areas along the highway reserve. While this is a healthy sign for elephant populations, it does pose an element of danger for both elephants and vehicles.

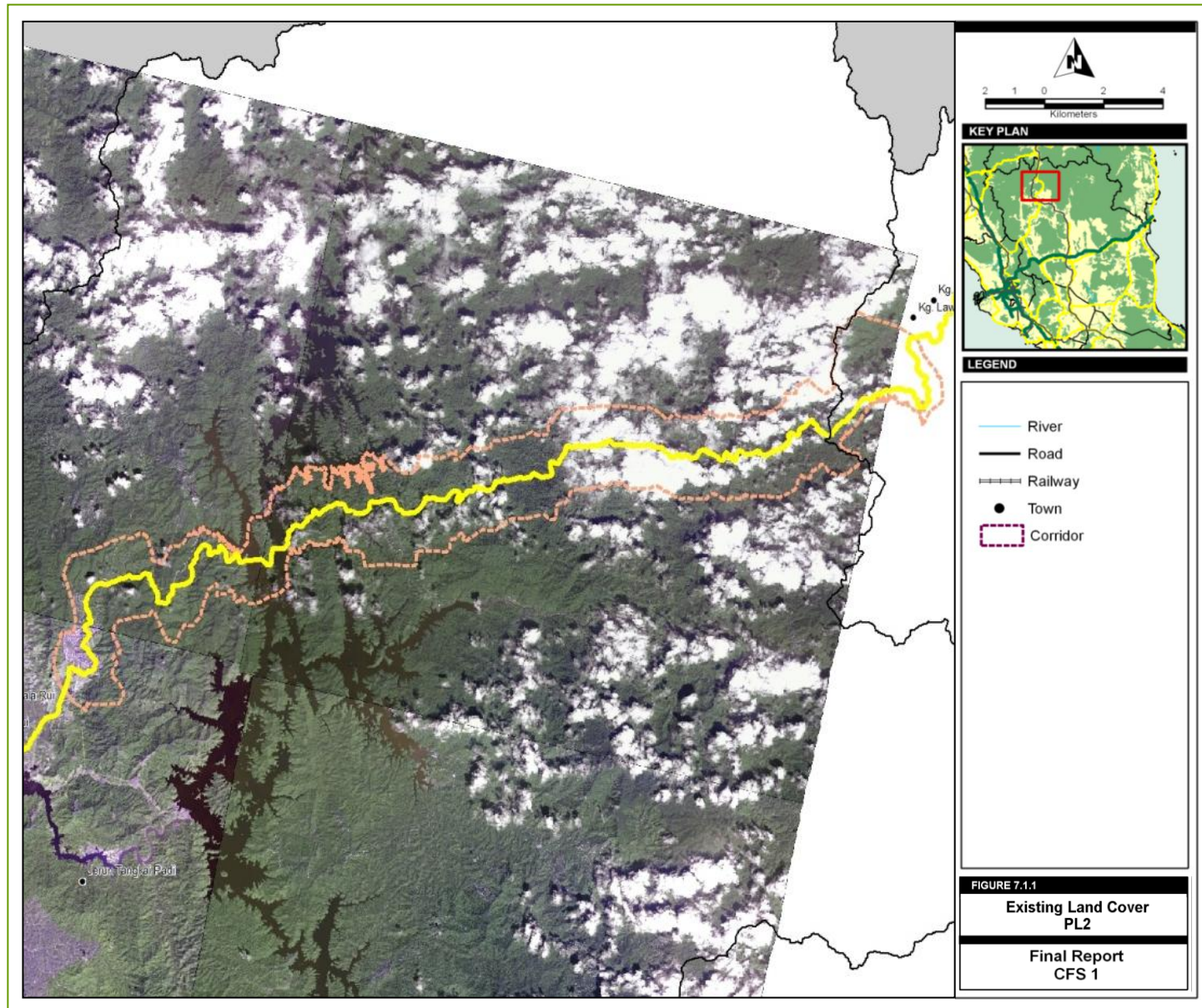
There have, however been various development proposals for agriculture, plantations, tourism and education. Any development taking place here needs to consider a number of issues. Firstly, the great importance of maintaining connectivity between Belum and Temenggor; secondly, the potential economic implications of development in an area with a high elephant population; thirdly, the feasibility of developing an area with steep terrain; and lastly, the value of keeping the area pristine (aesthetic, wilderness aspects) in generating income from eco-tourism. **Figure 7.1.1** show the existing land cover for the PL2 corridor.

7.2 OBJECTIVE, TARGETS AND KEY PERFORMANCE INDICATOR (KPI)

7.2.1 Objective

- To establish and maintain a wide, protected, forested corridor between Royal Belum and the rest of the Main Range forest complex.
- To ensure the safe passage of wild animals across this corridor.

Figure 7.1.1: Existing Land Cover



7.2.2 Targets

The general target is to maintain and enhance the functionality aspects of the corridor, i.e. in terms of its use by wildlife. The targets are therefore:

- Increase in use of corridor by wild animals.
- Decrease in mortality rates of wild animals (due to poaching and road accidents).

7.2.3 Key Performance Indicators

Key Performance Indicators (KPI) are used to measure the effectiveness of the linkage in meeting the targets. This involves biological criteria relating to species populations within the linkages as well as in the adjacent habitats, and the safe passage of species across of the corridor (in particular across the specific wildlife crossings). (Table 7.2.1)

In order to measure changes and trends, initial surveys are required to determine the baseline for all KPI.

Table 7.2.1: KPI for Achieving “Functional Linkage”

KPI	Criteria*	Survey Method
Focal species population - In the linkage - In adjacent habitats (Hala Bala Wildlife Sanctuary and Main Range)	<ul style="list-style-type: none"> • Population of focal mammal (elephant, tiger, primates) and bird species (hornbills, raptors) in the linkage and adjacent habitats. 	<ul style="list-style-type: none"> • Camera trapping programme. • Survey of animal presence. • Bird Census and monitoring programme
	<ul style="list-style-type: none"> • General status of biodiversity (species richness and abundance) 	<ul style="list-style-type: none"> • Biodiversity survey.
Usage of the wildlife crossing structures	<ul style="list-style-type: none"> • Recording and monitoring of animals using specific wildlife crossing structure (species diversity and numbers) and time and frequency of usage 	<ul style="list-style-type: none"> • Camera trapping programme. • Survey of animal presence.
Human-wildlife conflict	<ul style="list-style-type: none"> • Number of roadkills in the corridor 	<ul style="list-style-type: none"> • Monitor roadkill trends within the corridor.
	<ul style="list-style-type: none"> • Number of elephants trespassing into adjacent plantations and villages 	<ul style="list-style-type: none"> • Monitor human-elephant conflicts
	<ul style="list-style-type: none"> • Effectiveness of anti-poaching enforcement 	<ul style="list-style-type: none"> • Survey of poaching presence.

Note : * In order to measure changes and trends, initial surveys are required to determine the baseline for all KPI/criteria



7.3 CORRIDOR PROFILE

7.3.1 Physical and Land Use

This Section provides the physical and land use background information of the PL2:Temenggor Forest Reserve- Royal Belum State Park (PL2) and its surrounding region (Mukim Gerik) for assisting in the designation of ecological linkages, particularly the location and type of wildlife crossing physical structure and necessary mitigating measures, to connect the forest islands identified. It will set out the ecological linkage physical profile in terms of location and size, terrain, soil, rivers and land uses.

7.3.1.1 Location and Size

The PL2:Temenggor Forest Reserve- Royal Belum State Park ecological corridor is 70 km long and 15 km wide of predominantly forested land. It covers a relatively small area of approximately 950 km² or 9.5 hectares.

It is located within the District Hulu Perak at the right edge of Royal Belum State Park, about 30 minutes drive from the Gerik town. With the Titiwangsa R&R at roughly the central position of the corridor, it straddles along the Federal Route 4 linking the towns of Gerik and Jeli (**Figure 7.3.1**). On the left side are the Royal Belum State Park and Gerik Forest Reserve, which are an integral part of the Main Range; and on the right side is the Temenggor Forest Reserve adjacent to State Park. These natural forested habitats support a vast diversity of mammals and bird species. It has been observed that many large mammals, particularly elephants and tigers, have been using this stretch of road as a vital linkage corridor for moving between the Main Range and Royal Belum State Park. However, the Federal Route 4, as east west expressway, has acted as a barrier to wildlife movement as evident by numerous animal sightings and roadkill recordings.

7.3.1.2 Terrain

Most of the PL2 Corridor and its surrounding region are characterised by highland and highlands with steep slopes in many areas. Their elevations vary from 300m to 1,000 meter above sea level (**Figure 7.3.2**). Topographically, the PL2 Corridor comprises 15.40 percent lowland (lower than 150m), and 32.94 percent hill land and no highlands (above 300m) as shown in **Table 7.3.1**. The proposed wildlife and ecological linkages need to be located in both the lowland and hill lands to cater for the needs of as many species of flora and fauna as possible.

**Table 7.3.1: Area and Percentage of Terrain in PL2:
Temenggor Forest Reserve- Royal Belum State Park**

Elevation	Description	Hectare	Km ²	%
0m - 150m	Low Land	4,295.70	42.96	15.40
150m - 300m	Hill Land	9,187.05	91.87	32.94
300m - 1000m	Highland	14,345.45	143.45	51.43
Above 1000m	Mountain	63.52	0.64	0.23
TOTAL		27,891.72	278.92	100.00

Source: RFN



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In terms of land slope, a large portion of the PL2 Corridor is dominated by a land slope of less than 20° as shown in **Table 7.3.2**. PL2 Corridor highlighting locations of slope with varying steepness. These areas are more suitable to be proposed for ecological linkages as these less steep slope areas are suitable for wildlife movement by develop a natural viaduct.

**Table 7.3.2: Area and Percentage of Slope in PL2:
Temenggor Forest Reserve- Royal Belum State Park**

Slope Category (Degrees)	Hectare	km ²	%
0 to 11.9	2,984.25	29.84	10.70
12 to 19.9	12,826.44	128.26	45.99
20 to 24.9	2,396.07	23.96	8.59
Above 25	9,684.70	96.85	34.72
TOTAL	27,891.45	278.91	100.00

Source: RFN

Figure 7.3.1: Location Plan

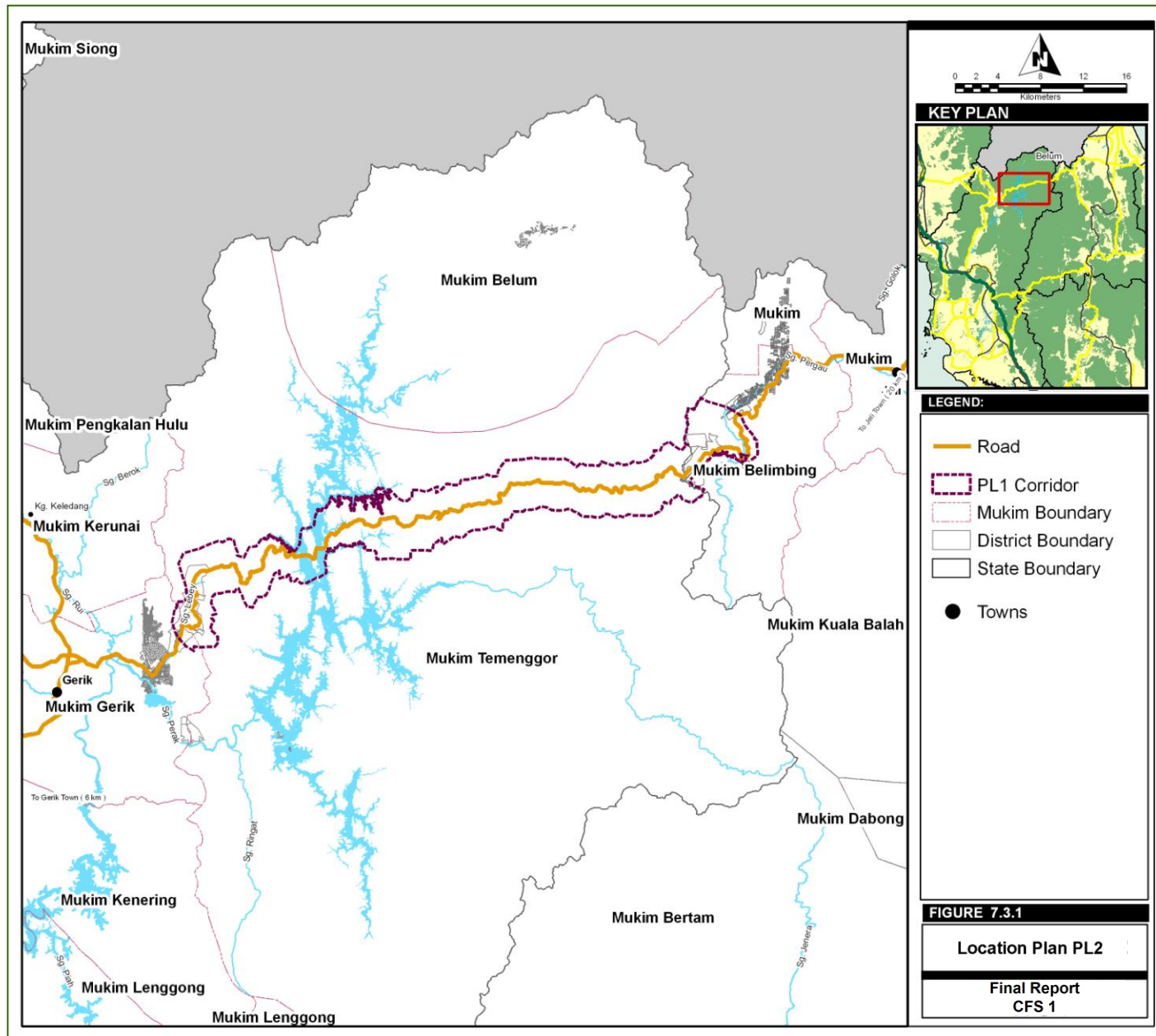
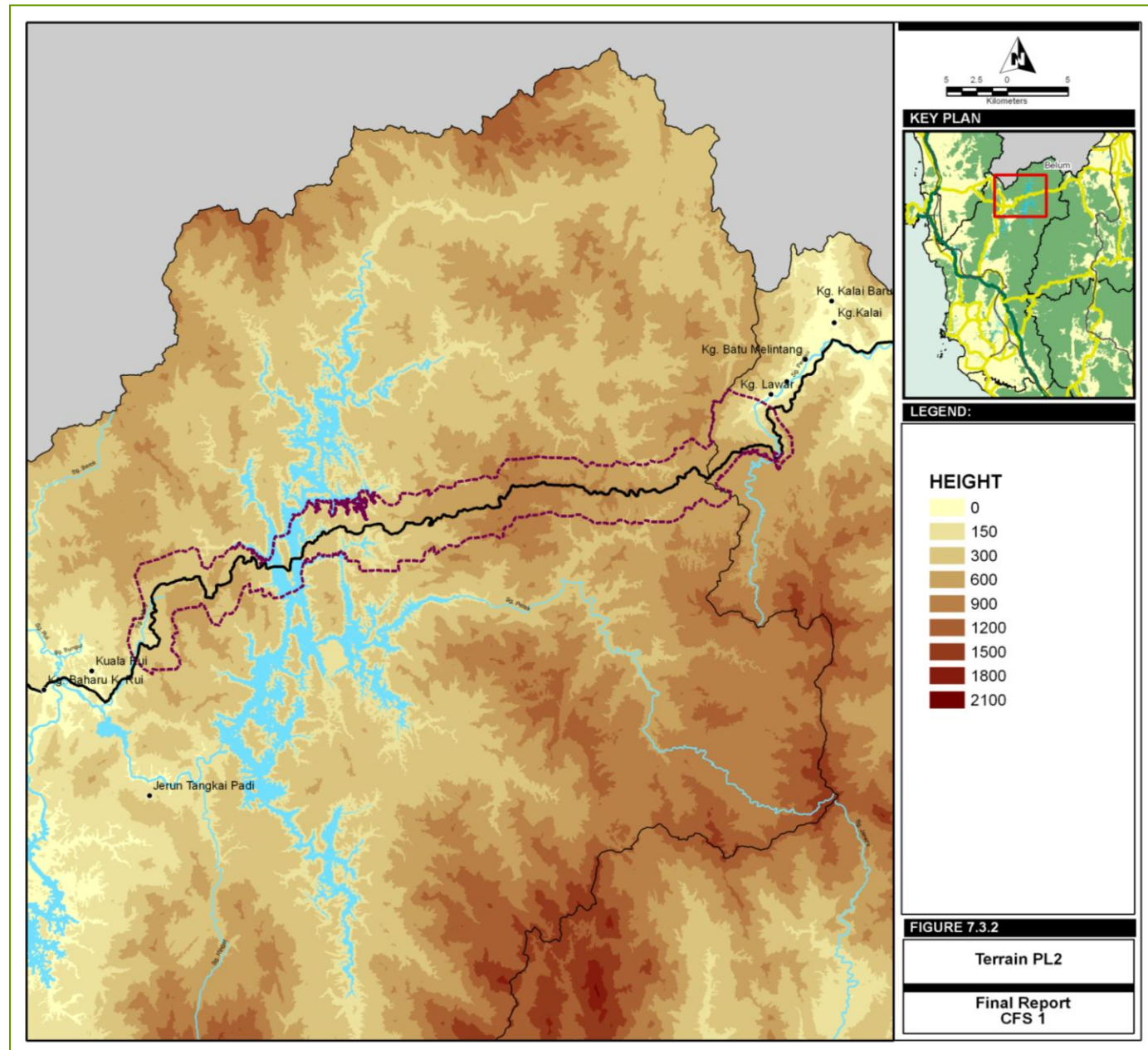


Figure 7.3.2: Terrain





7.3.1.3 Soils Suitability Classification

Soils provide the physical base for land development. Knowledge of the potentials and limitations of soil types is therefore necessary to evaluate crop production capabilities or when considering construction of buildings, infrastructure, or even the acquisition of the land for reforestation and wildlife corridor purposes. Agriculture activities are not suitable on soils which are characterized by poor filtration, slow percolation, flooding/ponding, wetness, steep slope and subsidence. These areas that are deemed as unproductive for agricultural crop production may be reclaimed and restored as forested corridors that function as wildlife crossings and as ecological linkages. (Table 7.3.3)

Table 7.3.3: Area of Soil Suitability Class in PL2 Corridor

Soil Class	(Area) Hectare	km ²	%
Class 2	173.76	1.74	0.6623
Class 4	133.00	1.33	0.5062
Class 5	25,965.30	259.65	98.8315
TOTAL	26,272.06	262.72	100.00

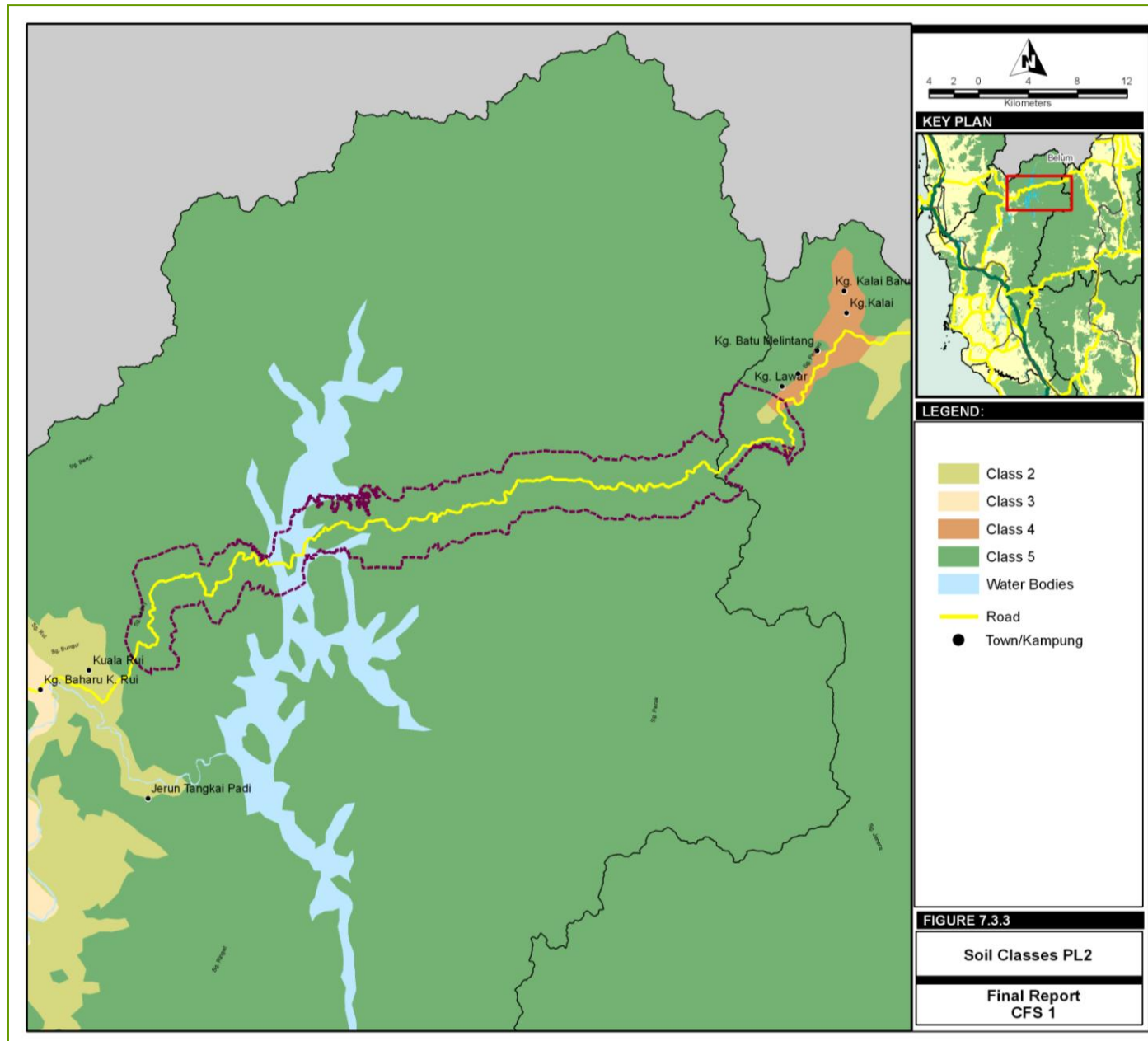
Notes:

- Class I Soils with no limitations to agricultural development.
- Class II Soils with few minor limitations to agricultural development. It can support a wide range of crops.
- Class III Soils with one serious limitation to agricultural development. It supports a limited range of crops.
- Class IV Soils with more than one serious limitation to agricultural development. It is only marginally suitable for crops.
- Class v Soils with more than one very serious limitation to agricultural development. This group is not recommended for any crops.

Source: RFN

The soil class analysis indicates the land suitability for agricultural development. Most of soil (99 %) in Jerantut District is Class V i.e. soils with more than one very serious limitation to agricultural development thus which are not recommended for crops. The major limiting factor is the terrain. A significant proportion of soil (0.51%) is in Class IV which is only marginally suitable for crops. This is due largely to the steep slope, high terrain and type of soil. Only the narrow strips of alluvial along the river banks are suitable for a limited range of crops. This implies that the PL2 Corridor area is best conserved as forested areas which can serve as animal habitats. (Figure 7.3.3)

Figure 7.3.3: Soil Classes





7.3.1.4 Rivers or Lake

The major lake draining this area is Tasik Temenggor which is between Royal Belum Forest Reserve and Temenggor Forest Reserve (**Figure 7.3.4**).

7.3.1.5 Land Use

Except for a few government buildings and orang asli settlements along the Gerik- Jeli road, very little development has occurred in and around the proposed PL2 Corridor (**Figure 7.3.5**). This is due largely to its remote and rural location and weak economic base. It is situated far away from the mainstream Central Growth Corridor (i.e. Klang Valley-Kuantan corridor along the East Coast Expressway Phase I) and is dependent mainly on low value-added resource- and agriculture-based economic activities (i.e. agriculture, ecotourism and logging).

Within the PL2 corridor, the predominant land use is forest which makes up about 85.20% of land as depicted in **Table 7.3.4**. The forests are bisected by the Federal Route 4 with about 400 meters of Stateland forest, scrub and grassland running along it on both sides. Scrub areas consist of 5.25% of the area and may be able to reclaim as forest area for connectivity purposes. There are some rubber and oil palm agriculture plantations owned by FELDA along both sides of the road at the western tip. It is important to note that the whole PL2 Corridor is defined as ESA Rank 1 except for the agriculture areas.

Table 7.3.4: Existing Land Use 2006 for PL2 Corridor

Landuse	(Area) Hectare	km ²	%
Built-up Area	480.55	4.81	1.72
Cleared Land	123.39	1.23	0.44
Forest	23,748.51	237.49	85.20
Grassland	445.23	4.45	1.60
Oil Palm	7.37	0.07	0.03
Others Agriculture	90.01	0.90	0.32
Rubber	299.33	2.99	1.07
Scrub	1,464.75	14.65	5.25
Water Bodies	1,214.76	12.15	4.36
TOTAL	27,873.88	278.74	100.00

Source: RFN

The nearest towns from PL2 Corridor are Gerik with a population of 28,438 people located 25 km to the west, and Planning Block Royal Belum with a population of 1,193 people situated right to the north. Built-up areas mostly at Banding Island and mainly are Eco-tourism and research buildings. While the built-up area covers a very small portion of the PL2 area, it is concentrated in the centre of the area, and therefore will impact on the location and type of wildlife crossing and mitigating measures to be taken to protect the safety of the residents.

The Hulu Perak Local Plan has indicated major development proposal in and around the PL2 area will be developed new agriculture land for herbal and oil palm plantation.

Figure 7.3.4: Hydrology

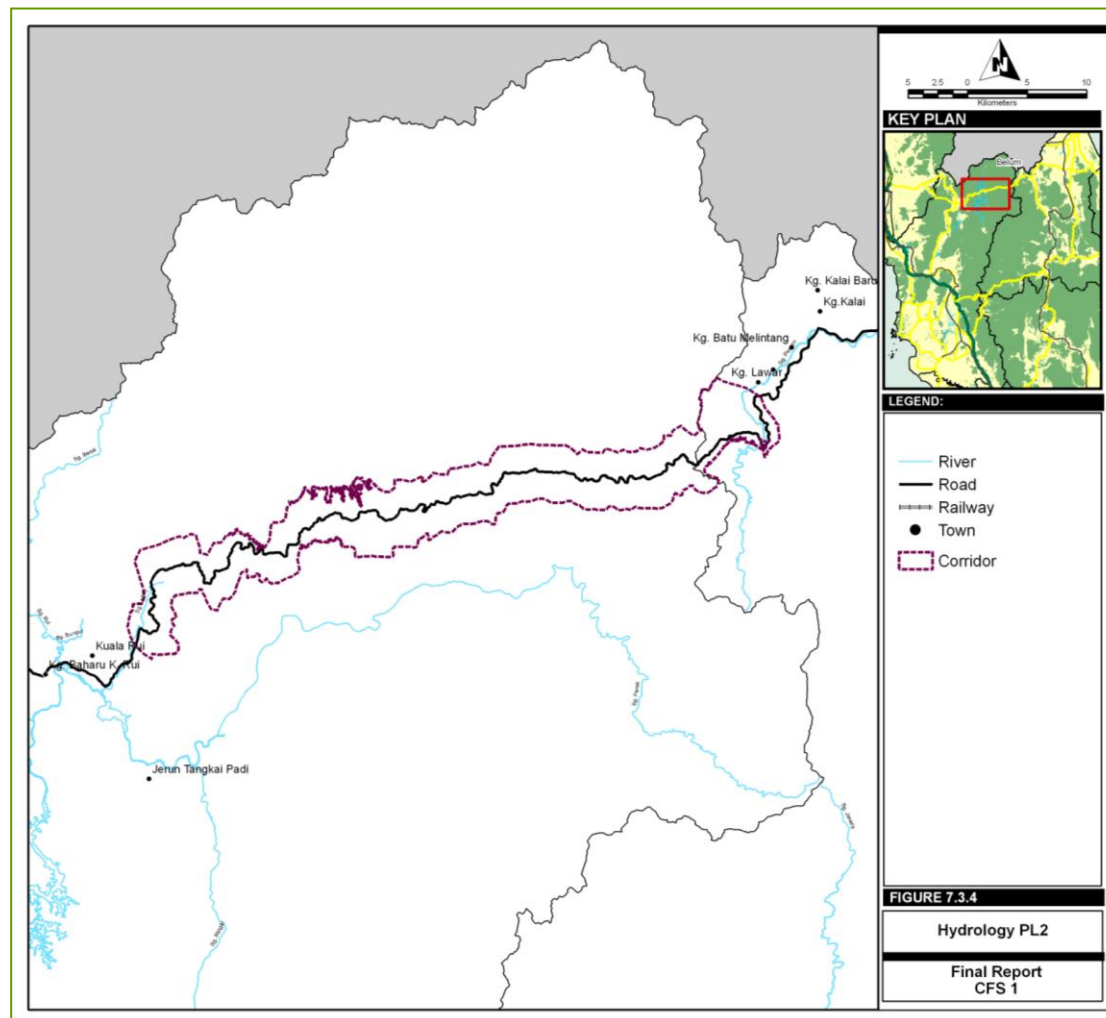
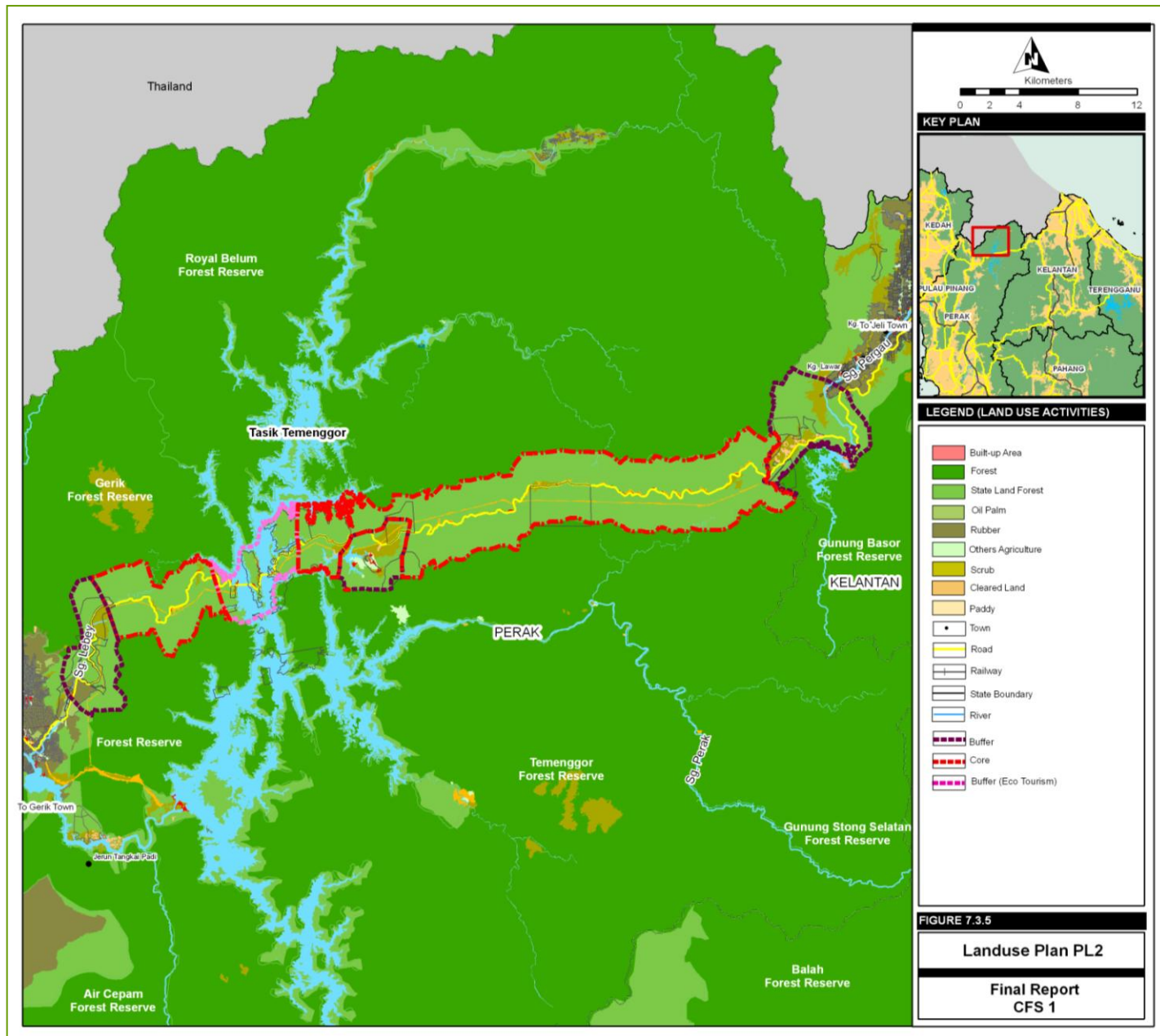


Figure 7.3.5 : Landuse PL2





7.3.2 Biological

1) High Conservation value forest

Both the Royal Belum State Park and Temenggor Forest Reserve are known to be particularly rich in wildlife. In particular, it is known that there are a number of salt licks in the vicinity which are visited by large mammals. Further research is required into the specific locations of salt licks and the movement of animals around them. Nevertheless, the connectivity of the surrounding forest can safely be said to be particularly important for elephants. Furthermore, large trees in general and fruit trees in particular have an exceptional importance in this area due to the abundance of hornbills. **(Refer Figure 7.3.6)**

2) Wildlife Habitat

Royal Belum State Park is an important conservation area recently gazetted by the Perak State Government. The area, next to the borders between Malaysia and Thailand, covers some 117,500 ha of the total 300,000 ha of the Belum and Temenggor Forest Reserves. The forested areas here are unique because it represents a mixture of the Thai-Burma and Malaysian types and it is not found elsewhere in the Peninsular. The establishment of the Royal Belum State Park clearly opens up the opportunity to link this with other conservation areas in Thailand (Hala-Bala Wildlife Sanctuary) which, together with the remaining part of the Belum Forest Reserve and Temenggor Forest Reserve in the south, will create perhaps the largest single protected area on the Malay Peninsular.

This forest complex is an irreplaceable haven for biodiversity as it supports over 3,000 species of flowering plants, 274 types of birds, 100 different types of mammals and many more. It has the highest concentration of hornbills in a single forest complex anywhere in the world; and above this, records an unprecedented global phenomenon with the congregation of over 2,000 globally threatened Plain-pouched Hornbills recorded in just one evening.

The outstanding value of this single large block of mostly prime forested areas as a large landscape ecosystem supporting large mammal populations such as the Asian Elephant, Sumatran Rhinoceros, Malayan Tiger, Gaur (Seladang), Leopard and Malayan Tapir would be compromised if its components are fragmented and isolated from each other by monoculture plantation and other non-forest landuse along the major parts of forest at both sides of the East-West Highway. These populations desperately need large forest areas to survive, and the Belum-Temenggor-Thai forest complex is perhaps the last such refuge left in Malay Peninsula.

Elephants can be seen almost any day, browsing amongst the vegetation along the highway. Since the verges have been opened up to light, elephants have been attracted to the herbaceous growth that has flourished there. Instead of converting the forest to monoculture plantation, this corridor could be 'farmed' for elephants and tourists: the former coming for food, the latter for the wildlife experience of a lifetime - seeing large wild animals in their natural habitat.

It is also recognized internationally as an Important Bird Area (IBA) - an area designated as being globally important habitat for the conservation of bird populations. **(Refer Figure 7.3.7)**

Figure 7.3.6: Forest

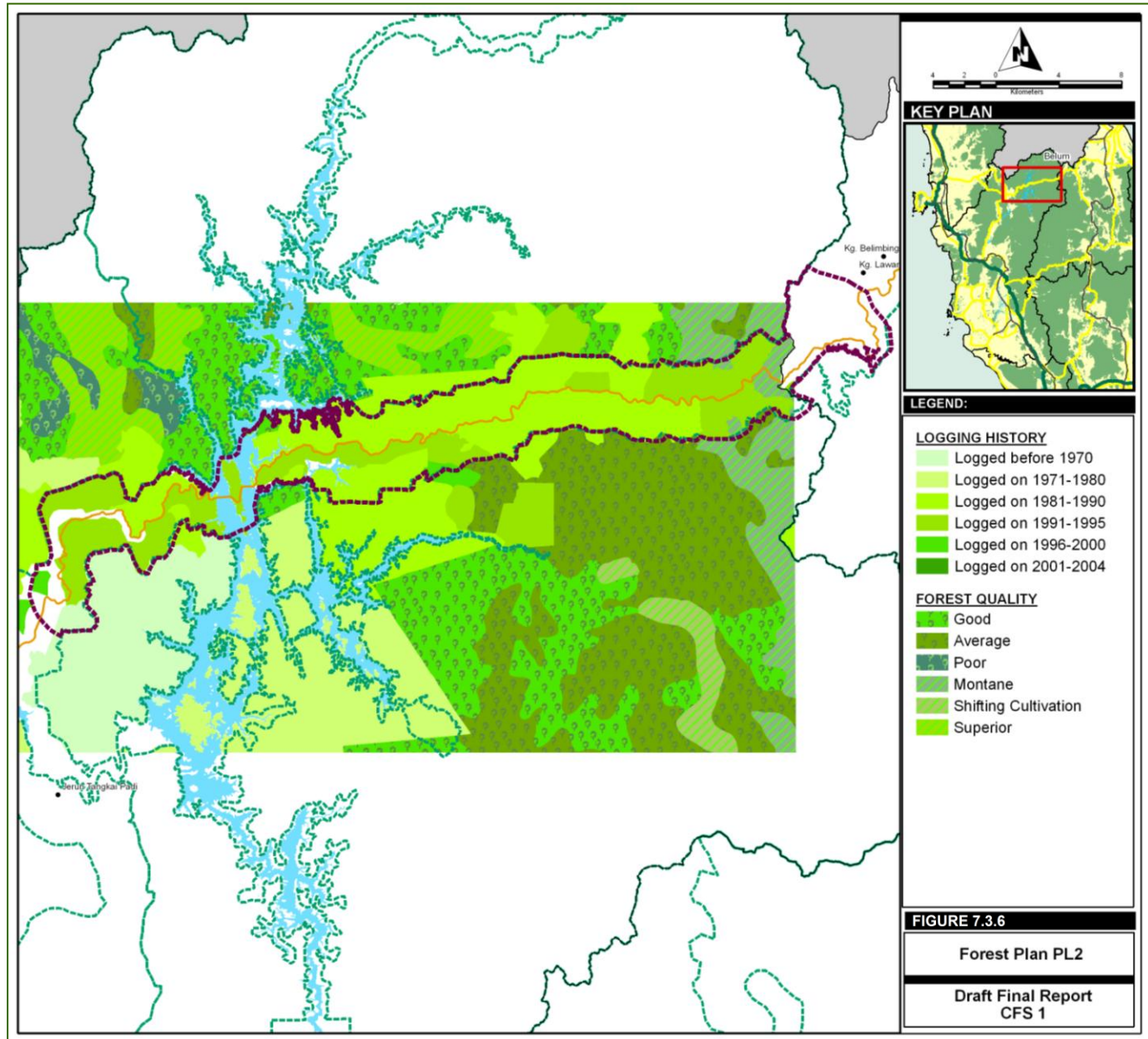
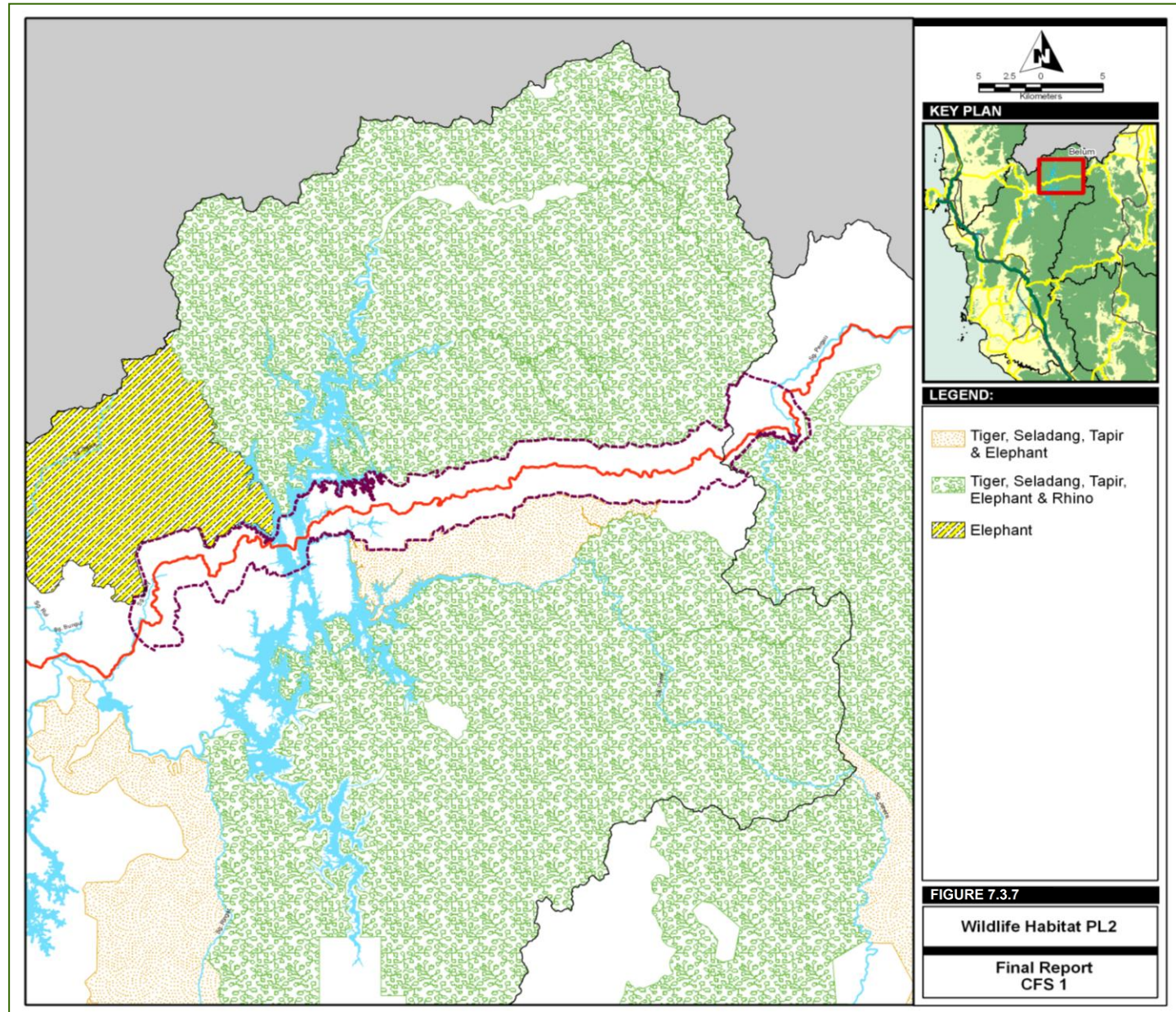


Figure 7.3.7: Wildlife Habitat



WWF-Malaysia has been conducting rhinoceros population surveys since 2007, and anti-poaching patrols in RBSP and along the Gerik-Jeli highway to reduce poaching presence since 2008. The results from current surveys of animal movements along the highway will be used to refine existing GIS least-cost path models to identify suitable corridors.

WWF has set camera traps in the Royal Belum State Park and Temenggor Forest Reserve for many years. The camera record shows that there are rich wildlife in the FR. **Figure 7.3.8** shows the animals living in the forest reserve.

Figure 7.3.8: Animal Found in the FR near PL2 Corridor





Wild boar family found in the Royal Belum State Park



Seladang found in the Royal Belum State Park



Tiger found in the Taman Negara



Elephant found in the Royal Belum State Park

3) Environmental Sensitive Areas

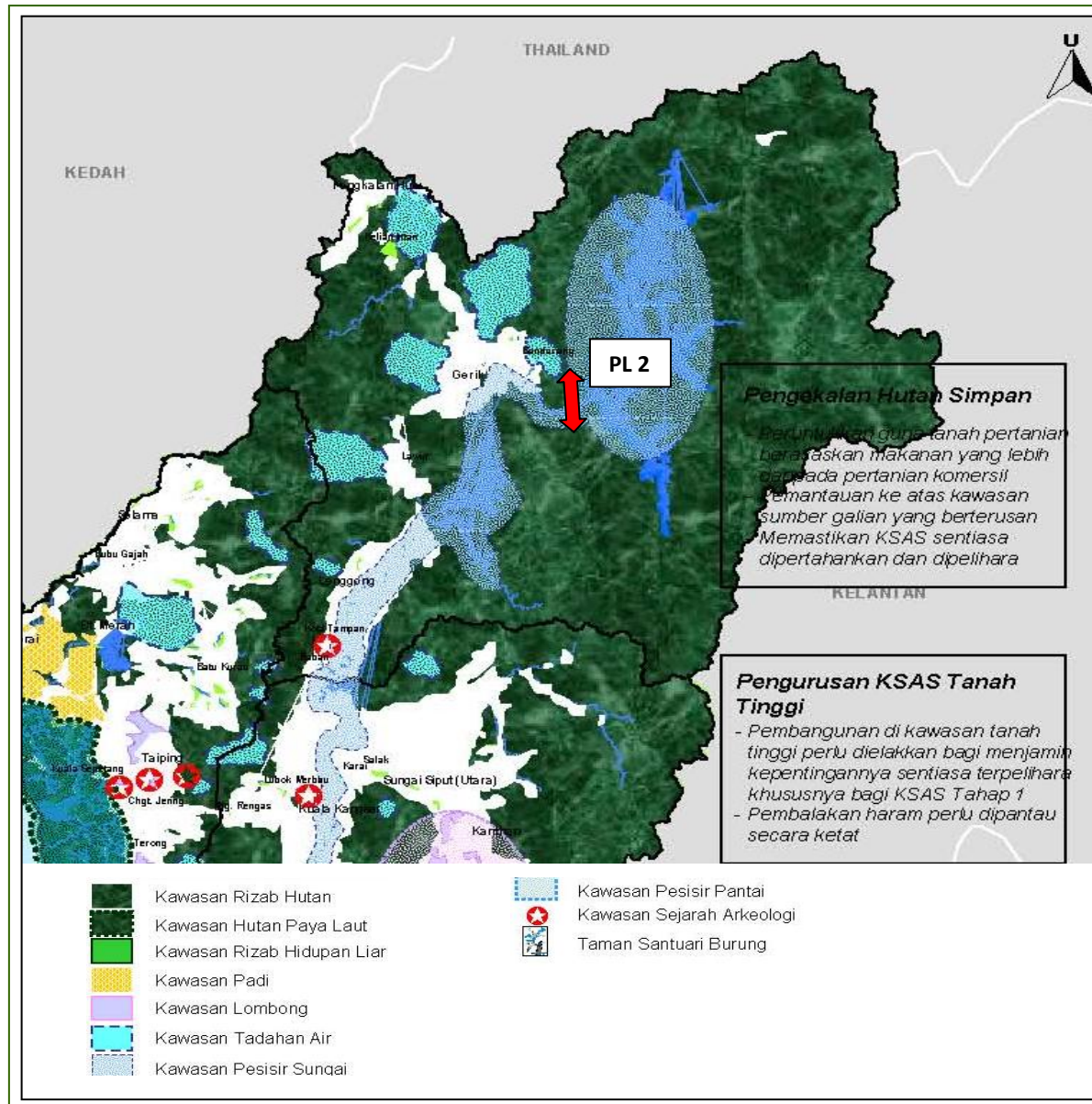
NPP 18 of the National Physical Plan (NPP) states that Environmentally Sensitive Areas (ESA) shall be integrated in the planning and management of land use and natural resources to ensure sustainable development.

The ESAs are further refined, expanded and delineated at the Structure Plan and Local Plan levels. The application of ESAs at the NPP, Structure Plan and Local Plan levels are given in **Table 7.3.5. (Refer Figure 7.3.9 and Figure 7.3.10)**

Table 7.3.5: Application of ESAs for PL2

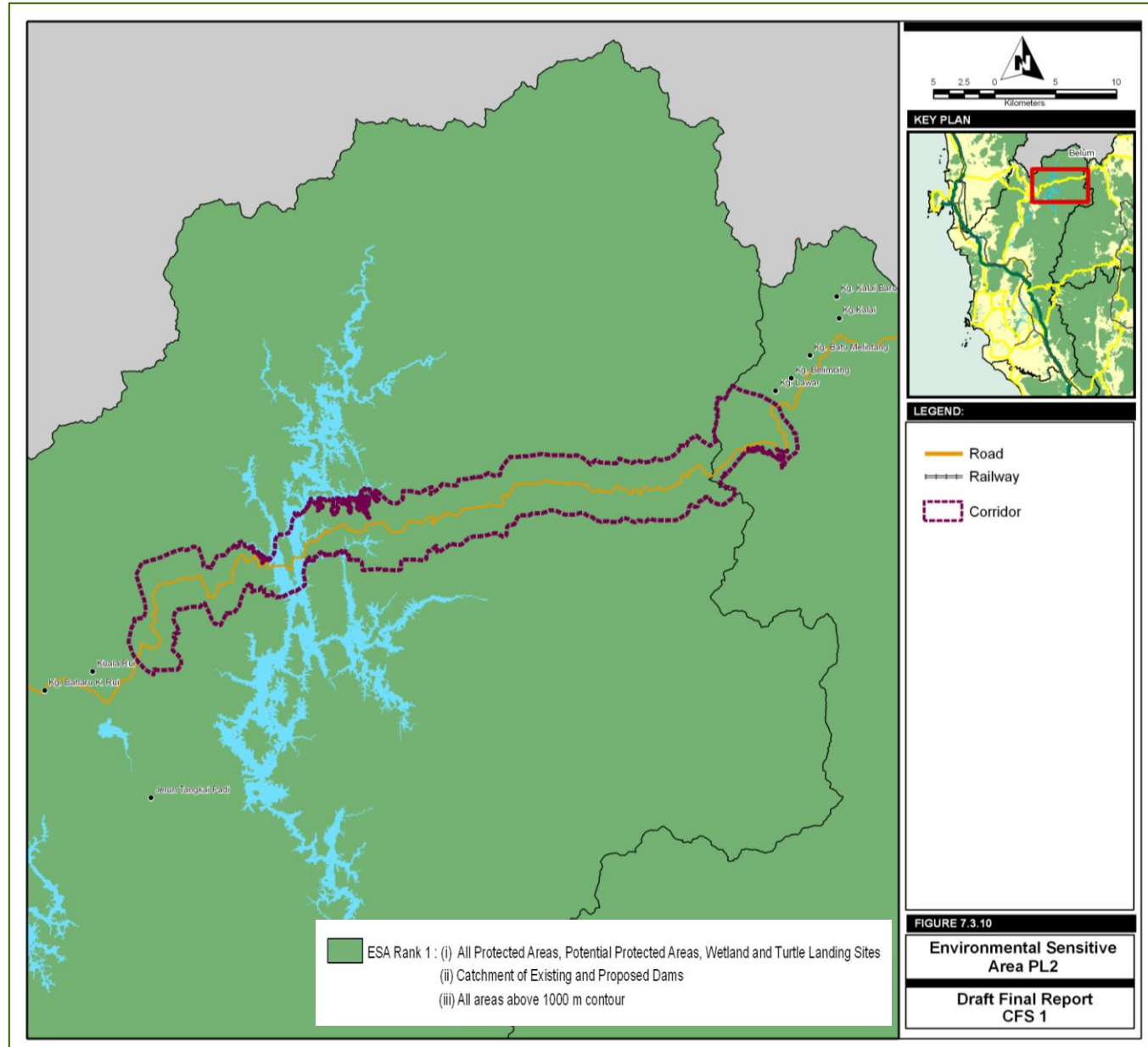
Spatial Plan Level	ESA Ranking	Notes
National Physical Plan	Rank 1	The entire northern section of the Main Range, including Belum Forest Reserve and Temenggor Forest Reserve were designated as ESA Rank 1 in the NPP.
Perak Structure Plan 2020	N/A	<p>The plan specified two thrusts for ESAs, i.e.:</p> <ol style="list-style-type: none"> 1) Strengthen the control mechanism on the State's environment towards achieving zero pollution by 2020. A key step to achieve this is to tighten the rules and regulations in existing acts relating to preventive measures for large-scale economic activities at ESA areas such as logging, tourism and agriculture. Activities carried out in ESAs with potential impacts on the environment should be thoroughly scrutinized. 2) Formulate an integrated management plan for ESAs, for environmental conservation and sustainable development of natural resources. Four steps were outlined for the plan: <ol style="list-style-type: none"> i. Identify, delineate and gazette areas of high conservation value; ii. Include all eight categories of ESAs in the State's Management Plan for ESAs; iii. Implementation and monitoring of the State's Management Plan for ESAs should be based on fixed ESA indexes namely Level I (fully conserved and protected), Level II (restricted development with tight limitation) and Level III (controlled development); iv. Prepare a work plan for development of natural resources in the state with potential to be development sustainably. <p>In was highlighted in the fourth step that conservation of forests of "international importance" included in the 'Central Forest Spine' should have minimum disturbance.</p>
Hulu Perak Draft Local Plan 2002-2015	N/A	<p>The ESA categories in this plan are vague, and it is not clear whether ranking is used. For example, while Royal Belum is classified as ESA Rank 2; Temenggor is not ranked, while the overall ESA plan does not even utilize a ranking system, but specific classes of ESA (e.g. catchment forest, research forest, wildlife forest, virgin forest).</p> <p>While this makes it difficult to interpret the plan, a number of points should be taken into account:</p> <ol style="list-style-type: none"> i. A blanked statement made for Planning Block 9 (Temenggor), which includes the areas along the Gerik – Jeli road, is that large scale development projects are not allowed here to protect the flora and fauna. ii. The area within PL2 (including Royal Belum and Temenggor FR) is afforded a mosaic of two ESA categories, which sometimes overlap, namely: <ul style="list-style-type: none"> - Elevation over 150m - Steepness over 25°

Figure 7.3.9: Environment Management Perak State



Source : Structure Plan Perak State 2001-2020

Figure 7.3.10 : ESA



7.3.3 Socio Economics

7.3.3.1 Population and Socio Economic Profile

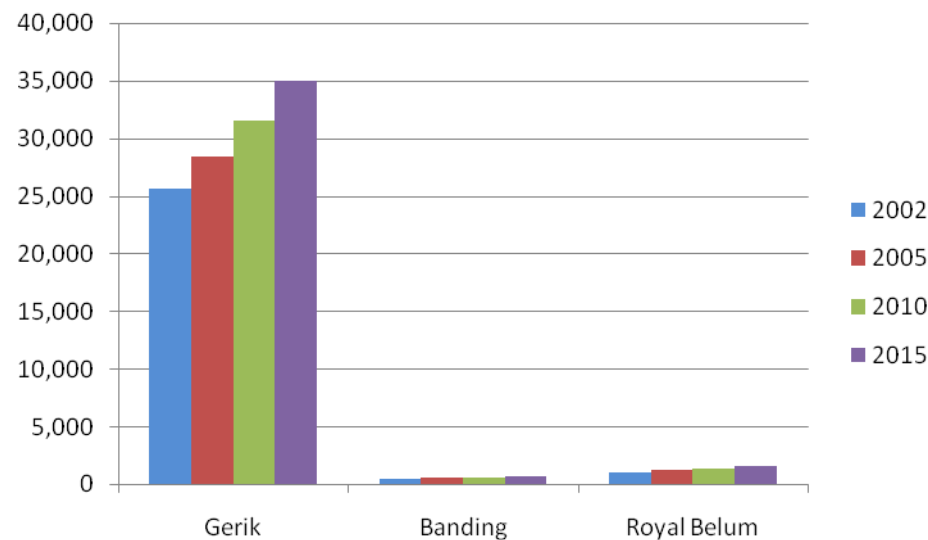
Within the PL2, besides the Pulau Banding has developed for the eco-tourism use, the whole stretch along the road, there is not human settlement because the slope is steep and this is a highland area. Some of the area within this corridor is flat and there are orang asli settlements, oil palm plantation and rubber plantation. According to the local plan, there will be Herbal Park within the corridor. And latest information from Land Office Gerik, several areas within PL2 has been proposed for education, plantation and eco-tourism development.

Within the corridor, the populations are for orang asli settlements (Orang Asli Banun). While most of the people stay at the Gerik town which is around 15-20km from Pulau Banding. **Table 7.3.6** and **Figure 7.3.11** show the population projection from 2002 to 2015.

Table 7.3.6: Population Projection 2002-2015

Town/Year	2002	2005	2010	2015
Gerik	25,631	28,438	31,552	35,007
Banding	443	523	570	616
Royal Belum	1,029	1,193	1,383	1,603

Figure 7.3.11: Population for Gerik, Banding and Royal Belum from 2002 to 2015





7.3.3.2 Socio perception to Ecological Corridors

The Belum-Temenggor ecological linkage area represents a unique situation due to its history. Established as a “black area” during the communist insurgency, Belum was off-limits to development and tourism for decades. On the Temenggor side, the dam displaced some Orang Asli communities into settlements within the core zone. In general, there are no other communities in the corridor and buffer zones until reaching both ends at Gerik and Jeli.

Social perception of the corridor is difficult to qualify without much human activity beyond the Pulau Banding tourism zone. Although traffic is heavy along the East-West Highway, there have been no concentrated efforts to survey motorists or visitors stopping along the corridor on its scenic and natural attributes.

Several organizations are active with communities associated with the corridor. In Gerik, MYCAT conducted a workshop for school kids and their parents to learn about tiger conservation and problems with wild meat consumption. WWF Malaysia carried out the Tigers Alive! Programme in Jeli to mitigate human-tiger conflicts among villagers, especially rubber plantation smallholders. WWF is currently monitoring the Gerik to Jeli highway for elephant and other animal movements.

To gain further insights into community concerns, visits were made to two Orang Asli settlements inside the core zone and one settlement on the Temenggor Lake that receives tourists from Pulau Banding. Officials from Jabatan Hal Ehwal Orang Asli and the Department of Wildlife and National Parks accompanied us on these site visits.

The primary concerns relating to communities and people visiting areas within the corridor are the following:-

- 1) **Public Safety** – Observations made by DWNP and other groups highlight the need to protect the public from elephant confrontations along the highway. Warning signs at entry points urge motorists to slow down and practise appropriate behaviour (e.g. no honking, do not panic). However, nightly outings by elephants – up to ten in a group - to feed adjacent to the highway exposes both the animals and vehicles to constant danger. Despite few harmful incidences, the potential for deaths of motorists is a real threat. DWNP continues to monitor the situation and plans to find ways to keep elephants from using and feeding along the highway.
- 2) **Community Safety** – Orang Asli settlements in the core corridor zone are subject to harassment from elephant attacks. It is near impossible to grow fruit trees, crops and vegetables without attracting elephants. Even cooking causes problems as elephants have damaged homes to get to salted foods. In addition, staff at the local school is afraid of conflicts with elephants searching for food near the compound. There is no training from DWNP on how to handle elephant intrusions. The Orang Asli try to scare them away with torch lights.
- 3) **Tourism Opportunities** – At present there are only a few businesses operating in the corridor zones. Emkay operates Belum Rainforest Resort on Pulau Banding, the takeoff point for trips to Royal Belum and Temenggor Lake. There are smaller operators on Pulau Tikus and DWNP runs an ecotourism facility on Pulau Perhentian. The potential exists to use the proximity and access of Orang Asli settlements very close to the ecotourism zone. Communities are agreeable to pursuing homestay programmes, guide services and establishing wildlife observation posts or other types of activities that bring tourists to their area.



- 4) **Business and Income Earning Opportunities** – The lack of electricity in Orang Asli settlements continues to be a major problem. Without proper food storage and lighting, most activity relates to obtaining food and sourcing forest products and produce. These conditions are not suitable for trying to establish businesses. Some villagers want to plant rubber plantations in nearby areas after logging operations cease. Under a JHEOA programme, one sundry and handicraft shop (Warisan Jahai) has been established at the Pulau Banding jetty.

The opportunity exists to showcase the benefits of the CFS project at Belum-Temenggor. Without much human activity and excellent wildlife habitat remaining, it is advisable to develop pilot projects to cater to public and community safety, and ensure ecotourism ventures are spread among different socio-economic groups.

7.3.3.3 Land Status

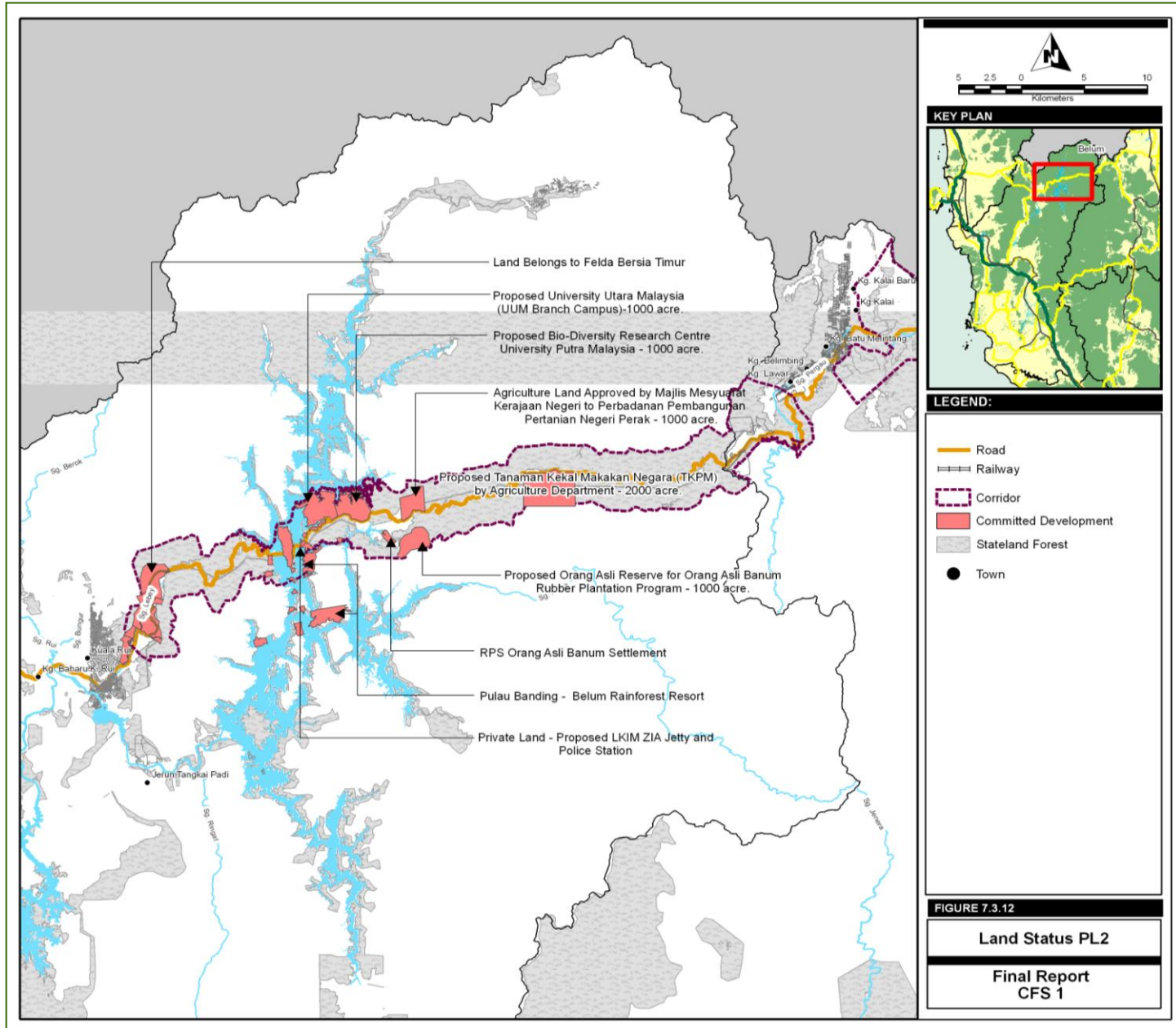
PL2 located between Gerik Town to Perak-Kelantan Boundary. For the stretch from Gerik town to right 15km of Pulau Banding, is under Gerik Local Authority administration while from the right 15 km of Pulau Banding until the Kelantan-Perak boundary, it will under Local Planning Authority.

Along the road, there are several developments such as military camp, Pulau Banding Eco-tourism development which include resort and research centre, Puncak Baring or R&R, orang asli settlements and etc. Latest application for the development along the road and within the corridor will be shown in the **Table 7.3.7**. **Figure 7.3.12** shows the location for the development proposal.

Table 7.3.7: Development Proposal within PL2 Corridor

Proposed Development	Land Category
Land belongs to Felda Bersia Timur	Private land/ agriculture
Pulau Banding – Belum Rainforest Resort	Existing and committed /building
Private land- proposed LKIM ZIA jetty and police station	Existing and committed
Proposed University Utara Malaysia (UUM Branch campus)- 1000 acre.	Approval in principle
Proposed Bio-Diversity Research Centre University Putra Malaysia-1000 acre	Application
Agriculture land approved by Majlis Mesyuarat Kerajaan Negeri to Perbadanan Pembangunan Pertanian Negeri Perak-1000 acre.	Approved
Proposed Tanaman Kekal Pengeluaran Makanan (TKPM) by agriculture department- 2000 acre.	Committed/agriculture reserve
RPS Orang Asli Banum Settlement	Existing/ state land
Proposed Orang Asli Reserve for Orang Asli Banun Rubber Plantation Program-1000 acre	Committed/ agriculture

Figure 7.3.12: Land Status





7.3.3.4 Agriculture Activities

1) Disturbance and Threats

The principle threats to the linkage are a number of agricultural projects that are either ongoing or being planned along the East-West Highway, both in the core areas as well as in the buffer areas (**see Figure 7.3.13**). The projects that have been planned include:-

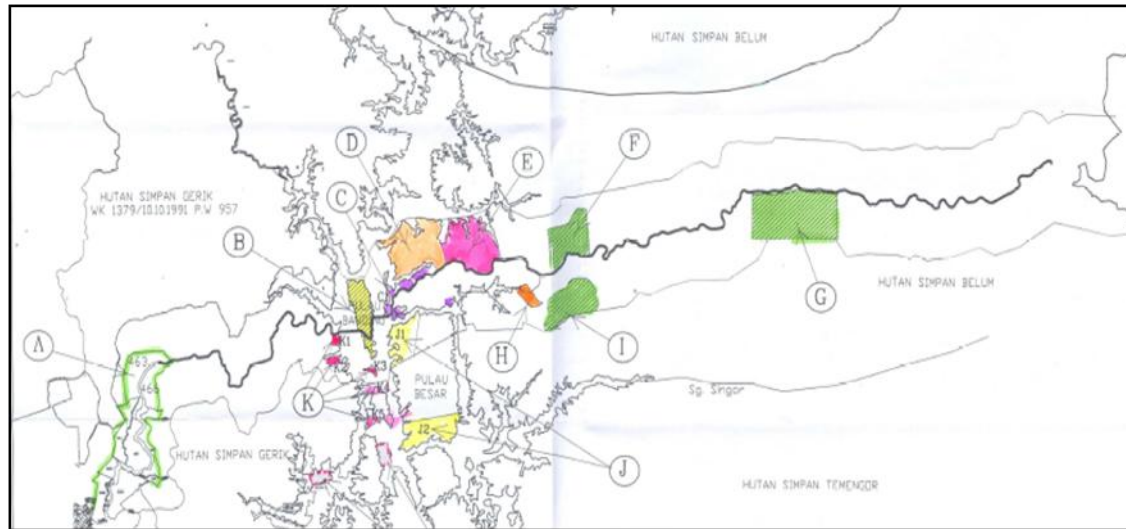
- i) Development of highland agriculture in Puncak Baring (2,000 acres) under the Permanent Food Park Zone concept by the Department of Agriculture (**see G in Figure 7.3.13**). This project has been approved by the state government
- ii) Development of Rubber under FELDA Bersiar Timur (about 1,000 acres). This land Lot 463 and Lot 466 is owned by FELDA (**see A in Figure 7.3.13**)
- iii) Freshwater Fisheries Complex in Lot 474 and Lot 475 under LKIM. This project is already ongoing and committed (**see C in Figure 7.3.13**)
- iv) Agriculture plantations most probably rubber (1,000 acres) under the State Agricultural Development Corporation (SADC) (**see F in Figure 7.3.13**). The project has been approved by the state government
- v) Land settlement schemes (RPS) for orang asli in Banun. This project is ongoing (**see H in Figure 7.3.13**)
- vi) Rubber Planting Scheme for orang asli in Banum (1,000 acres) (**see I in Figure 7.3.13**). This project is a committed project.

2) Soils and Land-Use

There is no soil-type information on this area as the area is located in the highland and is in the forest reserves. Due to its steep topography, the area is generally categorised as Class V in the Soil Suitability Classification with very serious limitation to agricultural development. As such the area is regarded as unsuitable for extensive agricultural development. In general soils developed on steepland areas are generally shallow and juvenile and are not suitable for agriculture.

Since the proposed primary linkage (PL2) is in the forest reserve, there is no agricultural development in the region except for some cleared land and grassland along the road. There is some attempt to develop highland agriculture in Puncak Baring under the Permanent Food Park Programmes of the Department of Agriculture Perak. However the programme is thwarted somehow due to conflicts with wild elephants. There is some agricultural development however just outside of the buffer areas on the east and west of the linkage where rubber crops are planted. **See Figure 7.3.14** for the existing agriculture use for the PL2.

Figure 7.3.13: Agricultural Development Planned Along the Gerik-Jeli (East-West) Highway



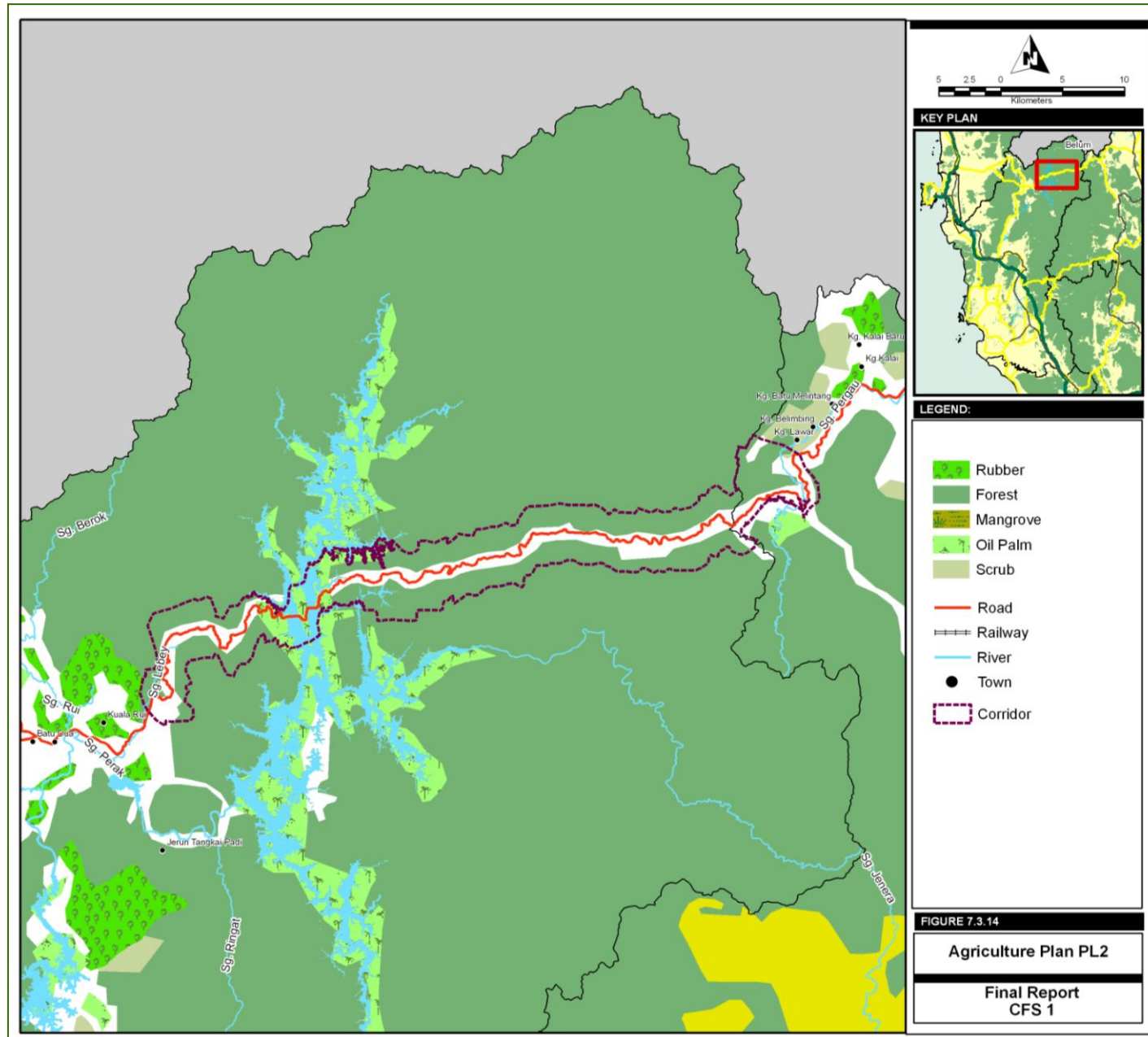
Source: Land Office Hulu Perak (2008)

Most of developments would be within the area designated as Hutan Darat in the Local Plan. These development projects would create a significant barrier to wildlife (especially elephants).

3) Issues

The corridor falls within the environment sensitive areas due to its steep topography and best left undeveloped as clearing of the steep land for development would likely lead to not only severe soil erosion but also involve very high development and maintenance costs. Moreover, because of the numerous conflicts with wild life in the region (especially elephant), planting of crops in this area is not economically feasible.

Figure 7.3.14: Agriculture





7.3.3.5 Tourism Activities

1) Tourism Activities

The proposed PL2 linkage located within premier ecotourism area of Belum – Temenggor Rainforest Complex, the National Ecotourism Site. The main ecotourism products within the area are Royal Belum State Park, Banding Island, Dataran Temenggor and Temenggor Lake. Royal Belum has been identified as state park and is greatly unique and estimated to be as old as 130 million years. It is recognized by Birdlife International as an Important Bird Area, the only place in Malaysia where all ten hornbill species of the region can be found.

Tourist frequently stay at Banding Lake on the man-made Temenggor Lake and enjoy the vastness of the lake and jungle. Visits to Belum can include a visit to the Terhong Waterfall, a Pering saltlick and Rafflesia, 1961 Kuala Cerendong helicopter crash site and the Orang Asli settlement (Temiar tribe) along Sungai Sara.

There are other tourism products within 50 kilometres from Banding Island such as follows:-

- Gendang Cave
- Kenderung Hill
- Gerik Hotspring
- Lata Lawin
- Lata Kala
- Lata Sg. Hitam
- Gendang / Itik Caves
- Pengkalan Hulu Hotspring

There are also some recreational forests within Hulu Perak District serves as the nature-based eco-tourism attractions within the region. Apart from of those along Sg. Sara, though there are also many Orang Asli Settlements within the surrounding vicinity, many are not develop as tourism product and unpopular among tourist.

To enhance the area as ecotourism destination, The Perak State Structure Plan has also proposed Kenering-Temenggor Wildlife and Safari Park (KTWSP) near Temenggor FR and S Hulu Piah RF. This effort is in accordance to its SP 2.4 policy that is to place Perak in the world map by diversifying and strengthening its tourism product and destination in line with the aim of increasing its contribution towards the state's GDP by the year 2020.

2) Tourism Support Facilities

Main access road to the proposed case study area is East west Highway, also well known as the Jumbo Trail by tourists. Majority of the areas in Royal Belum State Park and these forest reserves are not connected by road. Tourists need to use boats to explore the lake and enjoy the nature by on foot by trekking.



FINAL REPORT

Banding Island were developed along East West Highway as the Eco-Complex of Perak State with resorts, ecolodges / chalets and other facilities. Located in the centre of Belum – Temenggor Rainforest Complex, Royal Belum Rainforest Resort of Banding Island offers high end accommodation facilities and acts as gateway to Royal Belum.

Other than the above, a number of small chalets/ecolodges are developed around Temenggor Lake and there are also a number of budget hotels offered in Gerik (approximately 247 rooms available), the main gateway town to the ecoregion. A new Banding Hotel is currently being developed by Tasik Banding Hotel Sdn. Bhd. near Tasik Banding. This will add into high-end accommodation facilities which currently only being offered by Belum Rainforest Resort. More tourism facilities are currently being planned and developed within Banding Lake, including of those proposed by EMKAY Group.

Royal Belum Rainforest Research Centre is currently being developed in Banding Island as one of the tourism facilities for the ecoregion. When it is fully in operations, scientist and researches of Royal Belum will be furnished with close distant laboratories to assist them, and tourists will be accessible to their research findings at the library of the centre. The effort to setup such facilities will significantly enhance the resort as the Malaysian's premiere ecotourism destination. **(Refer Figure 7.3.15)**

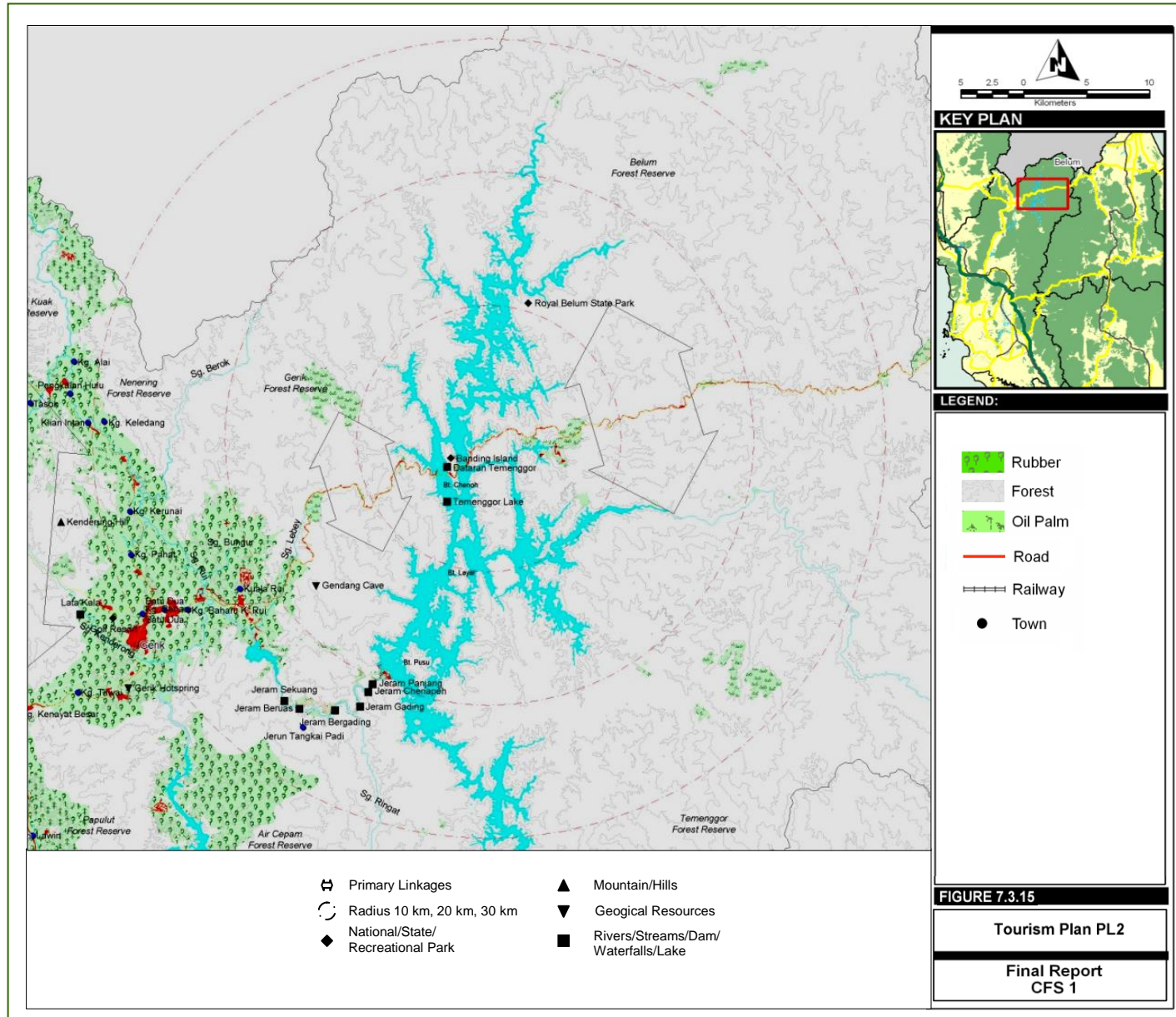
7.3.3.6 Forestry Activities / Logging

In 1991 the land to the north and south of the East-West Highway was gazetted as permanent reserved forest under the National Forestry (Adoption) Enactment (Perak En.3/1985). This included Gerik Forest Reserve (Pk. GN 1379-91) and Belum Forest Reserve (Pk. GN 806-91). These forest reserves are under the administration of the Perak State Forestry Department. Following a proclamation by the Sultan of Perak in 2002, on 3 May 2007, an area of 117,500 ha in the north-east of Belum Forest Reserve was gazetted as the Royal Belum State Park under the provisions of the Perak State Park Corporation Enactment 2001.

About a third of the Belum-Temengor Forest Complex has already been logged. In particular, the East-West Highway Protected Area was heavily logged between 1970-1995. However, much of the forest has since shown substantial regeneration. More recently, further logging activities have been carried out in and around the lake. Indeed, TNB had a licence to carry out logging in the area (including underwater logging); the licence expired on 31 May 2005.

Long-term logging activities are also being carried out to the south of the East-West Highway Protected Area. This includes extensive logging concessions in the Temengor Forest Reserve. The government-linked Perak Integrated Timber Complex (PITC) has a concession that has been certified as “well managed” by the Forest Stewardship Council (FSC).

Figure 7.3.15: Tourism





7.4 THREATS, OPPORTUNITIES AND CONSTRAINTS

7.4.1 Physical and Land Use

The evaluation of the physical, socio-economic and biological characteristics of the Temenggor Forest Reserve area will indicate the potential barriers hindering the wildlife movement between the Royal Belum State Park and the rest of the Main Range forest complex as well as will enable to identify opportunities in encouraging and facilitating movement of species and ecological processes.

More specifically, the assessment will provide us the basis to select the precise location and appropriate type of physical structure required, e.g. underpass or overpass, to ensure the viability and functionality of the ecological corridor identified. It will also help in identifying the very limited number of wildlife-friendly uses that may be allowed within the core area of the ecological corridor and any conditions attached for such uses. In addition, it will allow us to define those compatible land uses and development that can be normally permitted in the adjacent buffer zone without compromising the biodiversity conservation objectives, e.g. minimal disturbance to the animal species and safety of the residents. Mitigating measures, e.g. electric fencing, may need to be taken to protect the security of the existing residents and property damage from wildlife attacks if relocation is not feasible.

7.4.1.1 Constraints

In identifying the location, extent and type of ecological corridor, particularly the physical structure, the following constraints must be taken into account, viz:-

- East-West Highway poses a dangerous and difficult barrier to wildlife movement;
- Parts of the forest reserves and Stateland forests have been and are being logged;
- The high and steep terrain and cut road embankment may deter animal crossing;
- The development of large-scale tourism facilities and structures in Pulau Banding within the proposed ecological corridor rather than in gateway towns will create potential wildlife-human conflicts and discourage sensitive wildlife from using the corridor;
- The existing large Orang Asli settlement in Banun will give rise to safety issues and potential wildlife-human conflicts
- A substantial numbers of proposed large-scale development have been approved and committed within the Stateland forest area, including:-
 - 962 acres for oil palm plantations to SADC;
 - 1,000 acres for RPS Banun expansion;
 - 1,000 acres for University Utara Malaysia Campus development
 - Pulau Banding zoned for tourism development; and
 - 2000 acres for agriculture development including Herbal Garden, *Acacia mangium* forest plantation and Highland Agriculture.



7.4.1.2 Opportunities

The following available opportunities should be fully exploited to ensure the creation of a viable and functional ecological corridor, namely:-

- Designation as a geo-hazardous area and life supporting value area requiring Geological / Environmental Impact Assessment in the Hulu Perak District Local Plan will discourage new development;
- Development on the predominantly hill land (>100metres high) and steep terrain (more than 50% area >25° steep) will lead to disastrous landslide and soil erosion as well as causing flood downstream, and thus more cost-effective in maintaining the area as forested natural topography;
- Tight control of pollution and untreated effluent discharge from development into water bodies, particularly Tasik Temenggor, must be implemented and strictly enforced as it serves as a life support system for water supply and power generation for electricity supply;
- Very little existing development, settlement and human activities except for the Orang Asli settlement in Banun and tourism resort in Pulau Banding mean minimal potential economic disruption, social dislocation / rehousing and human-wildlife conflicts if ecological corridor occur here;
- Existing dominant land use is forest, thus implying minimal need / cost for reforestation as well as economic loss for converting development back to forest;
- Hulu Perak Local Plan has zoned almost the whole corridor as forest land use and ESA Rank 1 prohibiting no new development except low impact nature-based tourism development in Pulau Banding (288 hectares) and human settlement in RPS Banun area;
- High potential for eco-tourism related to wildlife viewing at safe distance and nature trail due to the great biological richness in terms of large mammals and birds, and evidence of wildlife presence and animal movement particularly elephants; and
- Availability of a narrow strip of Stateland forest along both sides of the road which can be used to form the ecological corridor.

7.4.1.3 Threats

The following threats must be considered in drawing up the ecological corridor, namely:

- The narrow strip of Stateland forest with ecological corridor potential is not gazetted as protected land, and therefore can be alienated for agriculture and other development;
- Development pressure is spreading along the East-West Highway corridor which will hinder connectivity
- The proposed electrified high speed train between Kota Bharu and Penang will result in an increase of train frequency, speed of train and fencing of the rail track, and thus impeding wildlife crossing; and
- The proposed Trans-Peninsular pipeline from Yan to Bachok will act as a barrier to wildlife movement
- About 1000 acres has been applied for the development of the proposed Bio-Diversity Research Centre UPM, which falls within the core area of the PL2 ecological corridor,



7.5 LINKAGE STRATEGY

7.5.1 Strategic thrusts

1) Gazetted forest reserve and acquisition of land

- i) Immediate freeze on land alienation and development in the corridor (with the exception of tourism development on Pulau Banding) plus re-acquire land on a case-by-case basis as necessary.
- ii) Extend Royal Belum Park to the south across the highway right up to the border of Temenggor (South) Forest Reserve (this extension should stretch from the eastern shore of Temenggor Lake to the Kelantan border).
- iii) Likewise the sections of Gerik Forest Reserve north and south of the highway should also be reconnected by gazetting an extension to the forest reserve to cover the intervening land (including the forested land along the highway from Gerik to the western shores of Temenggor Lake).
- iv) Extend Belum FR to include Royal Belum Forest & gazette as protected forest
- v) Extend Gerik FR & gazette area concerned as Protected Forest

2) Establish wildlife crossing

- i) Establish wildlife crossing at this area such as viaduct or overpass to make sure there is a crossing for the animal to cross.
- ii) Create signposting and speed limits to ensure that motorists drive appropriately and are aware that they are passing through a wildlife corridor.
- iii) To increase patrolling and enforcement efforts along the Gerik-Jeli highway. WWF-Malaysia & traffic has uncovered numerous poaching access points into RBSP & Temenggor FR along the highway. Persistent poaching presence will impair the functionality of any corridor.

3) Landuse management control

- i) The development of the Herb Garden and Highland Agriculture should be revoked since these developments are not sustainable due to the steep terrain and conflicts with wildlife. However if the state decides to proceed with these development, then it must comply with guidelines as outlined in 'Guidelines for Sustainable Agricultural Management of Plantations' especially in relation to the development of steep land.
- ii) Prohibit expansion of agriculture along the entire stretch of this highway in order to maintain the conservation and ecotourism benefits. Establish checkpoints at various parts of the highway to counter poaching
- iii) Long-term monitoring to identify critical elephant crossing sites.
- iv) Establish wildlife viewing areas within core area and associated tourism facilities within suitable location.
- v) To be promoted as the National Ecotourism "Jumbo Trail" site.



7.5.2 Land Use Zoning and Control Plan

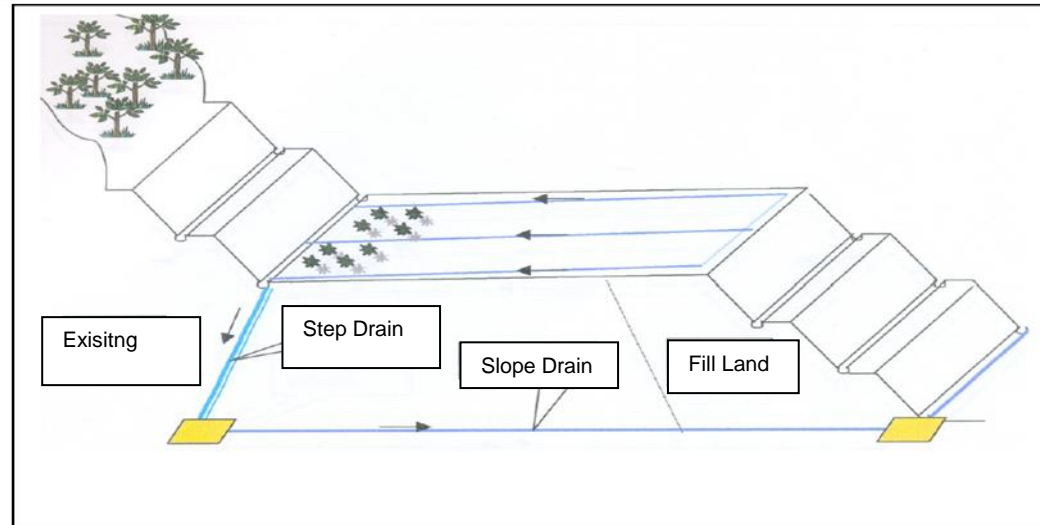
1) Future Agriculture Zone and Activities

Expansion of agriculture in the core linkage area along the highway should be prohibited in order to maintain the conservation and ecotourism benefits of the area.

The development of the Highland Agriculture in Puncak Baring in the core areas and rubber in the buffer areas should be revoked since these developments are not sustainable due to the steep terrain and conflicts with wildlife. However if the state government decides to proceed with these development, then it must comply with guidelines as outlined in 'Guidelines for Sustainable Agricultural Management of Plantations' especially in relation to the development of steep land. Among others these include practising land conservation techniques on steep land i.e. where slope is between 6 to 30 degrees through the following means:-

- i. Shorten the length of the slope by constructing terraces
- ii. Use of broad-bench terraces sloping inwards
- iii. Construction of contour and perimeter drains as shown below: **(Figure 7.5.1)**
- iv. Planting cover crops
- v. Construction of drains in the form of steps to cushion the flow of water during heavy rain fall
- vi. Construction of toe drainage
- vii. Construction of silt
- viii. Construction of buffer bunds or maintaining existing river buffer zones
- ix. Construction of silt traps and check dams
- x. Construction of toe drains, culverts and gabion
- xi. Mulching
- xii. Staggering land clearing to minimize exposure of bare land
- xiii. Land clearing during the dry season to prevent soil erosion
- xiv. Minimal tillage
- xv. Planting base on contour
- xiv. Use of light machinery in field operations

Figure 7.5.1: Construction of Contour and Perimeter Drains



Source: Department of Agriculture

2) Village Boundary Limits

There are only orang asli settlements within the core area. The population for Banding area is only 616 people and 1,603 people at Temenggor area for year 2015. The existing human settlements there are not an issue for the wildlife corridor. There are no village boundary limits required for the core area.

Within the buffer area, which is at the west and east (Kelantan State, near to Jeli Town) of the corridor, no further expansion of human settlement be allowed. In the buffer area (East), there are signs of elephants. Therefore for this area, human settlement management strategy has to be applied to avoid human-elephant conflicts.

3) Buffer Zones

Besides the core area, there are several different landuse management zones within the buffer zone. There are eco tourism developments at Pulau Banding and Felda Bersia Timur Plantation to the west. To the east are human settlements next to Bukit Melintang and the area in the middle of the corridor where the Banun orang asli settlements and plantations are found.

The corridor within the buffer zone will need special management to avoid human-wildlife conflicts. Different landuse management strategies to be applied for each sector.

7.5.3 Establishing Wildlife Crossing (key initiatives)

7.5.3.1 Infrastructure description

The road is Federal Route No. 4 connecting Gerik in Perak to Jeli in Kelantan. It forms part of the East West highway and is a major road connecting the east coast and the west coast of Peninsular Malaysia.

Traffic volumes along the Federal Route No. 4 based on “Road Traffic Volume Malaysia 2005” published by the Highway Planning Unit, Ministry of Works is shown in **Table 7.5.1**.

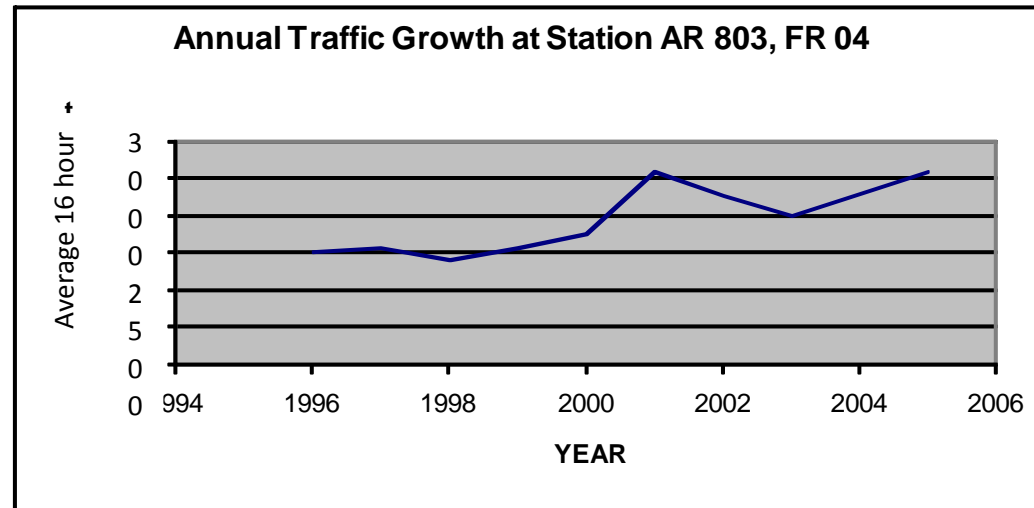
Table 7.5.1: Traffic volume and composition in Hulu Perak, (Oct. 2005)

District	Station No	Route No	16 Hours	Car & Taxis	Van & Utilities	Med. Lorries	Hvy. Lorries	Buses	Motor cycles
Hulu Perak	AR801	76	7186	54.25	10.57	6.79	2.84	1.97	23.58
Hulu Perak	AR802	76	6022	45.4	12.54	6.13	2.51	1.68	31.75
Hulu Perak	AR803	4	2948.43	52.12	18.83	9.74	7.39	1.93	9.98
Hulu Perak	AR804	76	6218	45.64	9.33	7.41	2.22	1.25	34.14
Hulu Perak	AR805	77	5255.71	44.35	10.32	3.36	1.58	0.41	39.97

Source : Highway Planning Unit 2005

Station AR 803 is located at 2.4km away from Gerik along the East West Highway is the closest station. It is noted that at this recording station the average 16 hour traffic count is 2,948 vehicles while the percentage of medium, heavy lorries and vans is 38% of this total. Comparing the average 16 hour traffic volume with the other roads within the Hulu Perak district indicates that Federal Route No. 4 has the lowest traffic volume count in the district. Traffic growth indicates a definite trend of increasing volume (from 1,516 in 1996 to 2,609 in 2005). The annual traffic growth is shown in **Figure 7.5.2**. While the road is not currently heavily used, traffic volume is increasing and will continue to increase in the future.

Figure 7.5.2: Annual Traffic Growth



Other road details are:

- FR No. 4 is the East West Highway and is the main connection between northern Peninsular Malaysia and the East Coast
- The road is a two lane highway with a speed limit of 90km/hr over most of its stretches.
- Lane width is approximately 3.5m.
- Side tables generally not paved.
- The terrain is hilly and the road has been constructed along the sides of the hills and therefore generally have a large number of bends.
- There are a few locations where the road crosses valleys. However, some of these valley crossings are constructed by a retaining wall/earthfill construction and therefore do not allow free passage below.
- The stretch of road within the PL-2 linkage area is approximately 55km long stretching from Kg. Pendok in Jeli Kelantan to 12km west of Pulau Banding. The 'core' zones measure approximately 40km long.
- In the future, there are plans to construct a high speed rail and a petroleum product pipeline. Wildlife crossings may need to be implemented for these infrastructures.

1) Flowchart

Refer to chapter 4 Appendix 1 of guidelines. The road is within a primary linkage and therefore requires consideration for wildlife crossings.

2) Type of wildlife crossings

Refer to chapter 4 section 2.1 of the guidelines. Wildlife under consideration are large mammals (elephants).



3) Location of Crossing

Refer to chapter 4 Section 2.2 guidelines. There is at present no detailed wildlife crossing study available. It is noted however that the World Wildlife Fund (WWF) is conducting a study on the habits of wildlife within this area. The study would likely provide sufficient detail to locate a crossing successfully. Pending completion of the WWF study, an at grade crossing with monitoring to be implemented initially and the underpass option is to be carried out in the next stage.

4) Form of wildlife crossing

Refer to **Table 4.4** of Guidelines. The wildlife under consideration is elephants and other large mammals and the road is a highway. Therefore suitable forms of crossing are :-

- Underpass – bridges and viaducts
- Overpasses

Due to lack of a detailed study on wildlife behaviour, these are to be implemented later once the study is completed.

Summary of Recommendation

Three (3) at grade wildlife crossing with monitoring is recommended as traffic volumes is still relatively low and no studies on location of crossings is available (stage 1). As the linkage area is large, three (3) at grade crossings is suggested. The locations are shown in **Figure 7.5.3, Figure 7.5.4 and Figure 7.5.5.**

Figure 7.5.3: Proposed Wildlife Crossing, PL-2 Site A

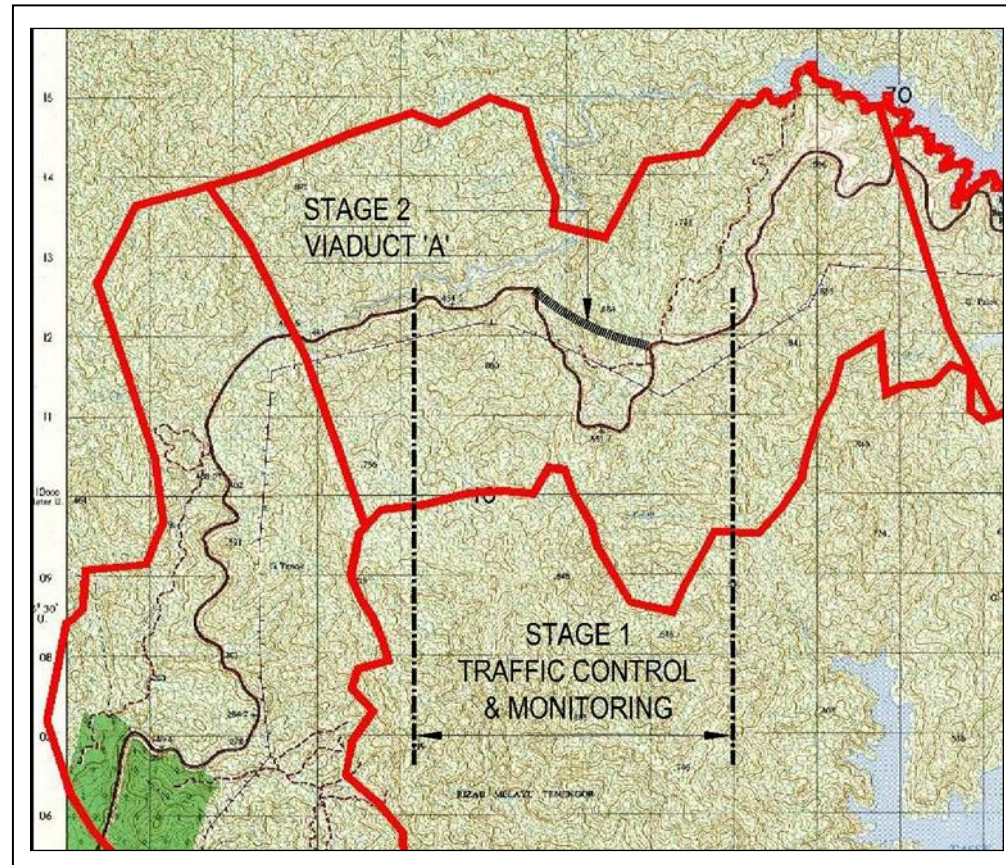


Figure 7.5.4: Proposed Wildlife Crossing, PL 2 – Site B

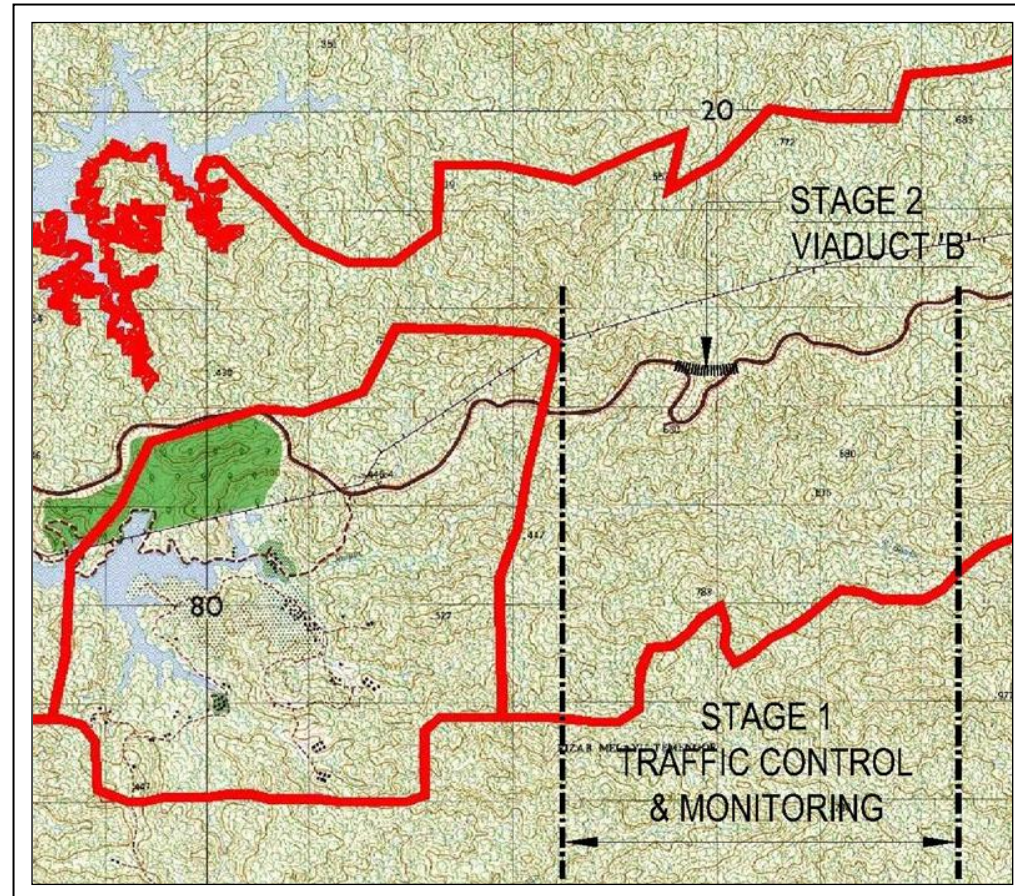
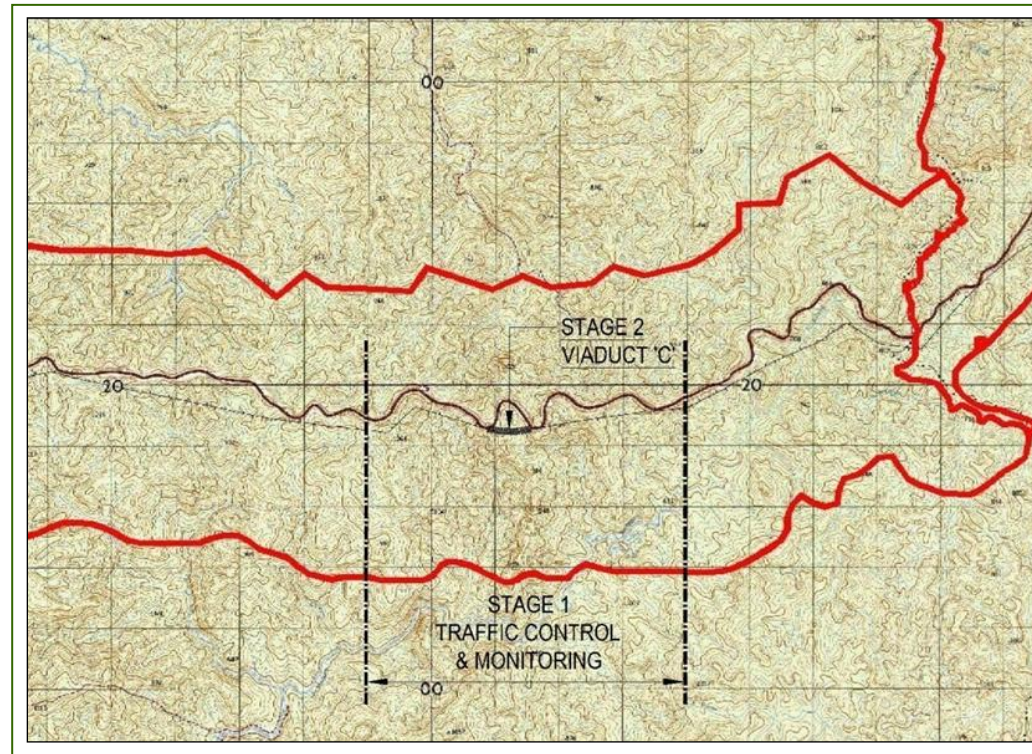


Figure 7.5.5: Proposed Wildlife Crossing, PL 2 – Site C



Underpass (viaducts) to be considered once monitoring is carried out (stage 2). These viaducts will replace the grade crossings. **Figure 7.5.5** shows a typical viaduct structure.

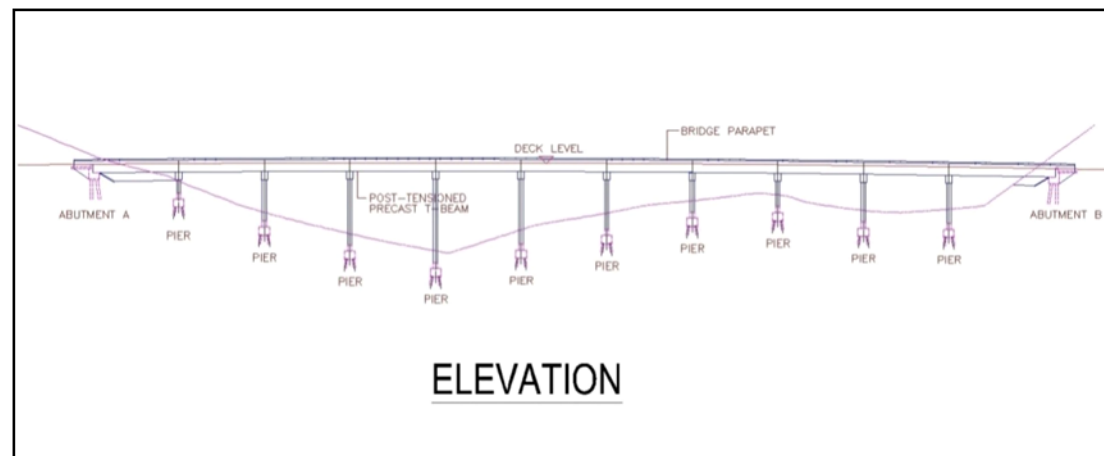
i) Components of Stage I

- Three (3) locations at grade crossing
- Each location approximately 5 km long.
- Additional signages (gantry type) and warning signs to be installed.
- Speed control to be limited to 60 km/hr along these stretches
- Wildlife monitoring program over a period of 5 years.
- Confirmation of wildlife crossing locations from monitoring program

ii) Components of Stage II

- Underpass at the locations via construction of viaducts.
 - Viaduct (1) - approximately 1,000 meters long
 - Viaduct (2) - approximately 200 meters long
 - Viaduct (3) - approximately 700 meters long
- Viaducts can be carried out as part of a road upgrade program as it will also make the road straight
- Remove previous speed limits of 60km/hr and reinstate to 90km/hr after structures are in place.
- Provide additional culvert crossing for smaller wildlife if necessary.

Figure 7.5.6: Typical Underpass (Viaduct) Wildlife Crossing in PL-2



Estimated Costs

Estimated costs for Stage I and Stage II are shown in **Table 7.5.2** and **Table 7.5.3**.

Table 7.5.2: Estimated Costs for Stage I

Item	Unit Cost RM	Qty.	Costs RM
1. Gantry signboards at entrance and exist of at grade crossings	100,000	6 nos	600,000
2. Warning signs at every 500m	2,500	30 nos	75,000
3. Monitoring/Remote Cameras for 5km stretch of road	500,000	15 km	7,500,000
4. Maintenance of monitoring cameras and other costs	300,000	5 years	1,500,000
Sub total			9,675,000
Add 20 % Contingency			1,935,000
Total for Stage I			11,610,000

Table 7.5.3: Estimated costs for Stage II

Item	Unit Cost RM	Qty.	Costs RM
A) VIADUCTS			
1. Viaduct Structures			
Viaduct A	5,000	10,000m ²	50,000,000
Viaduct B	5,000	2,000m ²	10,000,000
Viaduct C	5,000	7,000m ²	35,000,000
2. Realignment of approach roads (1 km of each side of viaduct)	500	6,000m	3,000,000
3. Drainage works	200,000	3 nos	600,000
4. Landscaping works (50m on each side)	5	190,000 m ²	950,000.00
5. Removal of existing roads	200,000	3 nos	600,000.00
B) MONITORING			
1. Cameras under viaducts	200,000	9 nos	1,800,000
2. Maintenance and reporting	200,000	5 years	1,000,000
Sub total			102,950,000
Contingency 20%			20,590,000
TOTAL			123,540,000



7.5.4 Strengthening Ecotourism Capacities (Key Initiatives)

- 1) Develop the wildlife corridor as one of the ecotourism attraction within Belum – Temenggor Rainforest Complex and to be integrated with the proposed Kenering-Temenggor Wildlife and Safari Park (KTWSP) near Temenggor FR and Hulu Piah RF.
- 2) Banding and Temenggor Lake Eco- Complex should be promoted as the tourist development zone and should cover only the designated area (refer the ecological linkage plan). Any new accommodation facilities with rooms more than 10 should be located within the zone, or if possible in the gateway towns of Gerik. Buffer and core area should be zone as extensive use visitor zone only where major tourism development is not allowed.
- 3) Belum/ Temenggor, Perak should be promoted as the National Ecotourism “Jumbo Trail” site whereby tourist can view wild animals in wild environments while sitting quietly in their car when they travel along the East-West Highway.
- 4) Travellers along the highway should be made aware that they are passing ‘environmentally sensitive areas’, common ground for both from awareness materials distributed at East west Highway R&Rs. Signs like “ Elephants Crossing, please slow down” may increase awareness among tourist passing by.
- 5) Tourism products within 50 kilometres suitable to be packaged together are as follows :
 - Royal Belum State Park
 - Banding Island
 - Dataran Temenggor
 - Temenggor Lake
 - Gendang Cave
 - Kenderung Hill
 - Gerik Hotspring
 - Lata Lawin
 - Lata Kala
 - Lata Sg. Hitam
 - Gendang / Itik Caves
 - Pengkalan Hulu Hotspring
- 6) Develop the ecotourism infrastructure and facilities within the tourism area or/and buffer area in close vicinity or in the wildlife corridor according to its suitability such as :
 - Tourist Centre in Banding Island and East-West Highway R&R including tourist parking area, tourist rest area, tourism information panels/boards and visiting schedules to designated wildlife potential viewing area
 - Jungle treks from the tourist centre to observation decks within the core zone
 - Observation decks, canopy walk and hideaway can be proposed at a distance of 200 to 250 meter from the salt lakes and the possible crossings.



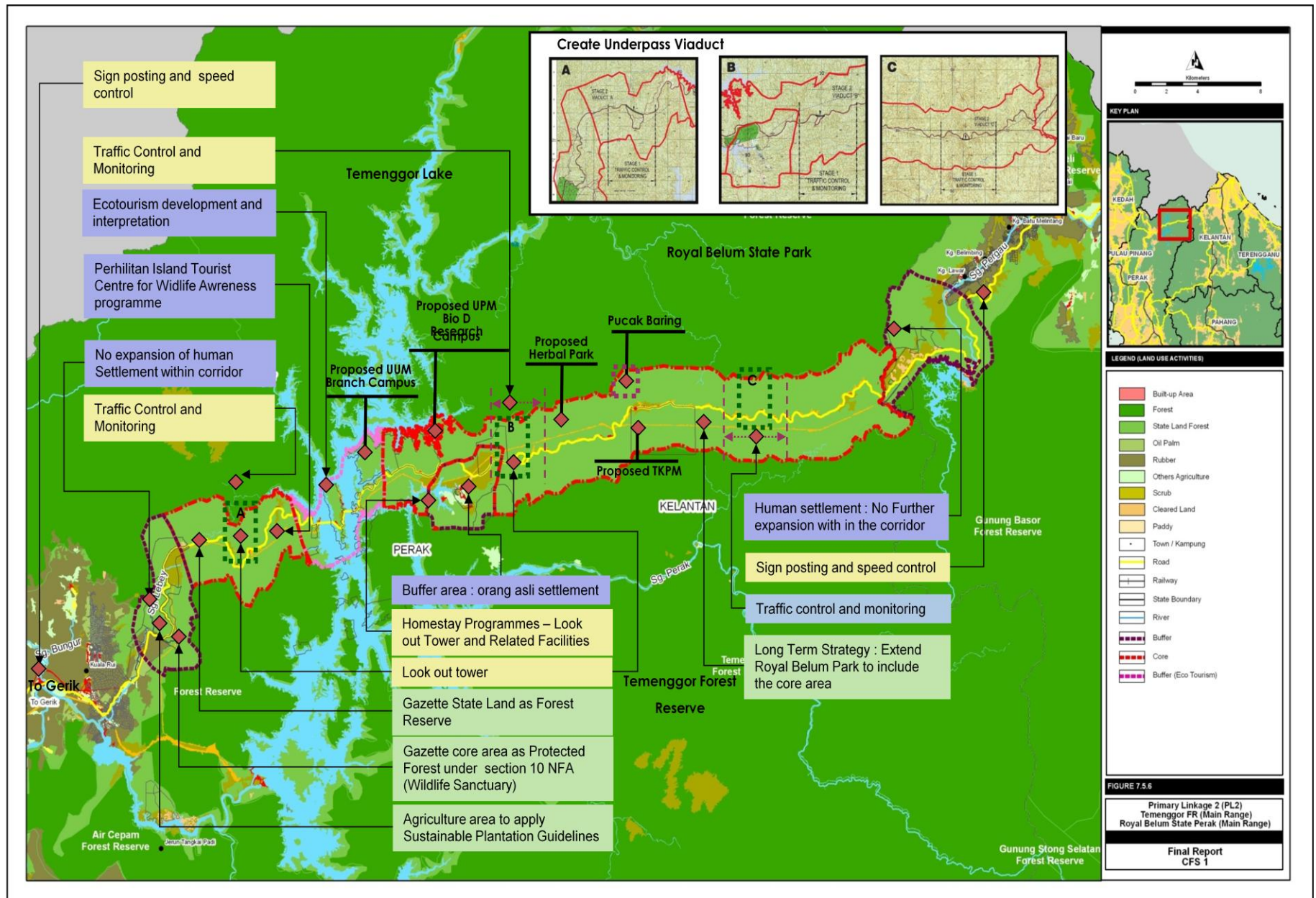
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- 7) Develop Gateway Town of Gerik to provide more (Existing nos of rooms: 247 rooms) and wider range of accommodation facilities. Majlis Daerah Gerik need to encourage local participations in all ranges of tourism related business, including tourist accommodation, transport, travel agents, licensed tourist guides, food and beverages, souvenirs and takeaways within Gerik Town. Better tourist accommodations need to be built in Gerik Town as to reduce pressure to Banding/Temengor tourism area.
- 8) Locals residing within the development and buffer zone should be encourage to take advantage in tourism economic activities, such as developing ecolodges and homestay facilities and be involved as trained local guides. Among other villages to benefits from tourism activities from the proposed linkage are the orang asli settlements of RPS Banun, Kg. Semelor, Kg. Sg. Tekam, Kg. Pulau Tujuh and Kg. Chuweh (Perhilitan Program).
- 9) Well-guided homestay programs to be initiated by JHOA and PERHILITAN with involvements of Orang Asli in tourism activities. EMKAY is also encouraged to play major roles in dispersing economic benefits of tourism to locals.
- 10) Pulau Perhilitan of Banding Lake can be promoted as the training ground for local guides and private ventures for sustainable tourism within the region, including the awareness tourism programs laid down within the wildlife corridor. Facilities within the island need to be upgraded to accommodate the need.

7.5.5 Forestry (Including Reforestation) (Key Initiatives)

Low-impact, selective logging activities in Temenggor Forest Reserve can continue although the high-impact clear-felling in areas along the East West Highway should cease. If Royal Belum can be extended across the highway to include all the state land and the southern part of Belum Forest Reserve, then logging can be confined to the forest reserves to the south, including Temenggor Forest Reserve. **Figure 7.5.7** show the overall corridor development for PL2.

Figure 7.5.7: Overall Corridor Development for PL2



7.6 ENABLING INITIATIVES

Institutional, legislative support, enforcement and monitoring, cost and funding and awareness, education and communication strategy will be discussed under this chapter for the Case Study PL2. The development cost, the implementation agencies, the awareness program will be shown in details under each sub-chapter.

7.6.1 Costs and Funding

1) Costs

Direct costs are incurred on proposed infrastructure works for PL2. They comprise road and drainage works, structural works, landscape, road signs, monitoring costs, and viewing towers.

Indirect costs arise from imputed costs of lands. Cost of lands is imputed from the average market price of agricultural lands sourced from the Property Market Report (2007). The underlying assumption is state forest lands can be put into alternative use through alienation. As market prices of agricultural land reflect location, level of maturity of crops, and types of crops, the imputed value of forest land is assumed to be lower, that is, at 25% lower.

The costs of lands include all state forestlands, scrub and grasslands, all of which are in the proposed linkage and ideally, are to be conserved to facilitate wildlife crossings. The estimated area of state forestland (23,750 hectares) and scrub and grasslands (1,477 hectares) totalled 25,227 hectares. Total cost of development is estimated at RM465.1 million (**Table 7.6.1**)

Table 7.6.1: Total Cost of PL2

Category	Cost Items	RM
Infrastructure	Road & Drainage Works	4,200,000
	Structural Works	95,600,000
	Landscaping	950,000
	Road signs	75,000
	Monitoring Devices & Maintenances	11,800,000
	Viewing Towers	300,000
	Contingency	22,525,000
	Sub-total	135,450,000
Imputed Cost of State Land Area: 25,227 ha	Cost of State Forests (Core & Buffer)	328,477,865
Awareness Campaign	Campaign & kiosk with interactive software	1,200,000
	Total Development Cost	465,127,865

Notes: (1) Average market price of land: RM52,083/ha. Property Market Report 2007 & 2006
 (2) Infrastructure costs are extracted from Section 7.5
 (3) Total development cost exclude imputed annual revenue loss from use of forested areas, estimated at RM69.6 million annually.



2) Benefits and Potential Revenue

A major benefit from this linkage is the provision of safe passage for wildlife, allowing them to access the larger forest complexes, hence, creating the enabling environment for their sustained existence. This adds to the overall conservation of biodiversity in the country. An estimate is made to gauge the potential of the linkage as a carbon sink, based on the area that will be converted to forest reserve. The approximate area of 25,227 hectares is expected to store about 2,901,117 metric tonnes of carbon (based on 115 metric tonne of carbon stored per hectare)¹.

The current market value of carbon credits traded under the EU carbon market averages US\$50 per metric tonne. At an exchange rate of RM3.543 (Bank Negara November 2008) to one US dollar, the potential income raised, if trading is undertaken, could be RM513.9 million. However, it is cautious to consider a lower market price, given that there are risks and constraints in obtaining certification, coupled with the current global financial crisis that would make trading in the immediate future difficult and generate uncertainties and fluctuations in carbon prices. A lower price of US\$30 per metric tonne is a more conservative estimate and more appropriate to estimate potential revenue. It could raise RM308.4 million annually, which is lower but still significant if the areas could be certified for carbon trading. Compared to an overall cost of RM465.1 million, an annual income stream of RM308.4 million would facilitate a quick payback for the proposed corridor within two years.

3) Sources of Finance

The proposed key source of finance is the Federal development budget through the creation of an ecological development programme under the Federal government's multi-state development fund.

7.6.2 Institutional Support, Legislative Aspects and Enforcement

1) Institutional arrangement

The Belum Temenggor is the second most important EC in the CFS1 area. Principally the area stretches from Gerik in Perak to Jeli in Kelantan along the East West Highway. The EC comprises two corridors separated by the Pulau Banding Ecotourism Zone. The EC should be designated as Ecological Corridor and an ESA under the National Physical Plan which will make it binding on the Structure Plans and Local Plans for the area.

This EC is the second most important Primary Link after Sg Yu in the CFS1 area. The ecological conservation efforts in this area will have international appeal and should be considered as a National Demonstration project on Malaysia's commitment to the CBD. A Detail Management and Implementation Plan will have to be done for the EC. This could be initiated by JPBD in association with key conservation agencies such as the Forestry Department and the Perak State Parks Development Corporation. It may be also possible to prepare the Detail Plan as a Special Area Plan (Management and Conservation type) under s16B TCPA.

¹ Weiss, J. (ed), (1994), The Economics of Project Appraisal and Environment, "Brown and Pearce, "The Economic Value of Non-Market Benefits of Tropical Forests: Carbon Storage."

The Key implementing agencies of the initiatives identified in the MasterPlan will include the Forestry Department, Wildlife Department, JKR, JPS, Director of Lands and Mines, State Parks Corporation and key land developers such as Emkay Lands which own the Pulau Banding and the Eco resort there.

The immediate implementation strategy is to gazette all state land within the core areas as protected forest under s10 NFA. The long term strategy will be to enlarge the Royal Belum State Park to include certain stretches of the corridor.

CSR initiative will be initiated with the key Corporate Entities in the area including the Emkay Group in formulating effective management and implementation programmes for the corridor.

The main institutional arrangements with respect to the Belum Temenggor Corridor is shown in **Table 7.6.2**.

Community participation and awareness raising programmes are important for the success of this corridor especially among the local villagers and the Orang Asli Community particularly in establishing a training programme for eco tourist guides and participating in the surveillance and monitoring programme.

Table 7.6.2: Institutional Arrangements With Respect to the Belum Temenggor Ecological Corridor

Preparation of a Detail Plan which should include both a Physical Development Plan and a Management and Implementation Plan	JPBD in association with key conservation agencies such as Forestry Department, Perak State Parks Development Corporation, Wildlife Department and NGO's especially WWF and MNS. This could be done as a Special Area Plan under s16 TCPA
Key Implementing Agencies	<ol style="list-style-type: none"> 1. Forestry Department 2. Wildlife Department 3. Local Planning Authority of Ulu Perak 4. State Director of Town and Country Planning (JPBD) 5. JKR 6. JPS 7. Director of Land and Mines 8. Perak State Parks Corporation 9. Key land Developer in the area such as MK Lands
Formulation of Rules and Regulations	<ol style="list-style-type: none"> 1. Forestry Department 2. Director of Lands and Mines 3. JPBD 4. Local Planning Authority of Ulu Perak and Jeli
Monitoring and Surveillance	<ol style="list-style-type: none"> 1. Wildlife Department 2. Forestry Department 3. NGOs including WWF and MNS 4. Local Villagers and the Orang Asli Community
Education , Research and Publicity	<ol style="list-style-type: none"> 1. NRE, 2. JPBD, 3. Wildlife Department , 4. Universities , 5. NGO's 6. State Tourism Action Council 7. Pulau Banding Rainforest Research Center



2) Legislative implications

The key implementation strategies identified in the plan will be supported by enabling legislation. All state land forest and scrubland within the Core Area of the EC should be gazetted as Protected Forest under s10 NFA. No further land alienation for development should be allowed within the Core Areas of the Corridor. Pockets of alienated land within the core areas may have to be acquired under the Land Acquisition Act or purchased in the open market, however there are not expected to be many in this corridor. The long term strategy will however be to extend the Royal Belum State Park to include parts of the EC. **(See Table 7.6.3)**

Table 7.6.3: Key Strategies

Key Strategies	Relevant Laws To Be Applied
Gazette all state land forest and scrubland within the Core area as protection forest (Sanctuary for wildlife)	S10 NFA , Perak Forest Enactment
No further land alienation for development purpose (agriculture, building or settlement) within the core areas of the corridor	National Land Code
Revoke any allocation of land to State Agencies within the Core Areas including the purported TKPM along the corridor	NLC
Acquire any alienated land within the core area and gazette it as protected forest under the Forestry Act or reserve it as Ecological Areas under s62 NLC	Land Acquisition Act 1960 , NLC , NFA
Long term strategy (Expand the boundaries of the Royal Belum to include parts of the Core Area of the EC)	Perak State Parks Corporation Enactment 2001
Establishing Riparian Reserve of rivers in the corridor	National Land Code , Waters Act 1920

3) Enforcement and Monitoring

Enforcement and monitoring will be carried by the key agencies that have enabling laws to do so. This will include the Forestry Department, Director of Lands and Mines and the Local Planning Authority for the Area. Although the EC is not a wildlife reserve or sanctuary, the DWNP has powers under the Wildlife Act to act against hunting and poaching of endangered species of animals.



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7.6.3 Awareness, Education and Communication

As a national endeavour, the Central Forest Spine project deserves a publicity platform to promote its objectives and progress towards the protection of biodiversity. The Belum-Temenggor ecological linkage represents the best option to champion the CFS study.

Two major documents already recognized its importance as a priority for conservation. The National Physical Plan lists Belum-Temenggor as an Environmentally Sensitive Area and the National Tiger Action Plan identifies the area as vital habitat for tigers. The overall goal of the ecological corridor is to maintain a connection between the Royal Belum Park and the Main Range.

With elephant crossings a common occurrence, it is extraordinarily rare for a major road to traverse through prime large mammal habitat. In essence the East-West Highway is really a jungle road. And the ecological corridors along the highway present opportunities for tourists and travellers to experience wildlife in a unique way.

The key concerns relate to development along the highway that is incompatible with nature conservation and ecotourism. These include addressing plantations and other agriculture projects, railway and pipeline infrastructure and even problems related to poaching in the area:

- As the premier ecological corridor, ensuring government agencies understand the implications of land alienation and further development of habitats must be a priority.
- To maintain the integrity of the entire habitat by extending the borders of Royal Belum Park and other forest reserves calls for coordination with the Department of Forestry.
- As a major conservation initiative, the far-reaching benefits of tourism should outweigh agricultural activities, thus necessitating proper planning by the authorities.
- Already primed for ecotourism expansion and other tourism-related activities, tourism officials must capitalize on promoting compatible projects that do not interfere with large mammal populations.
- As the showcase ecological corridor in an accessible location, public awareness efforts should centre on environmental education and ecotourism ventures that bolster the objectives of the CFS study.

The following communications and awareness tools are necessary to reach out to selected stakeholders:-

- 1) **JPBD-CFS Web Portal** – Implementation of CFS recommendations requires multiple agencies and organizations to be informed and engaged. The web portal serves as the primary source of information to communicate the objectives, goals and roles of all parties towards pursuing positive action. Case studies, fact sheets, corridor maps and downloadable brochures for different sectors (i.e. forestry, tourism) all aid to increase awareness among potential participants. It is also a good option for the public to be updated on the progress and programmes of the initiative.



- 2) **Interpretation Centre** - An indoor facility to showcase the spectacular biodiversity present in this corridor should be established at Pulau Banding, since it is already designated as the gateway for tourism. Catering to tourists and travellers, the centre can offer information on natural history and local tourism packages, promote the entire CFS project to a wide audience and be an active place of learning with audio-visual presentations and special school outings. The centre would seek to complement, not compete with, any existing tourism-related facilities.
- 3) **Information Kiosks** - Engaging with the public directly at linkage areas is a first step for understanding the concepts of ecological corridors and their functions. Information kiosks located at high use facilities starts the awareness. The Belum-Temenggor corridor merits several kiosks to reach visitors to Pulau Banding and traffic rest areas at each end near Gerik and Jeli.
- 4) **Wildlife Safety Signs** – Ensuring safety for animals and motorists travelling on corridor roads is a priority. An effective safety sign awareness programme instils three key messages:-
 - A sense of importance for the surrounding habitats;
 - A sense of concern for wildlife crossings; and
 - An awareness to avoid animal conflicts and reminder to use appropriate behaviour and safe speeds.

The Road Transport Department and DWNP should be responsible to develop a series of ‘attention getting’ signs that promote safety first and send a positive message of caution to motorists.

- 5) **Corridor Campaign** - Special projects and special events are necessary to utilize the extraordinary natural features of the Belum-Temenggor linkage and corridor sites. The site should be considered for an official launch of the entire CFS project and a multitude of awareness activities:-
 - **Official CFS Launch** – In conjunction with World Biodiversity Day, or other promotional date, an official launch of the CFS project puts ecological linkages and corridors in the minds of the public and other stakeholders. The focus on biodiversity underscores the importance of CFS action on a national scale and alerts an international audience to Malaysia’s conservation intentions.
 - **NGO Project Cooperation** – Already active in the Belum-Temenggor area with large mammal surveys and tiger conservation education, NGOs such as WWF, MNS and MYCAT are perfect partners to support to assist DWNP and other agencies to better understand animal movements and develop environmental education activities.
 - **Media Tours** – Getting the media active early on requires organizing media tours to highlight CFS conservation objectives, to visit critical corridor passage sites and increase public awareness on their role to avoid human-wildlife conflicts and appreciate the efforts of project proponents.
 - **Ecotourism Initiatives** – Belum-Temenggor is already active with ongoing ecotourism tours to remote areas in Royal Belum Park and Temenggor Lake. However, the more accessible areas within the ecological core and buffer zones offer opportunities to establish day-trips and shorter duration treks to complement excursions to the interior forests.



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- Community Outreach – Illegal wildlife trade, poaching and wild meat consumption are problems associated with communities in and around the location. Organizing special events with school and other civic groups (e.g. MYCAT and WCS Teachers for Tigers Programme) addresses target groups directly.
- Border Biodiversity Festival – Despite the political issues surrounding the Thai-Malaysia, the opportunity exists to create an event that highlights conservation on both sides of the border that include Belum and Temenggor and Hala Bala and Bang Lang parks. As possibly the largest single protected area on the Malay Peninsula, tourism authorities (i.e. Ministry of Tourism and Thailand Tourism Authority) should organize a festival with ecotourism treks to all of these parks and other positive activities. By catering to local tourism operators and businesses in the region, the festival could be an annual boon to local economies too.

Secondary Linkages 2 (SL2) : Krau Wildlife Reserve – Bencah Forest Reserve – Som Forest Reserve – Yong Forest Reserve

Introduction
Objective, Targets And Key Performance Indicator (KPI)
Corridor Profile
Threats, Opportunities And Constraints
Linkage Strategy





8.0 SECONDARY LINKAGES 2 (SL2) KRAU WILDLIFE RESERVE – BENCAH FOREST RESERVE – SOM FOREST RESERVE – YONG FOREST RESERVE

8.1 INTRODUCTION

Once connected to Greater Taman Negara in the northeast and the Main Range in the west, the Krau Forest Island (located within the Benom Forest Complex) is has now become an isolated unit, fragmented from these forests mainly by large swathes of oil palm plantations.

If the Krau Wildlife Reserve is managed as an isolated unit, the value of biodiversity at the reserve will decline, as indicated by the decline or loss of certain large mammal species (e.g., tiger, elephant, etc.). It may be too expensive or too late to restore a 'physical' forest connection from the wildlife reserve to Taman Negara.

However, it is still possible to slow the rate of species loss and the decline in biodiversity, by establishing a 'functional biological corridor' in the northeast to Greater Taman Negara, which would allow wildlife (not including large mammals) and plants to disperse between the two forest complexes (the 'stepping-stone corridors' approach).

It is now isolated from Greater Taman Negara by a matrix of different land uses, including two roads, a railway line, settlements, and rubber and oil palm plantations. Three small forest islands (Som FR, Kerambit FR and Benchah FR) located in this matrix can be maintained as stepping stones, with a network of forested riparian corridors linking them. **Refer figure 8.1.1** for the existing land cover for corridor SL2.

8.2 OBJECTIVE, TARGETS AND KEY PERFORMANCE INDICATOR (KPI)

8.2.1 Objective

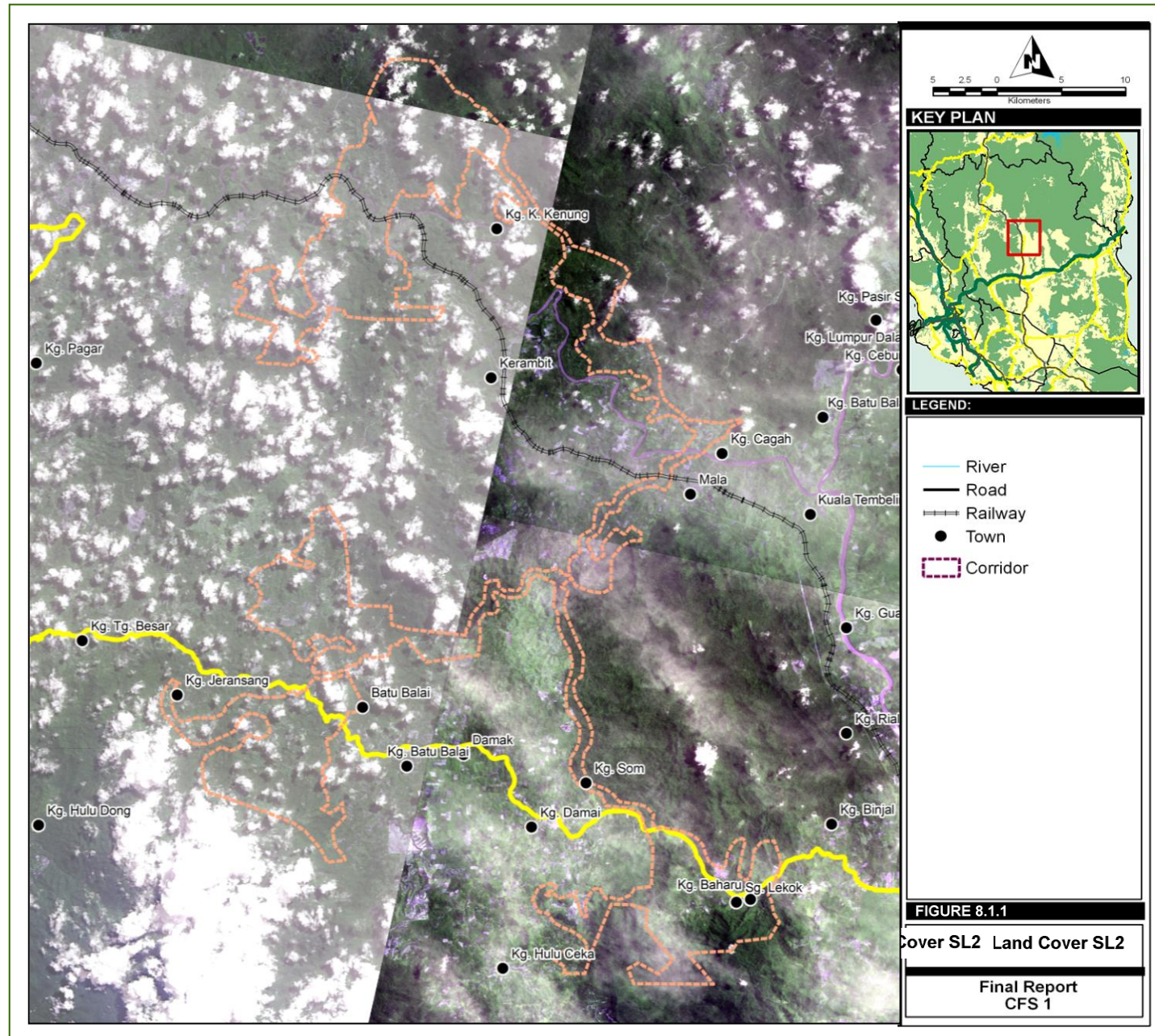
- To establish and maintain a matrix of forested stepping stones and riparian corridors between Krau Forest Island and the Greater Taman Negara.
- To ensure the safe passage of wild animals across this corridor.

8.2.2 Targets

The general target is to increase the functionality aspects of the corridor, i.e. in terms of its use by wildlife. The targets are therefore:

- Increase in use of corridor by wild animals.
- Decrease in mortality rates of wild animals (due to poaching and road accidents).

Figure 8.1.1 : Existing Land Cover



8.2.3 Key Performance Indicators

Key Performance Indicators (KPI) are used to measure the effectiveness of the linkage in meeting the targets. This involves biological criteria relating to species populations within the linkages as well as in the adjacent habitats, and the safe passage of species across of the corridor (in particular across the specific wildlife crossings). **(Table 8.1.1)**

In order to measure changes and trends, initial surveys are required to determine the baseline for all KPI.

Table 8.1.1: KPI for achieving “Functional linkage”

KPI	Criteria*	Survey Method
Focal species population - In the linkage - In adjacent habitats (Taman Negara and Krau forest island)	<ul style="list-style-type: none"> Population of small mammals and bird species in the linkage and adjacent habitats. 	<ul style="list-style-type: none"> Camera trapping programme. Survey of animal presence. Bird Census and monitoring programme
	<ul style="list-style-type: none"> General status of biodiversity (species richness and abundance) 	<ul style="list-style-type: none"> Biodiversity survey.
Usage of the wildlife crossing structures	<ul style="list-style-type: none"> Recording and monitoring of animals using specific wildlife crossing structure (species diversity and numbers) and time and frequency of usage 	<ul style="list-style-type: none"> Camera trapping programme. Survey of animal presence.
Human-wildlife conflict	<ul style="list-style-type: none"> Number of roadkills in the corridor 	<ul style="list-style-type: none"> Monitor roadkill trends within the corridor.
	<ul style="list-style-type: none"> Number of elephants trespassing into adjacent plantations and villages 	<ul style="list-style-type: none"> Monitor human-elephant conflicts
	<ul style="list-style-type: none"> Effectiveness of anti-poaching enforcement 	<ul style="list-style-type: none"> Survey of poaching presence.

Note : * In order to measure changes and trends, initial surveys are required to determine the baseline for all KPI/criteria

8.3 CORRIDOR PROFILE

8.3.1 Physical and Land Use

This Section provides the physical and land use background information of the SL2:Krau Wildlife Reserve-Bencah Forest Reserve-Som Forest Reserve-Yong Forest Reserve (SL2) and its surrounding region (Mukim Jerantut and Lipis) for assisting in the designation of ecological linkages, and necessary mitigating measures, to connect the forest islands identified. It will set out the ecological linkage physical profile in terms of location and size, terrain, soil, rivers and land uses.

8.3.1.1 Location and Size

The SL2: Krau Wildlife Reserve-Bencah Forest Reserve-Som Forest Reserve-Yong Forest Reserve ecological corridor is 20 km long and 40 km wide of predominantly forested land. It covers a relatively small area of approximately 16187 km² or 161.87 hectares.

It is located within the District Jerantut and Lipis about 15 minutes drive from the Jerantut and 30 minutes drive from Kuala Lipis town. It straddles along the Federal Route 64 linking the towns of Jerantut and Lipis (**Figure 8.3.1**). Within the corridor are the Som FR, Kerambit FR and Ulu Mas FR, which are an integral part of the Krau Wildlife Reserve; and on the FRs outside the corridor are the Yong Forest Reserve and Krau Forest Reserve. These natural forested habitats support a vast diversity of mammals and bird species. It has been observed that many small mammals, particularly small cats, have been moving between the Yong FR and Som FR. However, the Federal Route 64 will not act as a barrier to wildlife movement if there is no road widening in this corridor.

8.3.1.2 Terrain

Most of the SL2 Corridor and its surrounding region are characterised by hill land and hill land with gentle slopes in many areas. Their elevations vary from 0m to 300 meter above sea level. Topographically, the SL2 Corridor comprises 89.29 percent lowland (lower than 150m), and 10.71 percent hill land and no highlands (above 300m) as shown in **Table 8.3.1**. The proposed wildlife and ecological linkages need to be located in both the lowland and hill lands to cater for the needs of as many species of flora and fauna as possible. (refer figure 8.3.2)

Table 8.3.1: Area and Percentage of Terrain in SL2

Elevation	Description	Hectare	Km ²	%
0m - 150m	Low Land	14,453.61	144.54	89.29
150m - 300m	Hill Land	1,733.79	17.34	10.71
TOTAL		16,187.40	161.87	100.00

Source :RFN

In terms of land slope, a large portion of the SL2 Corridor is dominated by a land slope of less than 20° as shown in **Table 8.3.2**. SL2 Corridor highlighting locations of slope with varying steepness. These areas are more suitable to be proposed for ecological linkages as these less steep slope areas are suitable for wildlife movement by develop a natural viaduct.

Table 8.3.2: Area and Percentage of Slope in SL2

Degrees	Hectare	Km ²	%
0 To 11.9	6,029.00	60.29	37.24
12 To 19.9	8,487.52	84.88	52.43
20 To 24.9	477.30	4.77	2.95
Above 25	1,193.62	11.94	7.37
Total	16,187.44	161.87	100.00

Source :RFN

Figure 8.3.1: Location Plan

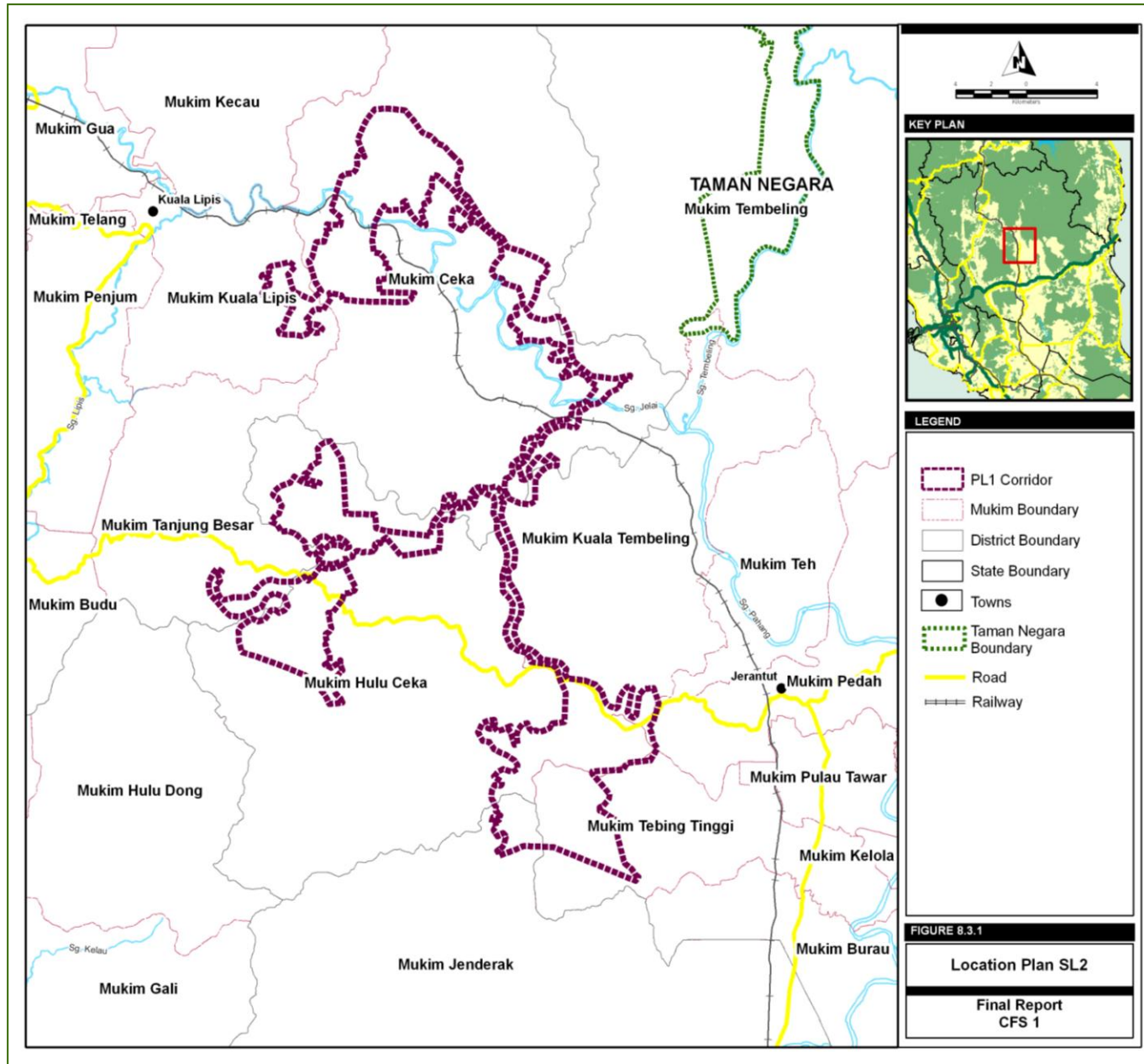
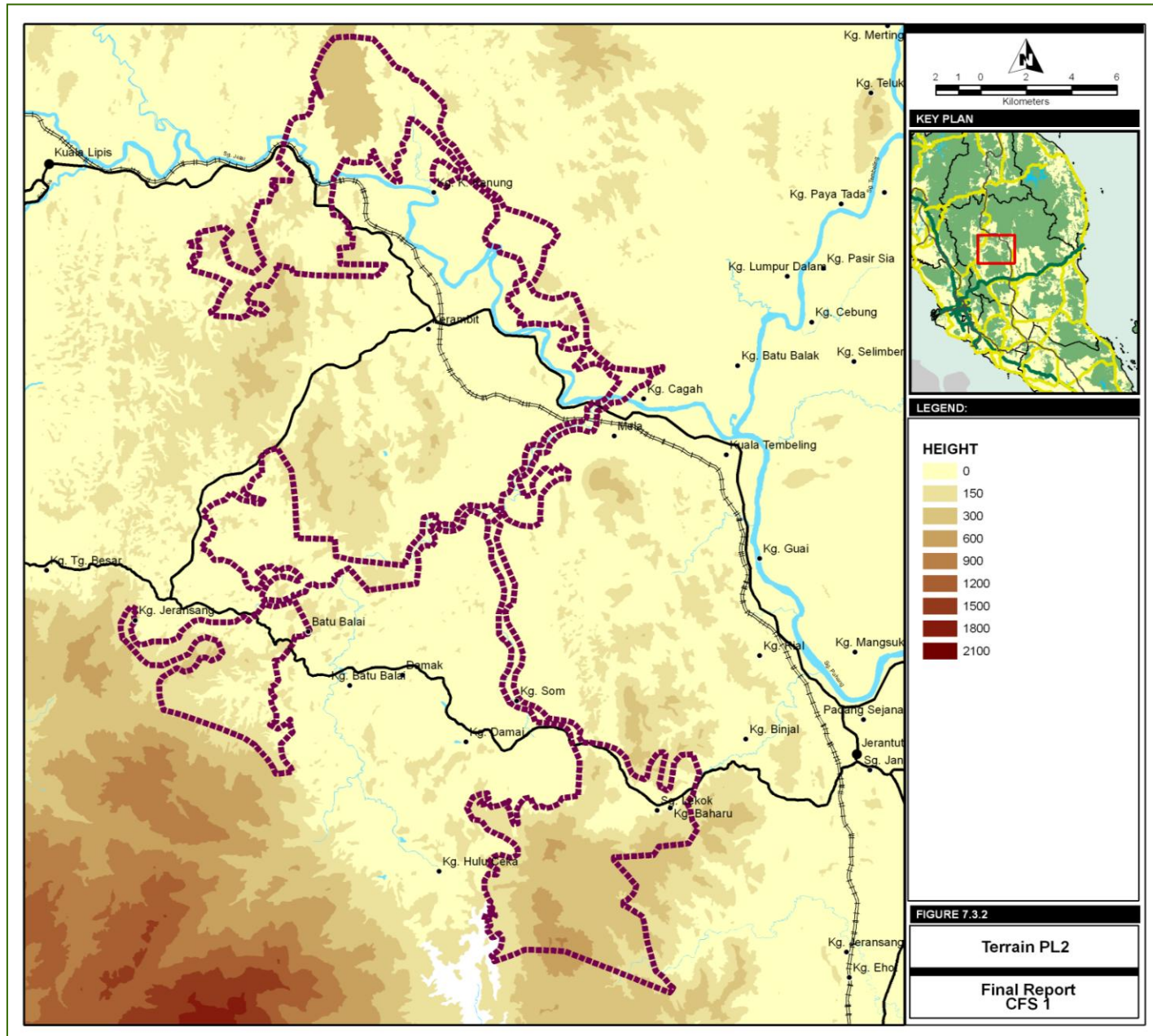


Figure 8.3.2: Terrain



8.3.1.3 Soils Suitability Classification

Soils provide the physical base for land development. Knowledge of the potentials and limitations of soil types is therefore necessary to evaluate crop production capabilities or when considering construction of buildings, infrastructure, or even the acquisition of the land for reforestation and wildlife corridor purposes. Agriculture activities are not suitable on soils which are characterized by poor filtration, slow percolation, flooding/ponding, wetness, steep slope and subsidence. These areas that are deemed as unproductive for agricultural crop production may be reclaimed and restored as forested corridors that function as wildlife crossings and as ecological linkages. **(Refer Table 8.3.3)**

Table 8.3.3: Area of Soil Suitability Class in SL2 Corridor

Soil Class	Hectare	Km ²	%
Class 2	6,761.07	67.61	41.79
Class 3	872.92	8.73	5.40
Class 4	4,105.85	41.06	25.38
Class 5	4,438.48	44.38	27.43
Total	16,178.32	161.78	100.00

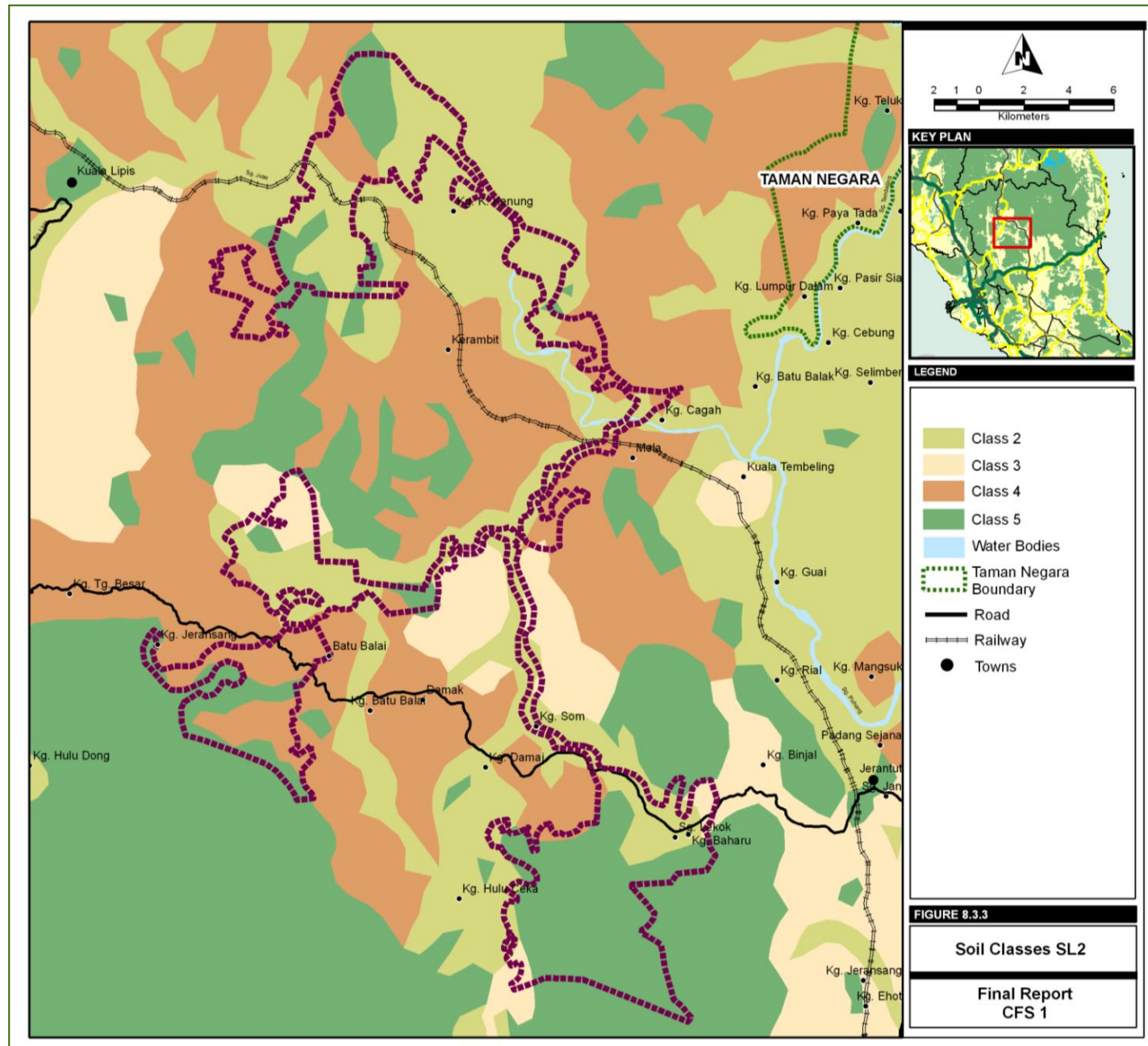
Notes:

- Class I Soils with no limitations to agricultural development.
- Class II Soils with few minor limitations to agricultural development. It can support a wide range of crops.
- Class III Soils with one serious limitation to agricultural development. It supports a limited range of crops.
- Class IV Soils with more than one serious limitation to agricultural development. It is only marginally suitable for crops.
- Class V Soils with more than one very serious limitation to agricultural development. This group is not recommended for any crops.

Source :RFN

The soil class analysis indicates the land suitability for agricultural development. Most of soil (41.79 %) in SL2 is Class II which with few minor limitations to agricultural development. It can support a wide range of crops. A significant proportion of soil (25.38%) is in Class IV which is only marginally suitable for crops. Another proportion of soil (27.43%) is in Class V which is more than one very serious limitation to agricultural development. This group is not recommended for any crops. **(Figure 8.3.3)**

Figure 8.3.3: Soils



8.3.1.4 Rivers

The major river draining this area is Sg. Jelai from Bukit Bentung to the east along the northern border of the SL2 Corridor (**Figure 8.3.4**). Three short tributaries, .i.e. Sg. Som, Sg. Ceka and Sg. Sepan, flowing from north to south start from Sg.Tanun.

The Lipis – Jerantut road crosses the Sg.Ceka. River that runs below the road, approximately in the middle of the SL2 Corridor area. In this respect, it offers a high potential area to create an ecological linkage with a riparian environment for animals to move from the north (Yong FR) to south (Krau WR). Not only riparian river corridors serve effectively as natural pathways for wildlife movement, it also does not involve the construction of expensive physical crossing structures, e.g. viaducts.

Areas still have viable riparian environment for wildlife usage. On the other hand, if a certain connection point is deemed very critical to create a contiguous forest area, then further analysis needs to be conducted to ensure that the riparian area can be rehabilitated.

8.3.1.5 Land Use

Human settlements have occurred in and around the proposed SL2 Corridor and is dependent mainly on low value-added resource- and agriculture-based economic activities (i.e. agriculture, ecotourism and logging).

Within the SL2 corridor, the predominant land use is forest which makes up about 77.24% of land as depicted in **Figure 8.3.5** and **Table 8.3.4**. The forests are bisected by the Federal Route 64 with about 800 meters of human settlement (kampongs) and scrub running along it on both sides. Scrub areas consist of 3.33% of the area and may be able to reclaim as forest area for connectivity purposes. There are some rubber and oil palm agriculture plantations owned by small holding found within the corridor.

Table 8.3.4: Existing Land Use 2006 for SL2 Corridor

RFN	Hectare	Km ²	%
Built-up Area	94.36	0.94	0.58
Cleared Land	71.70	0.72	0.44
Forest	12,503.25	125.03	77.24
Grassland	67.61	0.68	0.42
Oil Palm	440.16	4.40	2.72
Others Agriculture	433.09	4.33	2.68
Paddy	17.77	0.18	0.11
Rubber	1,848.25	18.48	11.42
Scrub	539.03	5.39	3.33
Water Bodies	158.21	1.58	0.98
Wetlands	13.96	0.14	0.09
TOTAL	16,187.39	161.87	100.00

Source: RFN

The nearest towns from SL2 Corridor are Jerantut with a population of 10,425 people located 5 km to the east, and Lipis with a population of 3,611 people situated left to the middle. While the built-up area covers a large portion of the SL2 area, it is concentrated in the centre of the area, and therefore will impact on the location and type of wildlife crossing facilities and mitigating measures to be taken to protect the safety of the residents.

Figure 8.3.4: Hydrology Plan

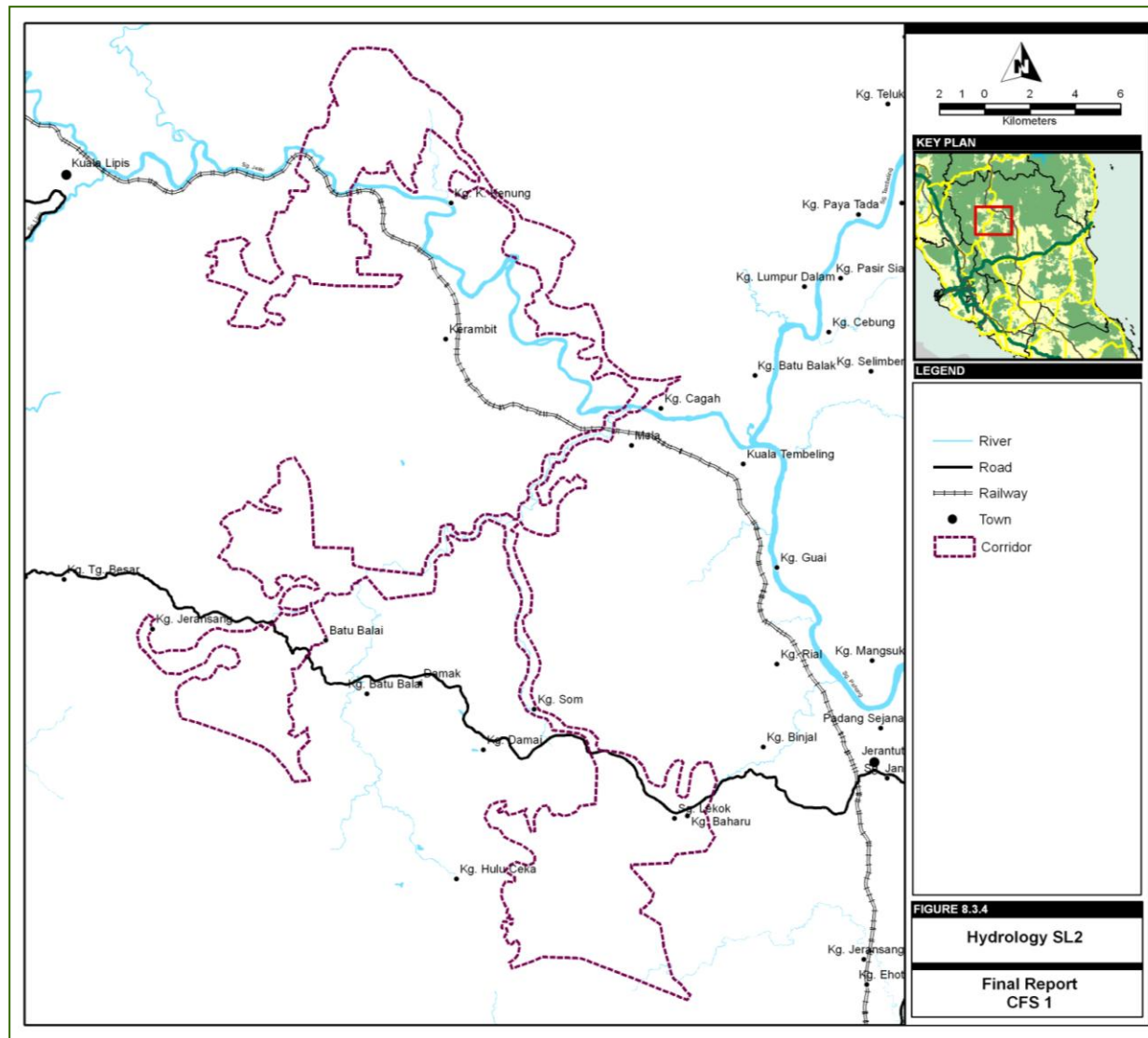
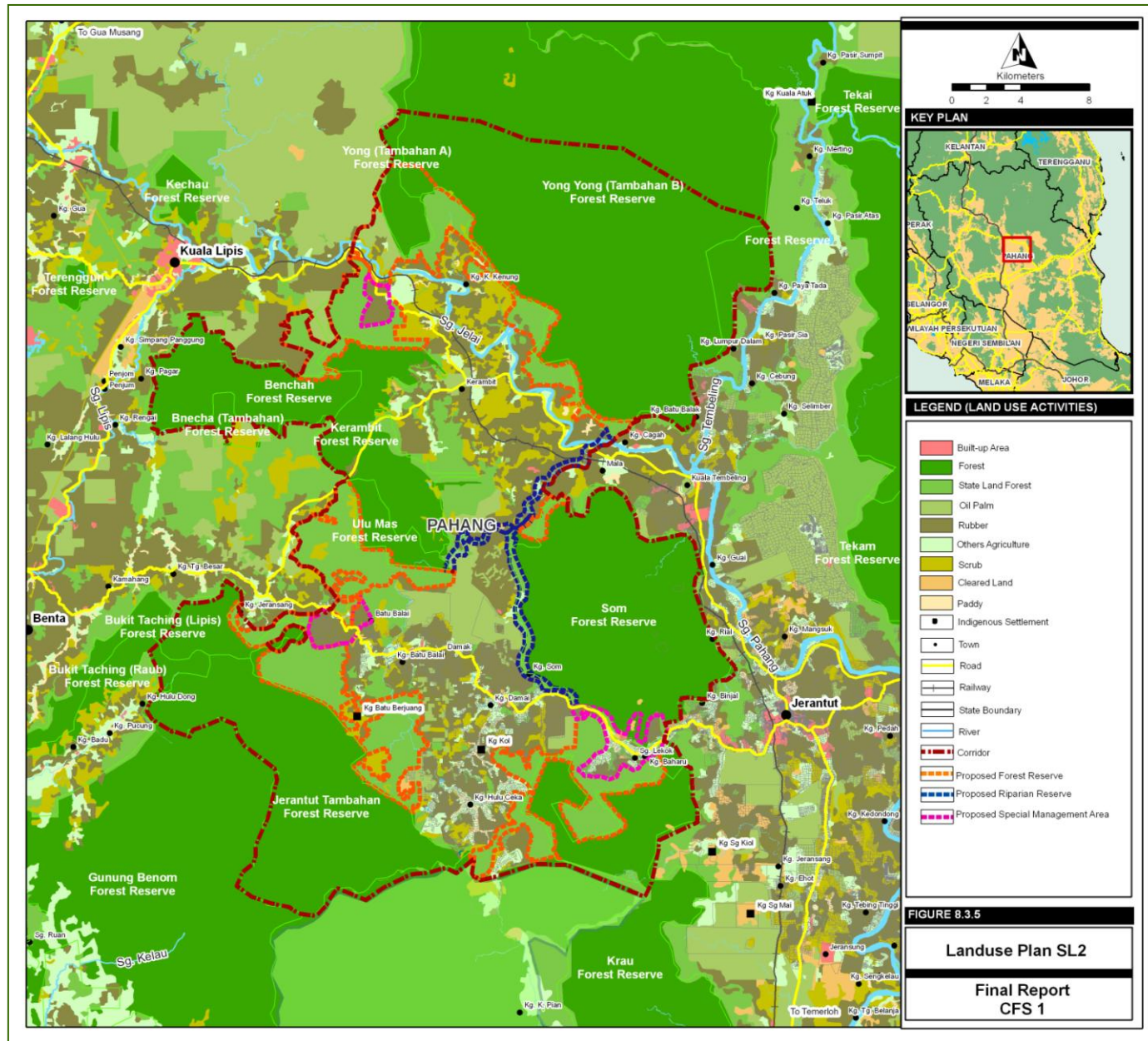


Figure 8.3.5: Land Use Plan SL2





8.3.2 Biological

1) High Conservation Value Forest

All existing natural forest is of high conservation value in terms of its proximity to Krau Wildlife Reserve and the extended habitats it provides to the animals whose home ranges overlap with these areas. In addition, lowland dipterocarp forest is a particularly threatened ecosystem which includes an exceptionally high number of species and is under-represented in the existing protected area network. **(Figure 8.3.6)**

2) Wildlife Habitat

Established in 1923, Krau Wildlife Reserve is an important protected area not only for the conservation of biodiversity in Peninsular, and also an important source of fresh water for Pahang, but also for scientific research and nature conservation education. With an area of about 62, 395 hectares, it encompasses an array of different habitat types: riverine, lowland, hill and lower montane dipterocarp forest to upper montane (Oak laurel and Ericaceous forest). The general topography is mostly hilly with flat lowlands, some of which is quite swampy. The low-lying areas are mainly found in the south and central part while the mountain range, with the fourth highest mountain in Peninsular Malaysia (Gunung Benom), is located in the northwest. It is bordered by Sungai Teris in the southwest and Sungai Terboi and Sungai Krau in the northeast.

115 mammal species have been recorded in the lowland forests. It is noted particularly for its rich primate fauna with seven out of ten species in Peninsular Malaysia. The wildlife reserve also hosts more than 330 species of birds, about 150 species of amphibians and reptiles, and 70 species of fish. This diverse habitat has been and still is a center of much valuable scientific research studies, producing a wealth of information available on its biota and other ecological aspects.

A 3-year collaborative project (*Management of Krau Wildlife Reserve, Capacity Building and Human Resource Development*) between the Malaysian and Danish Governments (through MoSTE and DANCED) has in 2001 produced a management plan for the wildlife reserve (*Management Plan for Krau Wildlife Reserve 2001-2006*).

Once connected to the Greater Taman Negara Landscape through a natural biological corridor in the northeast, it is now isolated by a road built about 30 years ago at this critical linkage area. This road has also opened up the adjacent lands for human activities and thus part of the area was excised in 1971 for the village settlements. If managed as an isolated unit, the value of biodiversity at the reserve will decline, as indicated by the decline or loss of certain large mammal species (e.g., tiger, elephant, etc.). It may be too expensive or too late for the state to resume land that has been alienated and restore a 'physical' forest connection from the wildlife reserve to Taman Negara. However, it is still possible for certain management interventions to be implemented to slow the rate of species loss and the decline in biodiversity. In order to do this, a 'functional biological corridor' to the northeast between Krau and Taman Negara, and to other contiguous forests in the Peninsular (Gunung Benom in the northwest and Lakum in the south) has to be identified and maintained, allowing wildlife and plants to disperse between 'forest islands' or along 'chains' of low human disturbance semi-natural vegetation between forests (the 'stepping-stone corridors' approach). It will take good inter-agency communication and a strong sense of working together for a common purpose to maintain such a landscape function. **(Figure 8.3.7)**



FINAL REPORT

3) Human Wildlife Conflicts

There are a number of villages located within the ecological corridor SL2. The villages within the corridor are Kg. Damak, Kg. Som, Kg. Baharu, Kg. Kuala Kenong etc. At the community participants meeting, the human wildlife conflicts within this corridor have been highlighted and extensively discussed. The important issues raised are:-

- i) In Kg. Damak – Kg. Som – Kg. Baharu areas, elephants had been observed to cross through these areas.
- ii) Panthers had been sighted within the corridor. In addition, footprints of tigers were found at Kerambit FR, besides elephant. Local villagers saw tigers at forest near Kg. Batu Balai and suspected that the tigers came from Bukit Taching. JKKK members revealed that there were wild boars presence in the corridor and they caused disturbances to local residents, e.g. not only destroying crops in the plantations, but also entered villagers' houses.
- iii) The main reason was attributed to the lack of food within the Forest Reserve which inevitably forced the animals to trespass into the village to search for food. In the past, the Forest Reserve had enough fruit trees to provide adequate food for the animals to eat. However, the recent illegal logging and illegal land clearing had affect adversely the imbalance of the biodiversity and food chain.
- iv) Kg. Kuala Kenong faced problems with elephant intrusion into and destruction of oil palm plantations area except for rubber plantation. As a result, bunds or physical barriers have been created to deter / prevent elephant entering the plantation area.
- v) Kajang and Seladang always appear in group of two to four. Selembu (mix of seladang and lembu) were found within the corridor. Rhinoceros footprints also discovered in the plantation area. However, the rhino didn't disturb the people and only passed through.
- vi) Kg. Som has problem of deer eating the new rubber tree's bark in the plantation area.
- vii) Kg. Batu Balai, which is surrounded by Felcra plantations, revealed that elephant have been passing through the plantations and settlement areas.
- viii) Kg. Koi, which has around 1,200 people, mentioned that no major human-wildlife conflict occurred in their village. Nevertheless, the only problem encountered is with wild boars which appeared in quite large number in the plantation area.
- ix) Kg. Damak is facing the problem of elephant destroying the plantation crops at Felcra Jaya Putera. In addition, the monkeys have been disturbing the people and entering into villagers' houses; and the problem is worsening as the number of monkey keep on increasing over time.
- x) In 2007, elephants had destroyed the certain oil palm plantations and invaded into the settlement area within the corridor.

- xi) The monkey (Kera) issue posed a really serious within the corridor; and the monkey has conflicted with people by encroaching into people's houses and stealing food.
- xii) DWNP has not explained to the local community regarding how to handle the human-wildlife conflicts if animals were to encroach into settlement area.
- xiii) DWNP has relocated the elephant to other areas. However, elephants have still been passing through the town and moved from Som FR to Krau FR.

Figure 8.3.6 : Forest

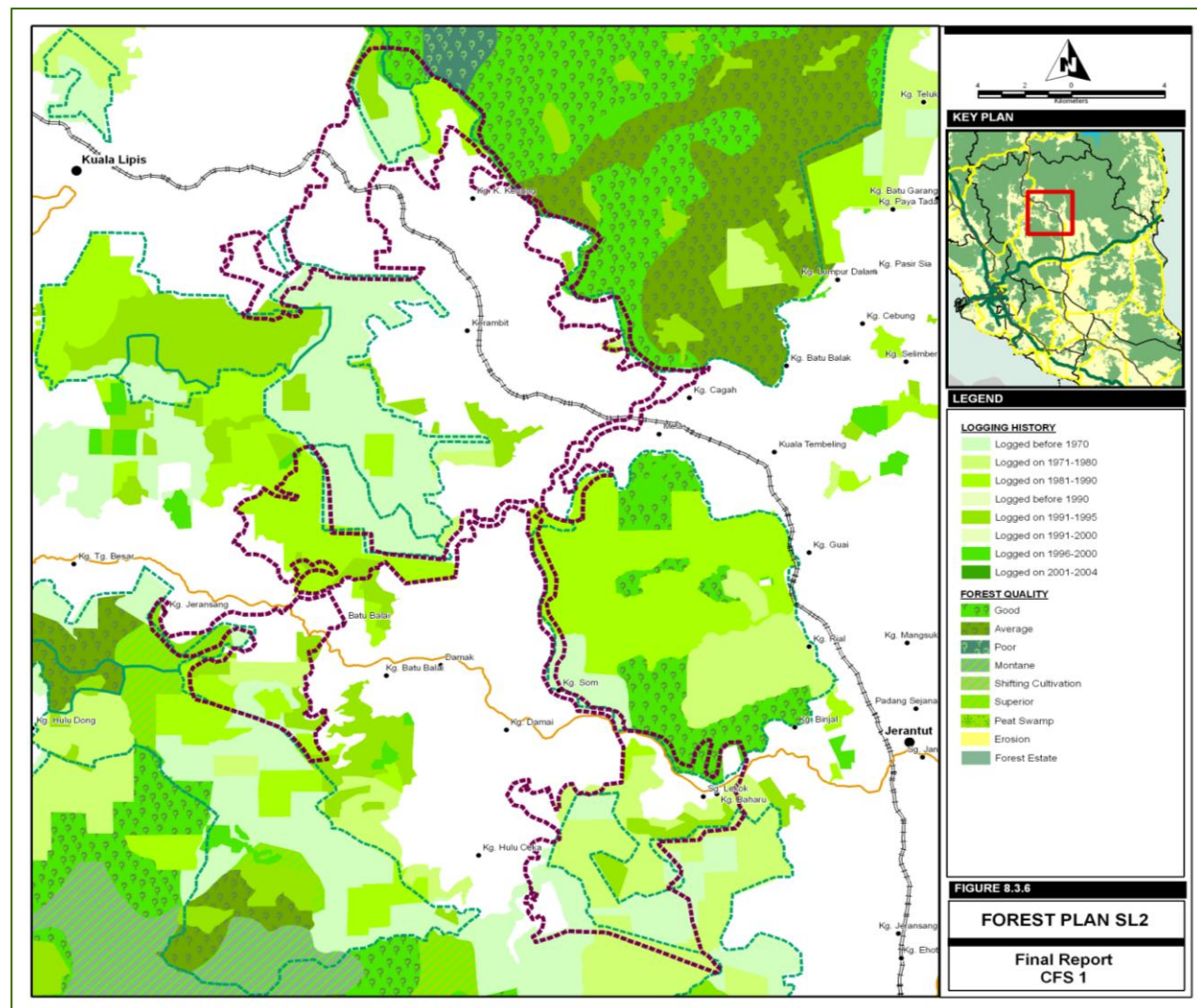
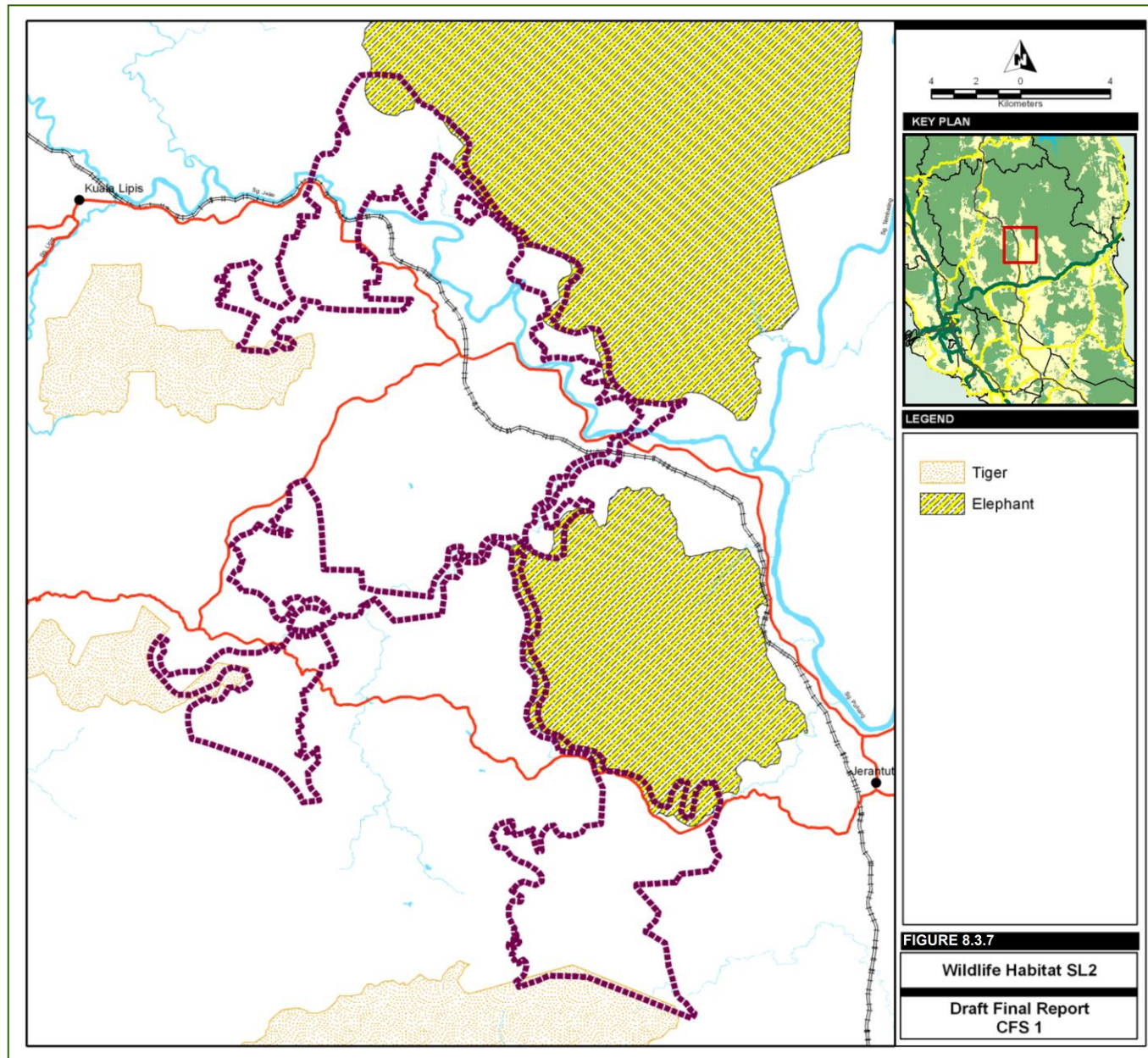


Figure 8.3.7: Wildlife Habitat



4) Environmental Sensitive Areas

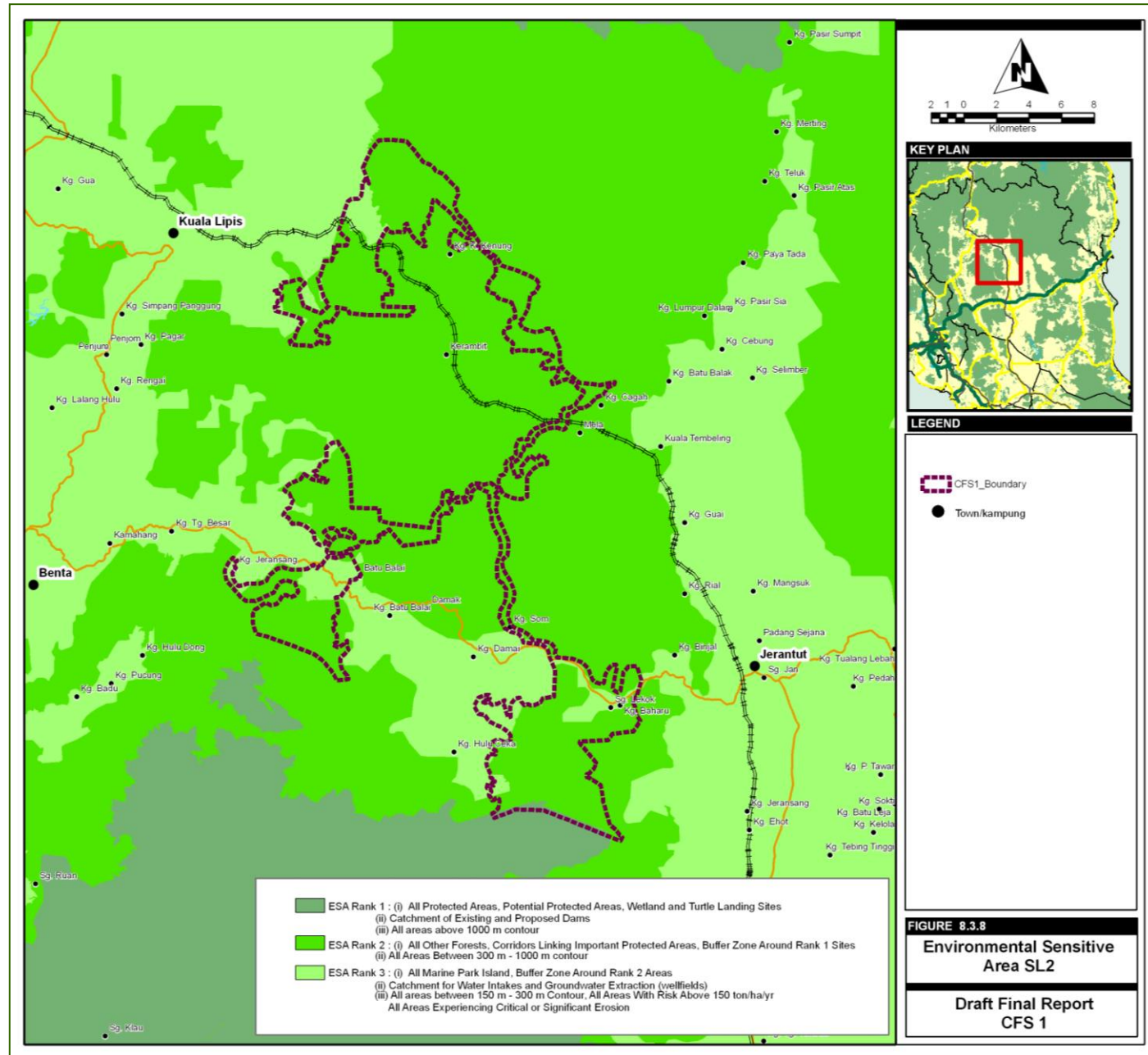
NPP 18 of the National Physical Plan (NPP) states that Environmentally Sensitive Areas (ESA) shall be integrated in the planning and management of land use and natural resources to ensure sustainable development.

The ESAs are further refined, expanded and delineated at the Structure Plan and Local Plan levels. The application of ESAs at the NPP, Structure Plan and Local Plan levels are given in **Table 8.3.5**. **Figure 8.3.8** shows the ESA plan for the SL2 Corridor.

Table 8.3.5: Application of ESAs for SL2

Spatial Plan Level	ESA Ranking	Notes
National Physical Plan	ESA Rank 2	Based on Figure IP8 in the NPP, Krau Wildlife Reserve is ranked as ESA Rank 1, while Yong, Bencah and Som Forest Reserve to the north are within ESA Rank 2. Forest gap between Krau WR and the rest of the forest reserves in the north are categorized as ESA Rank 3. The criteria for ESA Rank 3 in the NPP include buffer zone around Rank 2 areas, catchment for water intakes and ground water extraction, all areas between 150-300 m contour and all areas with erosion risk above 150 ton/ha/yr. SL 2 is aimed to reconnect Krau WR to the north, the southern tip of Taman Negara through ESA Rank 3 by implementing a stepping stone approach.
Pahang Structure Plan 2002-2020	N/A	The Pahang Structure Plan 2002-2020 does not rank ESAs, but delineates a number of ESA categories. There is a category called “Central Forest Spine”, of which all of the existing forest reserves in both PL1 and SL2 are included. The plan outlined six policies for environmental conservation. In particular, the second policy called for the sustainable and integrated development of the ESAs in the state which were identified in the National Physical Plan. The structure plan lists three steps for implementation, which include: <ul style="list-style-type: none"> • Formulating a management plan for sustainable development of the ESAs by the State Economic Planning Unit • Approval for development in ESAs can only be obtained through the State Planning Committee with advise from the National Physical Planning Council • Continuous monitoring of ESAs by relevant departments The sixth policy states that the conservation and integrated management of forest with neighbouring states is crucial to ensure the formation of “Central Forest Spine” is realized. In order to achieve this, the conservation and management of Taman Negara requires cooperation from Kelantan, Terengganu and Perak to ensure that the natural ecosystem is not disrupted. Opening up of new agricultural land at the borders should take into account the development at neighbouring states e.g. between Cameron Highlands and Dataran Tinggi Kinta, Perak and Cameron Highlands and Tanah Tinggi Lojing, Kelantan.
Local Plan		The Jerantut Local Plan is currently being drafted and is not available for review.

Figure 8.3.8: ESA





8.3.3 Socio Economics

8.3.3.1 Population and Socio economic profile–

SL2 located in between Kuala Lipis Town and Jerantut Town. All the settlements are along to road from Lipis Town to Jerantut Town. Population for District Jerantut is 36,287 and District Lipis is 37,008. There are kampongs within the corridor such as Kg. Mala, Kg. Batu Balai, Kg. Damai, Kg. Jeransang, Kg. Som, Kg. Kerambit and etc. Landuse within the corridor mostly is oil palm and rubber plantation. The residents who stay beside the railway will take a train to Lipis or Gua Musang from Jerantut to work. There are some kampongs as rural growth centre which has school, clinic and religions facilities such as Kg. Mala.

8.3.3.2 Socio Perception to Ecological Corridors

Secondary linkage locations usually consist of several core and buffer zones that are not contiguous but spread out over the entire ecological corridor. Instead of a single, long linear corridor, there are several smaller patches of disturbed forests and plantations that serve as 'stepping stones' to connect to larger forest islands. In this secondary link the main concern for connectivity is between the Krau Wildlife Reserve and the Greater Taman Negara area.

There are three different corridors that comprise the ecological linkage. One extends from Kenong Rimba State Park across the river to connect Yong FR to Benchah FR. The second connects the Kerambit-Ulu Mas FR complex to the Bukit Taching-Jerantut FR complex. And the third connects Som FR to the Krau FR.

In regard to community safety, there are no large mammal populations or movements to disturb settlements or plantations. On rare occasions there have tiger sightings but no recorded incidence of conflict. Many smallholders are even abandoning land due to poor road access.

In regard to public safety, there are no movement of large animals crossing the roads. Although smaller mammals (e.g. pangolins) may be at risk, there is no immediate concern for motorists. Most roads traverse outside of the main core and buffer zones.

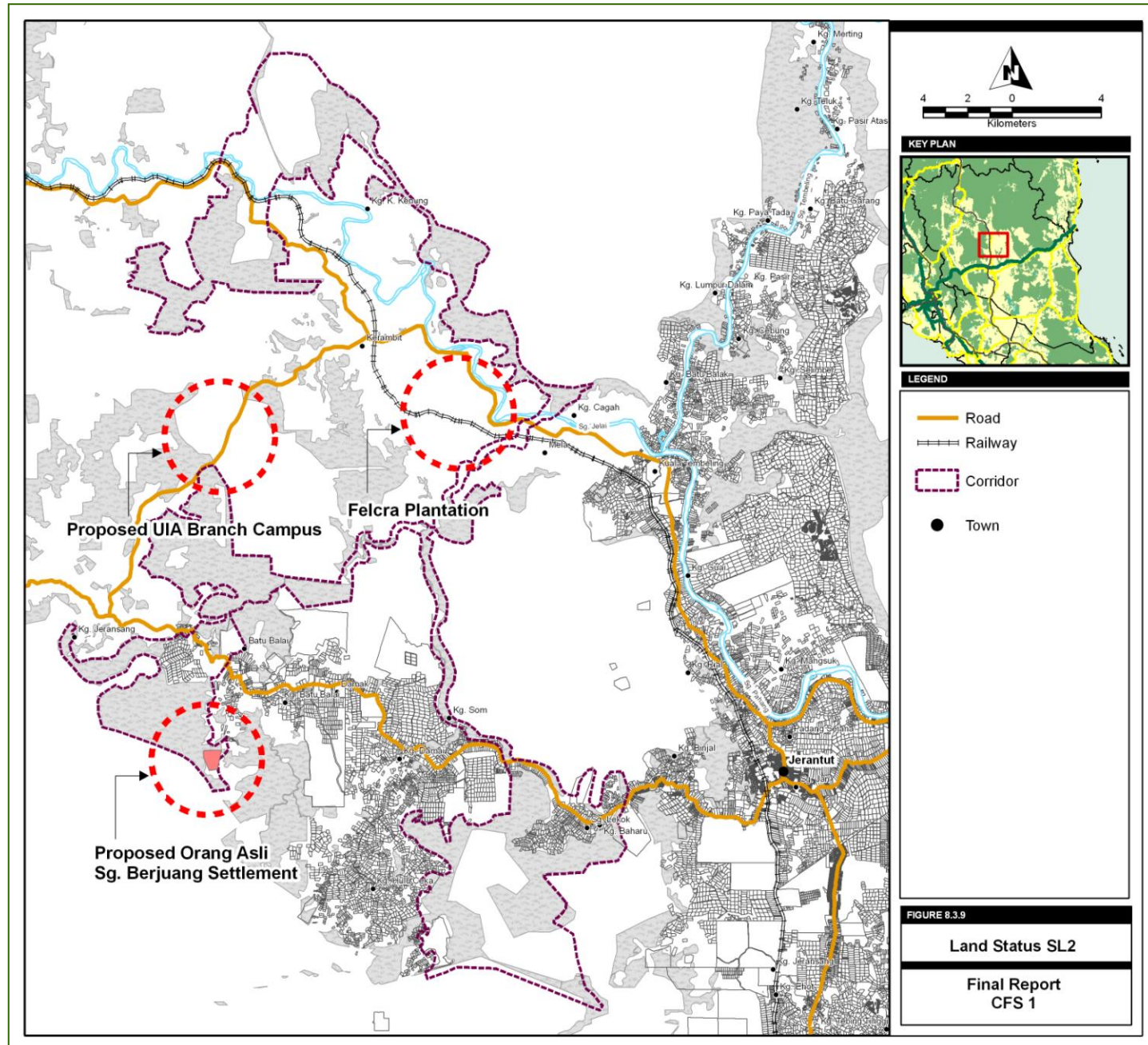
In regard to tourism opportunities, there is potential to improve activities in the Kuala Lipis and Jerantut areas. However, more focal group discussions are needed to test the viability of engaging communities in homestay programmes and outdoor recreation.

In summary, there are no immediate concerns for the public since large wildlife movement or disturbance is not an issue. The three corridors recommended do not alter the general land use patterns of existing communities and plantation estates. The opportunity exists to increase the profile of tourism to provide additional ecotourism businesses as a benefit of the CFS project.

8.3.3.3 Land Status

All the land along the road and river were alienated land. The landuse of these lands generally is housing and agriculture. Within the Kerambit Forest Reserve, Land area along the road from Jeransang to Kerambit, there is a proposal to develop the branch campus of Islam International University which is 1000ha. State land forest within the corridor has been illegal logged and clear to become farm. There is also proposal to convert the state land as oil palm plantation near Kg. Batu Balai. Along the river, there are no river reserves as the lots were alienated long time ago. A riparian reserve and land acquisition will be needed on a case to case basis. **(Refer Figure 8.3.9).**

Figure 8.3.9 : Land Status



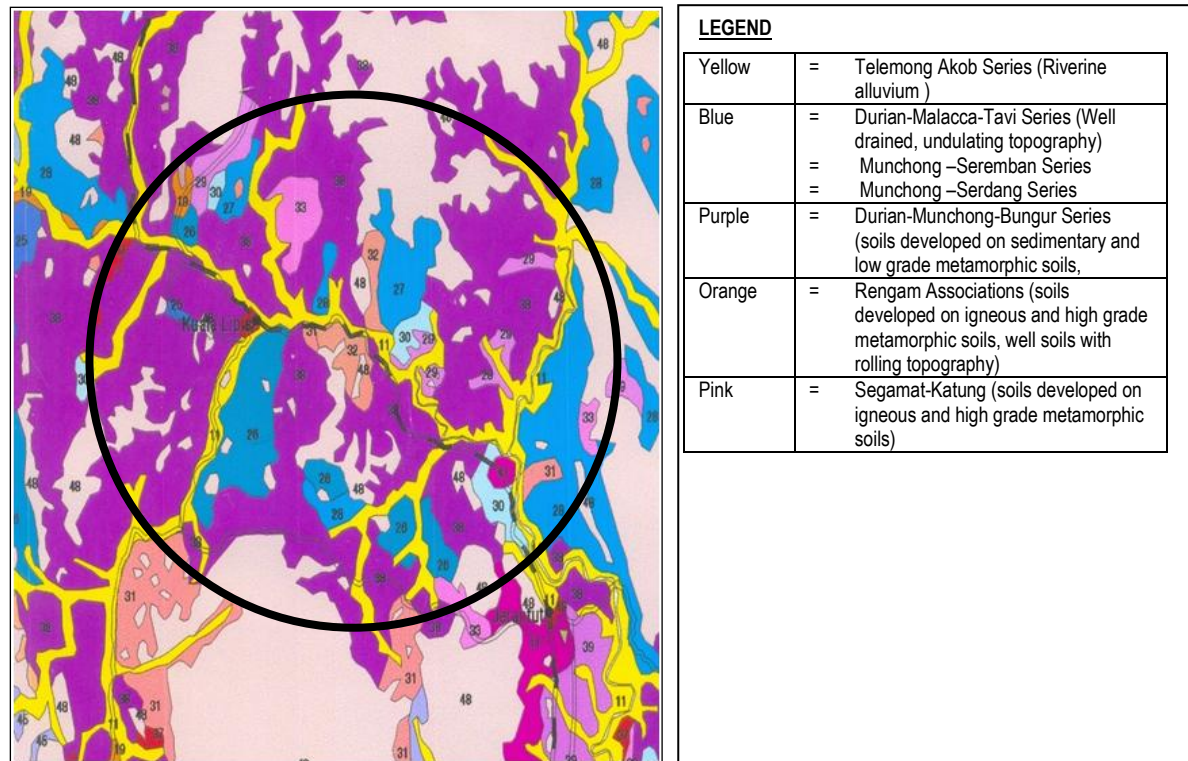
8.3.3.4 Agriculture Activities

The area represented by the secondary linkage is a highly developed area with high population base.

Soils and Land-Use

The ‘detailed reconnaissance soil survey’ conducted by the Department of Agriculture shows most of the soils in the area are undulating and consisting of riverine alluvium and mineral soils (**Figure 8.3.10**). These soils are mostly in the class 2 category that have very few minor limitations to agricultural development and suitable to a wide range of crops including rubber, oil palm and horticultural crops

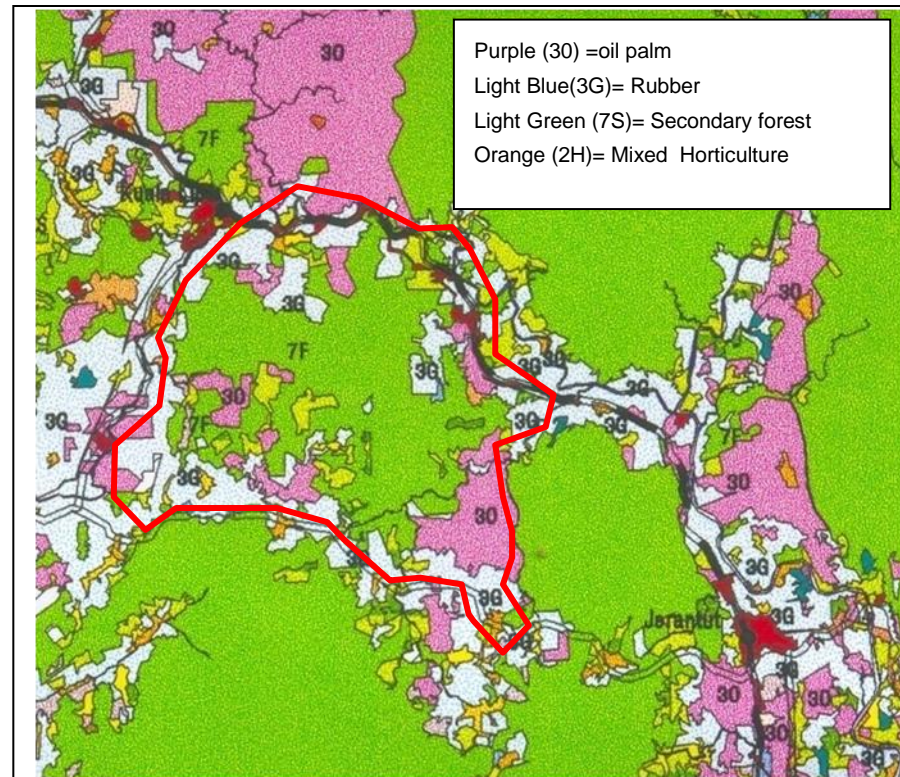
Figure 8.3.10: Soil Types Found in the Linkage Area



Source: Department of Agriculture

The major agriculture land use surrounding the forest reserves in the area are rubber, oil palm, mixed horticulture and scrubland (see Figure 8.3.11 and Figure 8.3.12).

Figure 8.3.11: Agriculture Land-Use in SL 2



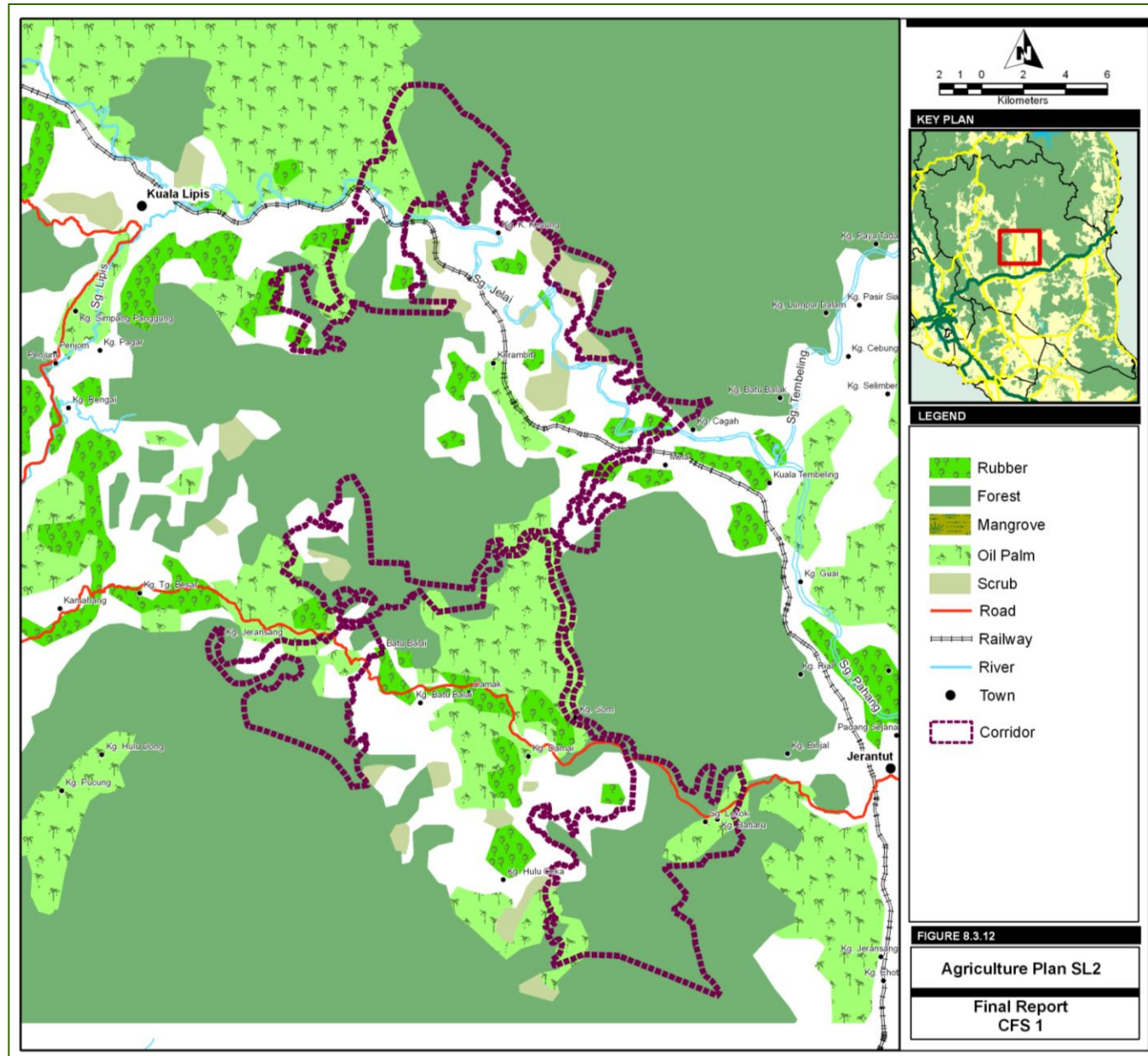
Source: Department of Agriculture 2006

There a number of plantations in the secondary linkage area. The major stakeholders in the area of the Federal Land Development Authority (FELDA), Federal Land consolidation and Rehabilitation Authority (FELCRA), and LKPP, RISDA and the private sector. Details of these plantations as shown in **Table 8.3.6** :-

Table 8.3.6: Number of plantation in SL2

Estate	Crop	Ownership	Area (Hectares)
FELDA Kechau 6	Oil Palm	FELDA	3605
FELDA Kechau 7	Oil Palm	FELDA	2442
FELDA Kechau 8	Oil Palm	FELDA	2098
FELDA Kechau 9	Oil Palm	FELDA	1457
FELDA Kechau 10	Oil Palm	FELDA	2307
FELDA Kechau 11	Oil Palm	FELDA	2728
FELDA Kechau 11	Oil Palm	FELDA	2036
FELDA Telang 1	Oil Palm	FELDA	1884
FELDA Lepar Utara 7	Oil Palm	FELDA	2055
FELDA Lepar Utara 8	Oil Palm	FELDA	2300
FELDA Lepar Utara 9	Oil Palm	FELDA	2690
FELDA Lepar Utara 11	Oil Palm	FELDA	2368
FELCRA Cheka	Oil Palm & Rubber	FELCRA Bhd	1786
FELCRA Sg. Poho	Oil Palm & Rubber	FELCRA Bhd	850
FELCRA Tembeling Tengah	Oil Palm	FELCRA Bhd	2206
RISDA Ulu Cheka	Oil Palm	Espek Sdn. Bhd/ RISDA	1215
LKPP Sg Rengai	Oil Palm	LKPP	2441
LKPP Temin			1444
Selbourne Estate	Rubber & Cocoa	KL Kepong	1210
Takau Estate	Oil Palm	Private	445
Padang Piol Estate	Oil Palm	Private	397
Yu Kee Estate	Oil Palm	Yu Kee Plantations Sdn. Bhd.	238

Figure 8.3.12 : Agriculture





There are also smallholders cultivating rubber and orchard in the area. Most of these rubber smallholdings are located along the main Jerantut-Kuala Lipis and Benta-Jerantut state roads, along the railway tract, as well as along the river tributaries

1) Disturbance and Threats

The rapidly increasing population and agriculture development in the region and, and the resulting rate of urbanisation puts a strong pressure of the various forest reserves and ecological corridors within the region

Pollution as a result of agriculture development is a serious threat as pollutants tend to accumulate in rivers and therefore affect ecosystems. Pollution arising from solid waste dumping, pesticides and herbicide residues from land-based agricultural activities, untreated effluent/discharges from industries and domestic areas, silt, and soil erosion are major threats to the ecosystems.

Agricultural development also affects the riparian areas within the river basin. Riparian reserves and wildlife corridors composed of natural forests should be maintained in oil palm and rubber plantations to provide habitats for indigenous plants and animals

2) Strategies

One of the most effective ways to obtain broad support for the secondary biological linkages in the area is to integrate the planning and management of the ecological corridor proposed with the agricultural activities that deliver benefits in sustainable land management (such as protection of water resources or sustainable use of natural products). The challenge is to find ways to achieve both goals of conservation and agricultural development without compromising conservation objectives.

This requires engaging the various stakeholders in the area to gain their support in collaborative actions in sustainable agricultural management practices to help reduce the negative impacts of agricultural practices in plantations to the environment in particular in the ecosystems in and around ecological corridors. This can be done through:-

- i) The protection of soil and water resources in the corridors,
- ii) The integration of linkages for wildlife with sustainable agricultural management in the developed landscapes through linked systems of natural vegetation along rivers and streams. Streams and rivers are usually the template for retained systems of habitat in managed forests because they provide a rich habitat for wildlife while also acting as buffers to minimize sedimentation and protect water quality in streams
- iii) Increasing biodiversity by providing a habitat for indigenous flora and fauna through a combination of forest and riverine conservation areas within the plantations. This include establishment of riparian reserves on the key rivers and carrying out enrichment planting / reforestation in the riparian reserves such as :
 - Sungai Som (the entire length of the river, including Sungai Kenong and Sungai Darah)
 - Sungai Ceka (from the Kuala Som to Kuala Rengat)
 - Sg. Tembeling and Sg Tekam



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Secondary corridors will require a landscape-level planning approach whereby a matrix of forest and agriculture land-use coexists to maintain landscape heterogeneity as stepping stones for wild life and bio-diversity. Estate managers and smallholders are encouraged to practice sustainable plantation management as outlined in 'Guidelines on Sustainable Agricultural Management of Plantations' to ensure plantations provide micro-climate for wild-life especially small mammals, birds and reptiles. These include:-

- Conservation of forest areas within their plantation areas, especially areas that are unsuitable for oil palm cultivation and rubber cultivation, to enhance its natural biodiversity.
- Promoting sustainable development through non-polluting commercial techniques for land preparation (eg zero burning)
- Practicing 'Integrated Pest Management (IPM) by using a mix of suitable techniques in plant protection eg biological control that minimizes damage to the environment.
- The efficient use of field residues to minimize waste and prevent pollution to the environment.

8.3.3.5 Tourism Activities

SL 2 Krau WR- Bencah FR- Som FR- Yong FR proposed case study area located within Kuala Lipis-Jerantut districts, less than 30 kilometre away from two ecotourism destinations of Pahang i.e. Taman Negara Jerantut - Kuala Tembeling and State Park of Kenong Rimba Park.

Other tourism products located within 50 kilometres from the proposed linkage are:-

- Batu 9 Homestay
- Historical town Kuala Lipis
- Taching Hill Recreational Forest
- Burung Mandi Lake
- Jeram Besu
- Sg. Som Recreational Forest
- Kota Gelanggi Cave
- Seladang Conservation Centre Jenderak
- Lata Meraung
- Lata Jarum
- Lata Besin
- Kg. Baharu Agrotourism
- Ulu Jeransang Recreational Forest
- Lata Lembah Kiol

Kenong Rimba Park, Som Recreational Forest and Taching Hill recreational forest are three tourism products located in closer distance to the proposed wildlife corridor. Kenong Rimba Park was developed as the State Park. It was then promoted by state as an option to Taman Negara for shorter visitation. Som Recreational Forest is only popular among locals. Taching Hill located at the foothill of Mount Benom and fringe of Benum Forest Complex and Krau Wildlife Reserve. Although was well known among bird lovers as bird paradise, Taching Hill Recreational Forest unfortunately was unattended and unsafe to tourists.



1) Tourism Support Facilities

Most tourists' accommodation facilities within the SL2 region located in gateway towns of Jerantut and Kuala Lipis. With completion of tarred road construction to Taman Negara Jerantut, Kuala Tembeling function as gateway for tourists to Taman Negara is greatly reduced. For tourists to Kenong Rimba Park, they would stay in Kuala Lipis town (less than 10km) or chose to stay in the chalets of Persona Rimba Resort available in the park. Kenong Rimba Park used to only accessible via Sg. Kenong until tarred road being built connecting Felda Kechau road to the park.

Tourist agents and nature guide services are available in Jerantut, Kuala Tembeling and Kuala Lipis. Their scope can be further expended to serve the proposed ecological linkage proposed within SL2.

2) Local Participation in Tourism

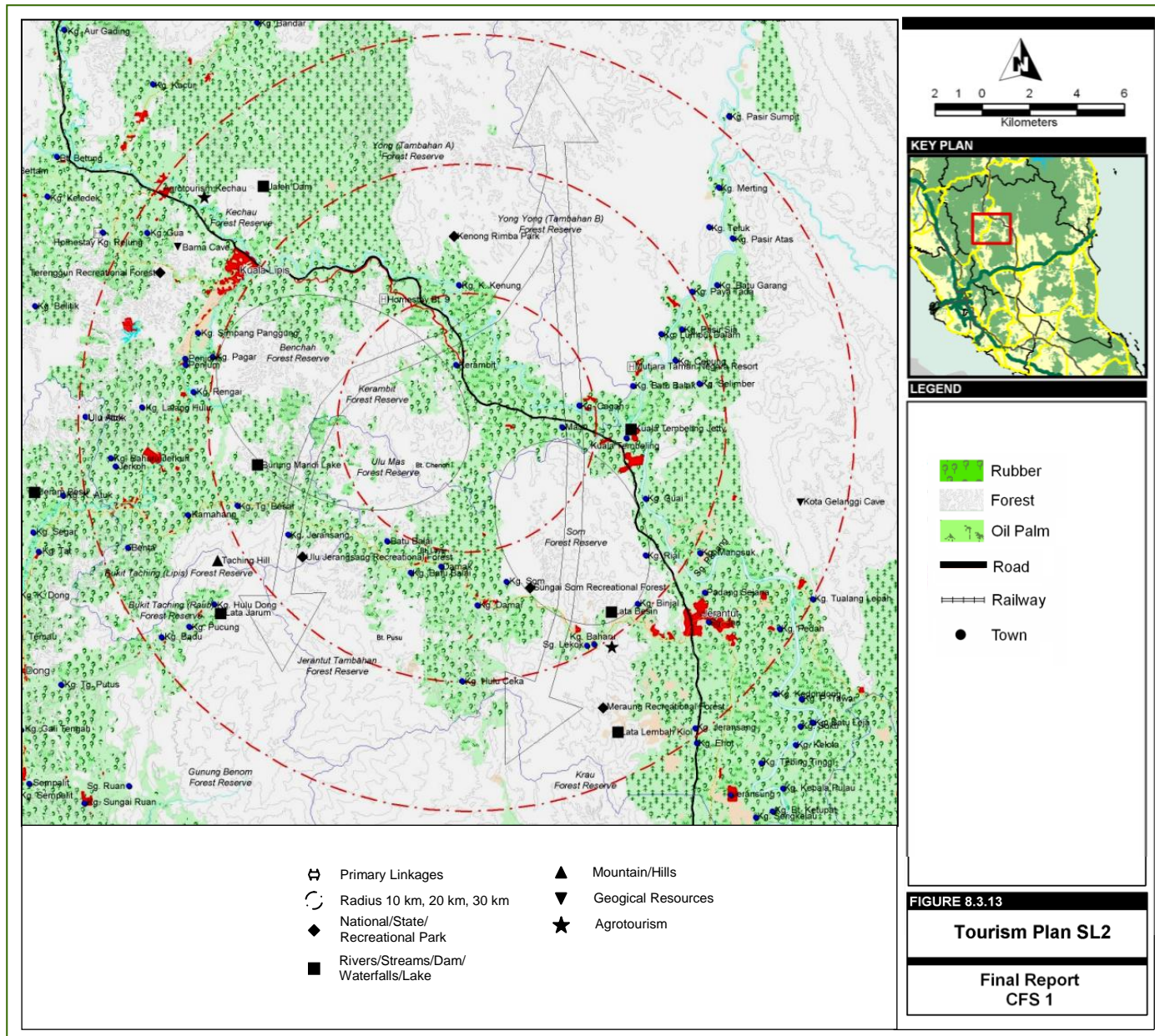
Local participation in tourism product development within the study area is minimal. Majority of products and facilities are developed either by government agencies or by Kuala Lipis and Jerantut local authorities. Participations by locals are mainly as tourist agents and tourist guides to Taman Negara and Kenong Rimba Park.

Although there were some efforts to promote Kg. Batu 9 Kerambit as homestay destination, and Taching Hill as birders destination, they were unsuccessful due to many reasons. With supports from the government, the locals can be encouraged to take part in developing and managing ecotourism products, including the wildlife corridor proposed within the region. **(Figure 8.3.13)**

8.3.3.6 Forestry Activities / Logging

Most of the forests in this area have been logged but is presently regenerating. The forest in the state land area has been logged relatively heavily but still has potential to serve as habitat for wildlife corridors. **(Refer Figure 8.3.6)**

Figure 8.3.13: Tourism





8.4 THREATS, OPPORTUNITIES AND CONSTRAINTS

8.4.1 Physical and Land Use

The evaluation of the physical, socio-economic and biological characteristics of the Krau WR – Bencah FR – Som FR -Yong FR area will indicate the potential barriers hindering the wildlife movement between the Main Range and Greater Taman Negara as well as will enable to identify opportunities in encouraging and facilitating movement of species and ecological processes.

More specifically, the assessment will provide us the basis to select the precise location and type of physical structure required, e.g. underpass or overpass, to ensure the viability and functionality of the ecological corridor identified. It will also help in identifying the limited number of uses that may be allowed within the core area of the ecological corridor and any conditions attached for such uses. In addition, it will allow us to define those compatible land uses and development that can be permitted in the adjacent buffer zone / special management area without compromising the biodiversity conservation objectives, e.g. minimal disturbance to the animal species and safety of the residents. Mitigating measures, e.g. electric fencing, may need to be taken to protect the existing residents from wildlife attacks.

8.4.1.1 Constraints

In identifying the location, extent and type of ecological corridor, particularly the physical structure, the following constraints must be taken into account, viz:-

- Krau Wildlife Reserve is isolated and severely fragmented from Greater Taman Negara and the Main Range by different surrounding non-forest land uses including agriculture plantation, vegetable farms, settlements and linear infrastructure;
- The two roads as well as the railway line linking Kuala Lipis Town and Jerantut Town pose a dangerous and difficult barrier to wildlife movement;
- Many small settlements, such as Sg. Mala, Kg. Batu Balai, Kg. Damai, Kg. Jeransang, Kg.Som, Kg. Kerambit etc. dispersed along the two roads linking Kuala Lipis Town and Jerantut Town will create potential wildlife-human conflicts and deter sensitive wildlife from using the corridor;
- Certain adjoining land lots along the rivers have been alienated to private individuals before the river reserve requirements was introduced, and therefore need to be acquired for establishing riparian wildlife corridor; and
- Most of the forests, including Stateland forest, have been logged which require reforestation for use as wildlife corridor and forest patches.



8.4.1.2 Opportunities

The following available opportunities should be fully exploited to ensure the creation of a viable and functional ecological corridor, namely:

- Krau Wildlife Reserve is a very important conservation area for lowland forest;
- It is endowed with great biological richness in terms of smaller species;
- National Biodiversity Centre is set up in Bukit Lanchang;
- The mostly low land (89.3%) and hill land (10.7%) are suitable to establish and maintain stepping stones corridors and small habitat forest patches (i.e. Som FR, Kerambit FR and Benchah FR); and
- Availability of riparian rivers reserves, particularly Sg. Ceka, Sg. Som and Sg. Sepan, can serve effectively as natural pathway for wildlife movement.

8.4.1.3 Threats

The following threats must be considered in drawing up the ecological corridor, namely:

- Rising population and higher urbanization rate will exert strong development pressure on the area which will lead inevitably to the loss of forest cover and increase in forest fragmentation, thus resulting in the elimination and deterioration of forest connectivity and wildlife movement;
- Likely loss and decline of large mammals, e.g. elephant and tiger, within Krau Wildlife Reserve as the area is no longer of a viable wildlife habitat size and isolated from other large forest complexes due to difficulty in establishing functional contiguous linear ecological corridors;
- Pollution, such as pesticides, herbicide and untreated effluent discharges into rivers from agriculture development, adversely affects the forest ecosystem and river riparian corridors;
- The riverine alluvium and mineral soil are suitable for agriculture which may lead to deforestation and forest fragmentation; and
- Numerous applications have been received to alienate state land and forest reserve in the area for development including a proposed branch campus of University within the Kerambit Forest reserve and a proposed oil palm plantation on state land near Kg. Balai.



8.5 LINKAGE STRATEGY

8.5.1 Strategic Thrusts

As the extent of human settlements and other artificial barriers in areas surrounding the forest complex is too great to allow for establishment of linear corridors, the stepping stone approach shall be taken to allow movement of birds and other small animals between Krau and Greater Taman Negara complex. The following key steps should be taken:-

1) **Gazetted as forest reserve**

- i) Gazette state land forests in the identified corridors as forest reserve.
- ii) Gazette all scrub land in the corridor as part of the forest reserve.
- iii) Establish a link to the Krau Wildlife reserve.

2) **Establish wildlife crossing**

- i) Establishment of wildlife crossing over roads in the SL2 area.
 - Maintain existing roads in the area in their present condition (i.e. no more than 2 lanes, no road widening, and no highways).
 - Put up sign posts and impose speed controls on road
- ii) Although elephants have been sighted along this secondary link, generally the target wildlife are small mammals.
- iii) The existing roads or railways do not appear to pose a major obstacle to wildlife crossings.
- iv) Route 64 is undergoing upgrading works and it may be necessary to incorporate elements of wildlife crossings in the upgrading works.
- v) For small mammals and reptiles, appropriate forms of crossings would be culverts, either box or circular. Both types of culverts may be used and if properly designed could also serve as drainage structures as well as for wildlife crossings.

3) **Create riparian corridor**

- i) Rivers play an important role to create continuous crossing which can connect the isolated forest islands.
- ii) Acquire land on a case-by-case basis as riparian reserve.
- iii) Gazette a riparian reserve as a wildlife corridor (50m wide on both sides) in order to link Krau complex to Sungai Jelai.
- iv) Immediate freeze on land alienation and development in the riparian reserves.
- v) Within SL2, Sg. Ceka, Sg. Som and Sg. Sepan have been identified to establish a riparian reserve to become a natural corridor for the animals.
- vi) Planting of selected tree species that attract animals and birds.



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4) Forest Management

- i) Carry out enrichment planting / reforestation in the riparian reserves.
- ii) Maintain the Som, Hulu Mas, Bukit Taching, Jerantut Tambahan, Krau, Kerambit forest reserves (i.e., no further degazettment).
- iii) Utilise principles 3 (Maintain structural complexity of habitat stand) and 4 (Maintain landscape heterogeneity), for managing biodiversity in the landscape (refer to the Common Vision, NRE) for all future land use planning in the buffer areas.
- iv) Unprotected state land forest should be incorporated into the forest reserve network. Low-impact, selective logging can be carried out as long as the impacts on connectivity are carefully monitored.
- v) Replanting appropriate fruit trees / selected species within Som FR to provide food for animals

5) Land use management control

- i) Practice sustainable agriculture as provided in the guidelines 'Guidelines for Sustainable Agricultural Management of Plantations' and RSPO guideline.
- ii) The wildlife corridor is to be promoted as part of the premier ecotourism destination of the National Park (Jerantut) and Kenong Rimba Park (Pahang State Park).
- iii) Establish special management zones to reduce wildlife animal-human conflicts. No further expansion of human settlements will be permitted within these SMAs such as Kg. Baharu and Kg. Batu Balai. Separation ditch should be constructed between Som FR and village.
- iv) The wildlife corridor is to be promoted as premier ecotourism destinations e.g. serve food to animals within the Som FR at selected locations and certain timing. This can be promoted as a tourism attraction.
- v) To develop a research and rehabilitation centre for small animals at Kenong (near Som Forest Reserve).
- vi) To build a new DWNP office at Kg. Kenong (middle of Kg. Baharu to Kg. Som) to enable villagers to quickly inform the responsible officer for immediate remedial actions if any human-wildlife conflict or problems arose (the nearest DWNP office is at Temerloh District).
- vii) Prohibit and prevent legal or illegal poaching within corridor so as to develop the corridor SL2 as the wildlife reserve.
- viii) To relocate the elephant from Som FR into Krau WR and make Krau WR as an elephant sanctuary.



8.5.2 Land Use Zoning and Control Plan

1) Future Agriculture Zone and Activities

SL2 apply the stepping stone concept which will create crossing for small animal and birds. For the agriculture within the corridor, mostly is oil palm plantation and rubber plantation, it will require to practise the sustainable agriculture as provided the guidelines 'Guidelines for Sustainable Agricultural Management of Plantations' and RSPO guideline.

2) River and Riparian Corridors

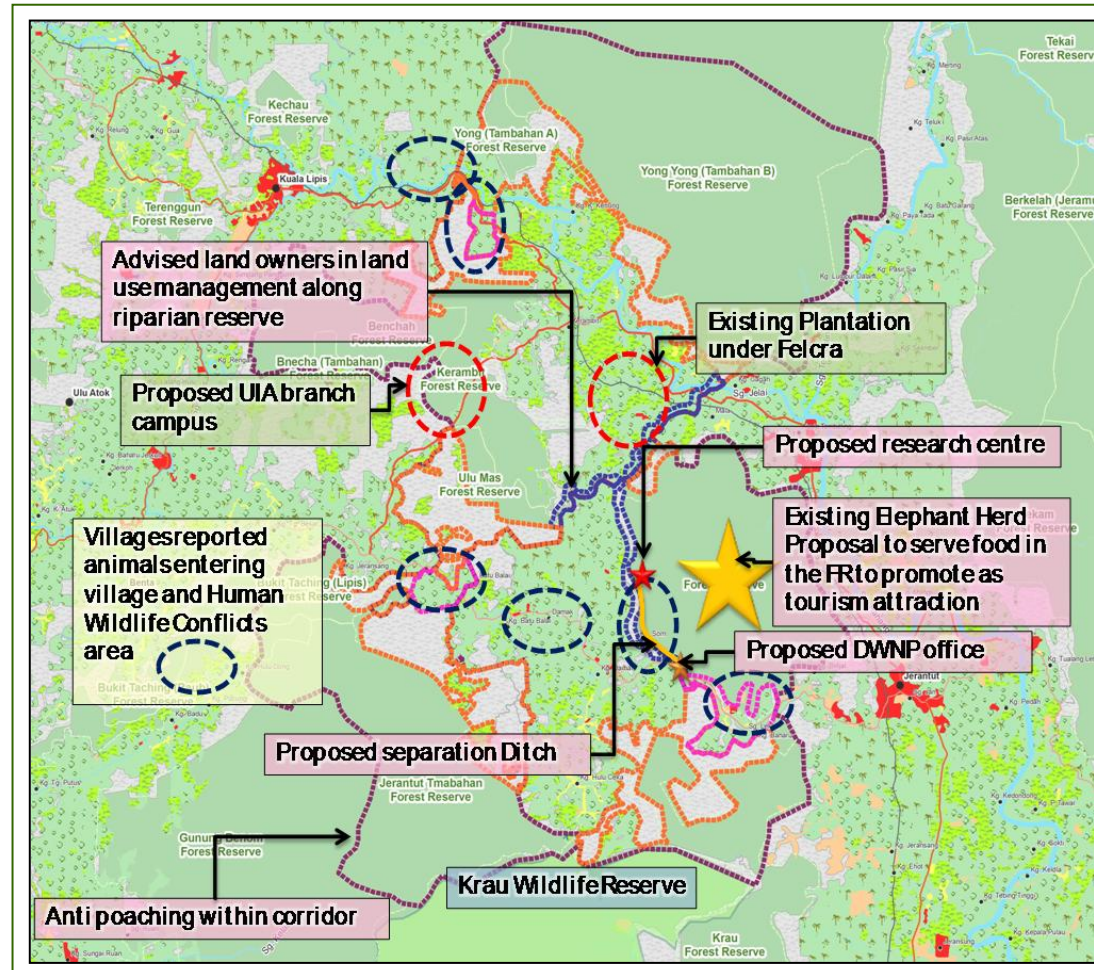
For the stepping stone concept, it will need the small patches of the forest in between the forest complexes to provide an area for animal to stay while they cross from one forest complex to another. Besides, rivers also play an important role to create continuous crossing which can connect the isolated forest islands. Within SL2, Sg. Ceka, Sg. Som and Sg. Sepan have been identified to create riparian reserve to become natural corridor for the animal. All the riparian reserve have to first gazette the river reserve (width of river reserve depends on the width of river) and riparian reserve after river reserve is 50 metres. At this natural corridor, trees which will attract the animal will be planted to guide the animal cross the forest complexes follow the river. For the lot adjacent to the river reserve (lots which not enough space for riparian reserve), the land owner will be advised to exercise proper and use management, to create an adequate buffer zone within the plantation and to make sure that animal would not enter their home.

3) Special Management Area

SMA located near to proposed animal crossing areas such as Kg. Baharu and Kg. Batu Balai. No further expansion of human settlements should be allowed within these SMAs. Human settlements management is also important to avoid the human-wildlife conflicts within these areas.

Since Kg. Som villages have conflicts with wild elephants such as elephants entering the village, disturbing the villages and destroying villager's properties, the construction / improvements of bunds or trench have been proposed to create a barrier / buffer between the boundary of village and Som FR. The location to create the bund / trench has been shown in **Figure 8.5.1**.

Figure 8.5.1: Management Strategy for SL2



8.5.3 Establishing Wildlife Crossing (Key Initiatives)

Although there is no mega wildlife crossing structure within this corridor, infrastructure development management is important for the safety of the residents and also the small animals which cross the road. Appropriate infrastructure will be installed to allow small animals to cross roads at suitable sites, at appropriate intervals along roads (e.g. culverts, overhanging wires). Within the SL2 corridor, no road widening is allowed. From the edge of the corridor, sign posting and speed limits are needed to control the vehicle that drive through the corridor.

Infrastructure

This secondary linkage involves three main linear infrastructure:-

- i) Railway line between Jerantut and Kuala Lipis
- ii) Federal Route No. 64 between Jerantut and Benta
- iii) Various State Roads
 - State Road C9 between Jerantut and Kuala Tembeling
 - State Road C160 between Mala and Kerambit
 - State Road C 154 Kuala Tembeling – Mala – Kerambit – Kuala Lipis. The stretch between Kerambit and Kuala Lipis is a newly constructed stretch of road.

The railway line is part of the main Kuala Lumpur – Kota Baru line. However, the frequency of trains on this line is low and it is not expected to be a major obstacle to wildlife crossing.

Federal Route No. 64 between Jerantut and Benta is a 2 lane road. At many stretches it travels through hilly terrain and has numerous bends and corners. This road has been planned for upgrading and short stretches are already upgraded while others are still under construction.

Information from JKR indicates that the whole of Federal Route No. 64 (Maran – Jerantut – Benta) will be upgraded in the future. **Table 8.5.1** and **Figure 8.5.2** below gains the current status of the road upgrading works.

Table 8.5.1: Status of Upgrading Works on Federal Route 64, Benta to Jerantut

Segment	Status
7A	Under Construction
7B, 8, 9, 10	Design Completed

Source : JKR, 2008

Figure 8.5.2: Upgrading works to Federal Route 64

Project name: Upgrading Jalan Benta - Jerantut - Maran, Pahang
Phase 1 - from Benta to Jerantut, Segment 7B, 8, 9, and 10

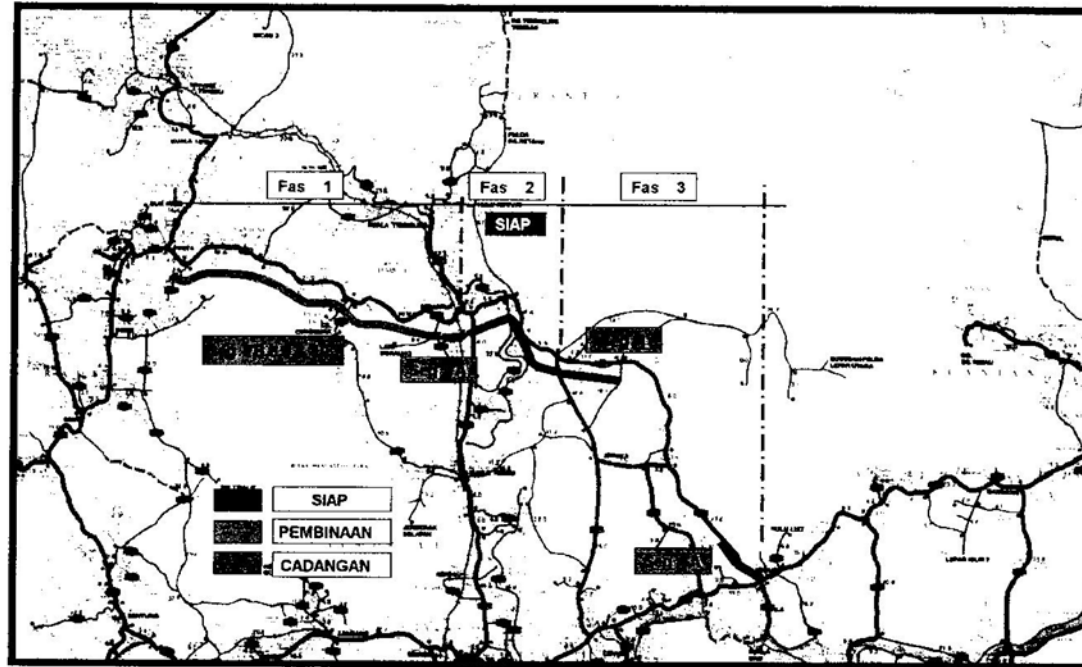


Figure 8.5.3 shows a portion of Federal Route No. 64 near Jerantut which is being upgraded. As can be seen from those figures, the upgrading works involve road straightening (realignment) works and the construction of new bridges to replace existing old bridges.

Figure 8.5.3: Road Construction and Design



Along the state roads (State Road C154, C9, C160) – Kuala Tembeling – Kuala Lipis, the traffic volume appears low. The new stretch of road between Kerambit and Kuala Lipis has several bridges along this road. Figure 8.5.3 shows one of the bridges. As can be seen from the figure, this bridge by virtue of its relatively large and flat river banks would enable wildlife to pass below the bridge.

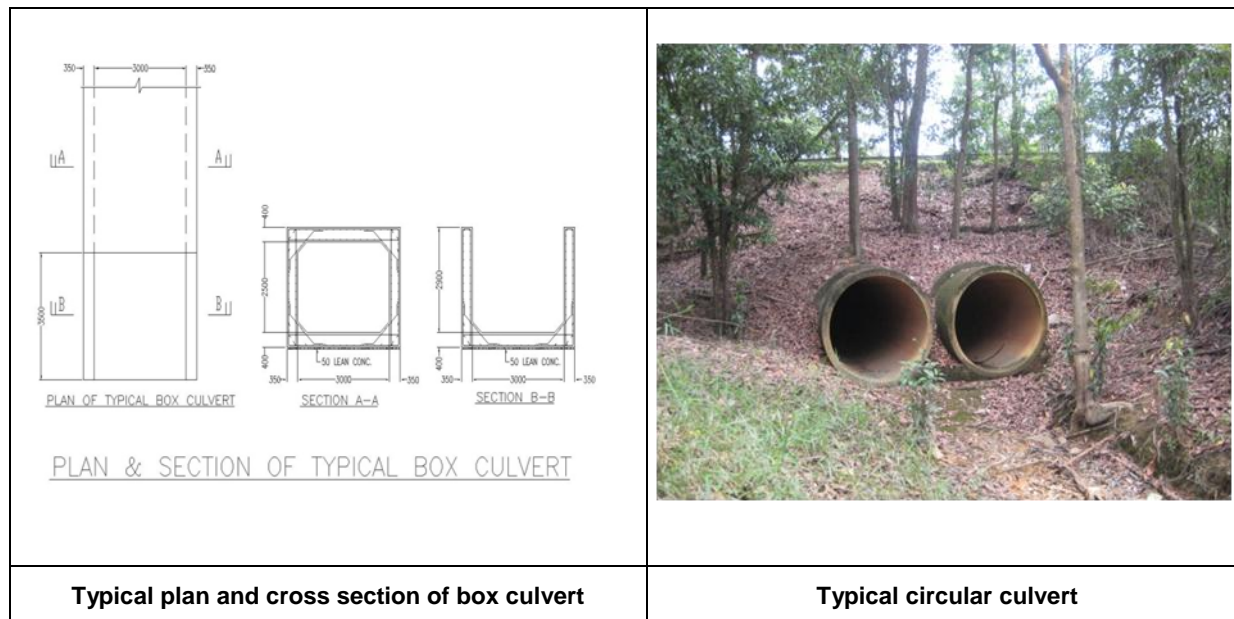
Recommendations for SL2-Krau North

Traffic volumes along the railways and the roads are likely to be low. The existing roads generally serve the local communities with the exception of Federal Route 64 which connects Maran to Kuala Lipis via Jerantut and Benta.

Although elephants have been sighted along this secondary link, generally the target wildlife are small mammals. The existing roads or railways do not appear to pose a major obstacle to wildlife crossings. Nonetheless it is recognized that Federal Route 64 is undergoing upgrading works and it may be necessary to incorporate elements of wildlife crossings in the upgrading works.

For small mammals and reptiles, appropriate forms of crossings would be culverts, either box or circular. These can be placed at strategic locations where wildlife are known to cross the road. **Figure 8.5.4** shows a typical plan and cross section of a box culvert and circular culvert. Both types of culverts may be used and if properly designed could also serve as drainage structures as well as for wildlife crossings.

Figure 8.5.4: Box Culvert Design and View



It may also be necessary to provide overcrossings in the forms of cables for small mammals such as monkeys to cross the roads. Cables can be strung from tree to tree on opposite sides of the roads. Cables strung across the road must have sufficient clearance for vehicles to pass safely below.



8.5.4 Strengthening Ecotourism Capacities (Key Initiatives)

- 1) Develop the wildlife corridor as one of the ecotourism attraction within Jerantut – Kuala Lipis region by including it into the Pahang State Park i.e. Kenong Rimba Park – Kuala Tembeling National Park. This can be done by extending the existing boundary of the state park to include some part of the ecological linkage proposed, particularly the one northern of Sungai Lipis.
- 2) Relevant authorities/NGO to carry out a detailed inventory to identify wildlife species bound to use the corridor. Findings will be useful in product creation and promotion. Tourist market segment suited for the proposed linkage are extended to Taman Negara and Kenong Rimba Park eco-tourists, international and domestic tourists and students.
- 3) Develop the ecotourism infrastructure and facilities within close vicinity (proposed at Sg. Som Recreational Forest, near Kg. Kuala Kenong and Lata Meraung), or in the wildlife corridor at according to its suitability such as :-
 - Tourist centre including tourist parking area, tourist rest area, tourism information panels/boards and visiting schedules to designated wildlife potential viewing area
 - Jungle treks from the tourist centre to observation decks.
 - Observation decks and hideaway can be proposed at a distance of 200 to 250 meter from the salt lakes and the possible crossings.
 - Canopy Walkway
- 4) Tourism products within 50 kilometres suitable to be packaged together are as follows :
 - Batu 9 Homestay
 - Taching Hill - Burung Mandi Lake
 - Sg. Som Recreational Forest
 - Seladang Conservation Centre Jenderak
 - Lata Meraung
 - Kg. Baharu Agrotourism
 - Ulu Jeransang Recreational Forest
 - Lata Lembah Kiol
- 5) Locals residing within 20 kilometer radius from the proposed linkage should be encourage to take advantage in business creation, such as developing ecolodges and homestay facilities. The nearest homestay and agrotourism activities from the linkage are Kg. Batu 9 Homestay and Agrotourism Kg. Baharu.
- 6) Majlis Daerah Lipis and Majlis Daerah Jerantut need to encourage local participations in all ranges of tourism related business, including tourist accommodation, transport, travel agents, licensed tourist guides, food and beverages, souvenirs and takeaways within Benta, Kuala Lipis and Jerantut Town.
- 7) Encourage conservation, responsible tourism awareness and education, interpretation and guide trainings among locals and interested parties within the ecotourism products and at the ecological corridor proposed. Awareness signs such as “*Wildlife Crossings – Slow Down*” should be provided along the existing road and at the tourist centre.



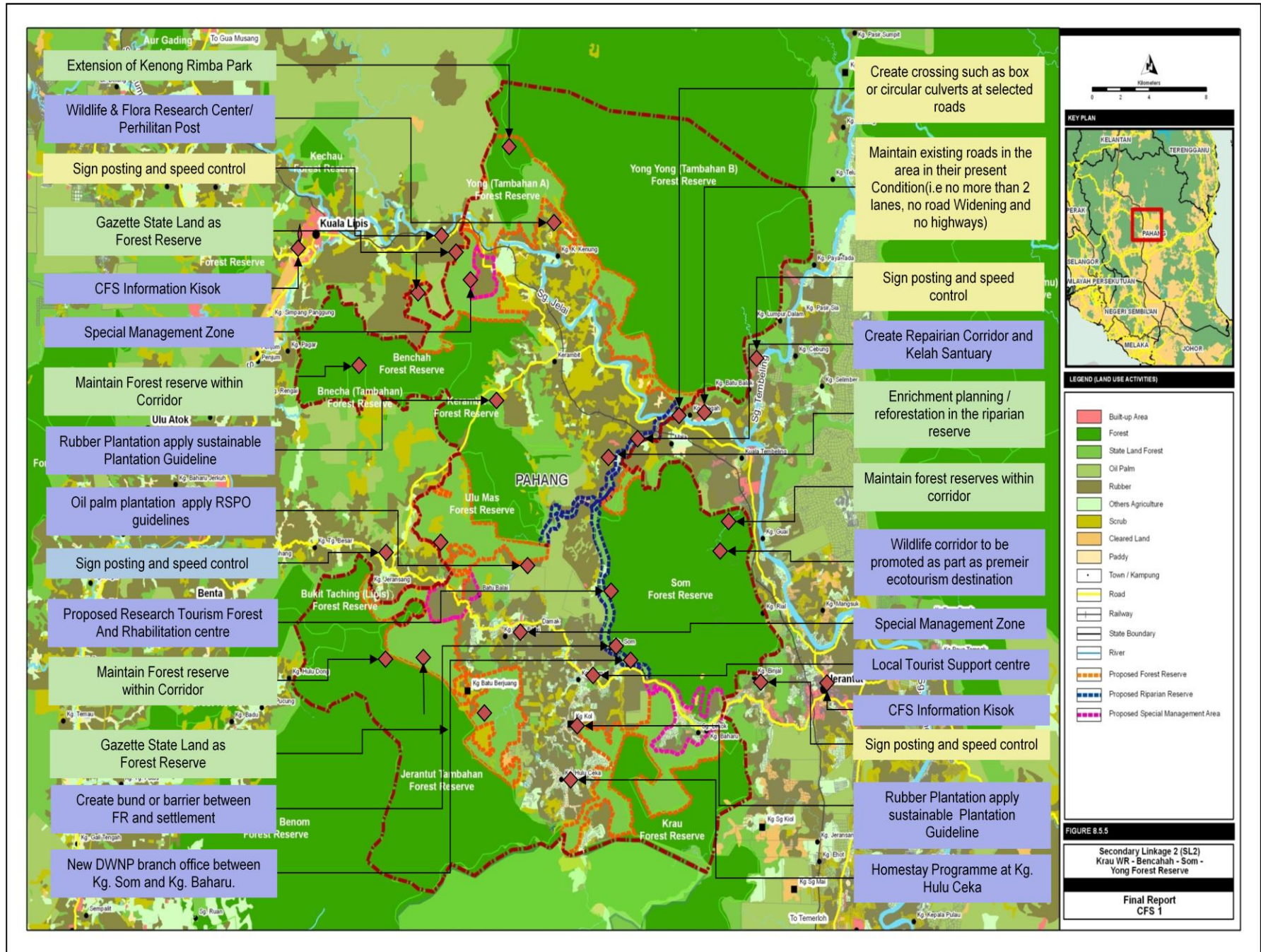
- 8) Outline visitors' code of ethics, role and responsibilities, and monitor tourist activities within the wildlife corridor and the surrounding ecotourism products.
- 9) Propose activity such as animal feed programme at Kg Som FR. Food is to be provided to the wildlife at the certain time. It can be developed as a tourism product (similar to Orang Utan Sanctuary, Kuching, Sarawak) to attract tourist to observe the animal behaviour. It is noted that corridor SL2 is facing the problem of wild animal entering /trespassing into human settlement in search of food. By developing the animal sanctuary (focus on elephant), animal will likely stop entering the village and villagers will also earn extra income from ecotourism.

8.5.5 Forestry (Including Reforestation) (Key Initiatives)

Unprotected state land forest should be incorporated into the forest reserve network. A number of forest reserve compartments should be zoned as protection forest under Section 10 of the National Forestry Act 1984. However, since this is a secondary linkage, a degree of logging should be permitted in accordance with the principles of sustainability. Low-impact, selective logging can be carried out as long as the impacts on connectivity are carefully monitored.

Refer Figure 8.5.5 for Overall Corridor Development Masterplan.

Figure 8.5.5: Overall Corridor Development Masterplan



8.6 ENABLING INITIATIVES

8.6.1 COSTS AND FUNDING

1) Costs

Direct costs are incurred on proposed infrastructure works for SL2. They comprise mainly road signs, and viewing towers. No major infrastructure works are envisaged in this secondary linkage.

Indirect costs arise from imputed costs of lands. Cost of lands is imputed from the average market price of agricultural lands sourced from the Property Market Report (2007). The underlying assumption is state forest lands can be put into alternative use through alienation. As market prices of agricultural land reflect location, level of maturity of crops, and types of crops, the imputed value of forest land is assumed to be lower, that is, at 25% lower.

The costs of lands include all state forestlands, scrub and grasslands, all of which are in the proposed linkage and ideally, are to be conserved to facilitate wildlife crossings. The estimated area of state forestland (11,002 hectares) and scrub and grasslands (539 hectares) totalled 11,541 hectares. Included here among the state forestlands are those located within the special management zone and the riparian reserves.

Total cost of development is estimated at RM225.3 million (**Table 8.6.1**).

Table 8.6.1: Total Cost of SL2

Category	Cost Items	RM
	Road signs & gantries & monitoring cameras	2,649,000
	Viewing Towers	300,000
	Sub-total	2,949,000
Imputed Cost of State Land Area: 11,541 ha	Cost of State Forests (Core & Buffer)	217,498,898
Awareness campaign		200,000
	Total Development Cost	220,647,898

- Notes: (1) Average market price of land: RM75,385/ha. Property Market Report 2007 & 2006
 (2) Infrastructure costs are estimated.
 (3) Total cost excluded imputed annual revenue loss from state forest lands of RM37.2 million



2) Benefits and Potential Revenue

A major benefit from this linkage is the provision of safe passage for wildlife, allowing them to access the larger forest complexes, hence, creating the enabling environment for their sustained existence. This adds to the overall conservation of biodiversity in the country. An estimate is made to gauge the potential of the linkage as a carbon sink, based on the area that will be converted to forest reserve. The approximate area of 11,541 hectares is expected to store about 1.327 million metric tonne of carbon (based on 115 metric tonne of carbon stored per hectare)¹.

The current market value of carbon credits traded under the EU carbon market averages US\$50 per metric tonne. At an exchange rate of RM3.543 (Bank Negara November 2008) to one US dollar, the potential income raised, if trading is undertaken, could be RM235.1 million. However, it is cautious to consider a lower market price, given that there are risks and constraints in obtaining certification, coupled with the current global financial crisis that would make trading in the immediate future difficult and generate uncertainties and fluctuations in carbon prices. A lower price of US\$30 per metric tonne is assumed, giving an approximate annual income of RM141.1 million from carbon trading. With an annual carbon trading income of RM141.1 million against a total development cost of RM 220.6 million, the payback period could be achieved relatively fast, i.e. within 2 years, assuming costs and prices are constant.

3) Sources of Finance

The proposed key source of finance is the Federal development budget through the creation of an ecological development programme under the Federal government's multi-state development fund.

8.6.2 Institutional Support, Legislative Aspects and Enforcement

1) Institutional arrangement

This is an important secondary corridor linking the Krau Wildlife Reserve to the Greater Taman Negara Complex. The key institutional arrangements are shown in **Table 8.6.2**. It is important that the Secondary Link is designated in the NPP and the other statutory development plans i.e. Structure and Local Plans. Again it is possible to prepare a Detail Plan for the Secondary Corridor as a Special Area Plan under s16 BTCPA. (Conservation and Management Type)

The key strategies identified will include the gazettelement of selected state land forest as permanent forest reserves under the NFA. The other key initiative will be establishment of a riparian reserve along Sg Som. Some of the key implementing agencies will include the Forestry Department, the Wildlife Department, the Local Planning Authorities of Kuala Lipis and Jerantut as the linkage covers two planning jurisdictions and the State Director of Land and Mines. The key infrastructure agencies will include JKR, KTM and JPS.

Community participation and awareness raising programmes are important for the success of this corridor especially among the local villagers

¹ Weiss, J. (ed), (1994), The Economics of Project Appraisal and Environment, "Brown and Pearce, "The Economic Value of Non-Market Benefits of Tropical Forests: Carbon Storage."

Table 8.6.2: Institutional Arrangements with Respect SL2 Krau Wildlife Reserve and the Greater Taman Negara Complex

Preparation of a Detail Plan which should include both a Physical Development Plan and a Management and Implementation Plan	JPBD in association with key conservation agencies such as Forestry Department, Wildlife Department and NGO's especially WWF and MNS. This could be done as a Special Area Plan under s16B TCPA
Key Implementing Agencies	<ol style="list-style-type: none"> 1. Forestry Department 2. Wildlife Department 3. Local Planning Authority of Jerantut and Lipis 4. State Director of Town and Country Planning 5. JKR 6. JPS 7. Director of Land and Mines 8. KTM
Formulation of Rules and Regulations	<ol style="list-style-type: none"> 1. Forestry Department 2. Director of Lands and Mines 3. JPBD 4. Local Planning Authority of Jerantut and Lipis
Monitoring and Surveillance	<ol style="list-style-type: none"> 1. Wildlife Department 2. Forestry Department 3. NGOs including WWF and MNS 4. Local Villagers
Education, Research and Publicity	<ol style="list-style-type: none"> 1. NRE, 2. JPBD, 3. Wildlife Department , 4. Universities , 5. NGO's 6. State Tourism Action Council

2) Legislative implications

Some of the key features of the strategy are to identify the key stepping stones within the corridor. These stepping stones are usually state land forest that could be made gazetted as permanent forest reserves under the NFA. Stepping stones which are abutting the Krau Wildlife Reserve can be gazetted as wildlife reserves.

One of the key linkage element to the various stepping stones within the corridor is the riparian reserve of Sg Som. It may be necessary to acquire private alienated land within the riparian reserve and introduce a reforestation programme on the riparian reserve. The relevant laws that would apply is shown in the **Table 8.6.3**.

Special Management Areas are also shown in the Plan in selected settlement areas. Generally settlement expansion is not encouraged in these areas.

Table 8.6.3: Key Strategies

Key Strategies	Relevant Laws To Be Applied
Gazette identified state land forest and scrubland which act as stepping stones within the Corridor as permanent forest reserve	NFA, Pahang Forest Enactment
No further land alienation for development purpose (agriculture, building or settlement) in areas identified as “stepping stones”	National Land Code
Establishing Riparian Reserve	National Land Code, Pahang Water Resources Enactment 1997
Acquire any alienated land within the key riparian reserve of Sg Som	Land Acquisition Act 1960
Designate some of key stepping stones as part of the Krau Wildlife Reserve	Wildlife Act
Establish Special Management Areas where settlement expansion will be controlled	Special Area Plan, TCPA

3) Enforcement and Monitoring

Enforcement and monitoring will be carried by the key agencies that have enabling laws to do so. This will include the Forestry Department, Director of Lands and Mines and the Local Planning Authority for the Area. The DWNP has powers under the Wildlife Act to act against hunting and poaching of endangered species of animals.

8.6.3 Awareness, Education and Communication

Secondary linkage locations are not usually as prominent as primary linkages. They consist of smaller patches of disturbed forests considered as ‘stepping stones’ that connect to larger forest islands.

At this secondary linkage, there are several forest reserves, one state park (Kenong Rimba) and Taman Negara, and the Krau WR to consider for connectivity. The key concerns are the connections between Krau Wildlife Reserve, a premier but isolated area for research, and the Greater Taman Negara forests. High development pressure from settlements, plantations, vegetable farms and roads and a railway surround most of the ecological linkage and corridor sites. Thus, the complex no longer supports large mammals but remains important for smaller species of mammals, birds and reptiles.

The implementation strategy targets maintaining and enhancing forest habitats, ensuring plantations assist in environmental improvements and using tourism attractions to increase linkage. The priority messages to communicate to key stakeholders include:

- With a scattered array of forest reserves providing the ‘stepping stones’ for the corridor, coordinating with the Department of Forestry is vital to maintain the integrity of the habitat.



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- Government agencies dealing with infrastructure projects must understand the benefits of not widening roadways and of installing appropriate wildlife crossing structures.
- Government agencies dealing with land matters need to be aware of re-acquiring land adjacent to key rivers to create riparian corridors.
- Since the linkage area is pocketed with plantations, this sector requires basic understanding of RSPO principles and certification to enhance wildlife movement via river corridors and improve environmental protection measures.
- Tourism officials must realize the importance of Kenong Rimba State Park and the area around Jerantut as valuable habitats to maintain corridor connectivity.
- Public awareness on the value of small forest patches to play a role in biodiversity protection is needed to promote secondary linkages.

The following communications and awareness tools are necessary to reach out to selected stakeholders:-

- 1) JPBD-CFS Web Portal – Implementation of CFS recommendations requires multiple agencies and organizations to be informed and engaged. The web portal serves as the primary source of information to communicate the objectives, goals and roles of all parties towards pursuing positive action. Case studies, fact sheets, corridor maps and downloadable brochures for different sectors (i.e. plantation, tourism) all aid to increase awareness among potential participants.
- 2) Information Kiosks – Engaging with the public directly at linkage areas is a first step for understanding the concepts of ecological corridors and their functions. Information kiosks located at high use facilities starts the awareness. There are three key tourism attractions for placement of kiosks to inform visitors, especially on the merits of secondary linkages:-
 - Jerantut – the gateway to Taman Negara with a major tourist facility;
 - Kuala Lipis - the gateway to Kenong Rimba State Park; and
 - Kuala Gandah Elephant Sanctuary– on the edge of Krau WR with a major tourism attraction.
- 3) Wildlife Safety Signs – Ensuring safety for animals and motorists travelling on corridor roads is usually a priority. An effective safety sign awareness programme instils three key messages:-
 - A sense of importance for the surrounding habitats;
 - A sense of concern for wildlife crossings; and
 - An awareness to avoid animal conflicts and reminder to use appropriate behaviour and safe speeds.

However, this secondary linkage location does not have large mammals crossing the roads. There may be added value to introduce signage as a means to promote corridors. A scaled-down sign programme, in comparison to primary linkages, may be more cost effective along lesser travelled routes to highlight measures taken to protect wildlife.



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- 4) Plantation Initiatives – Fragmented habitats dominate secondary linkages. Engaging with the oil palm plantation sector requires them to understand the aims of CFS to increase the integrity of ecological connections for all animals. By adhering to RSPO principles and developing management plans to protect wildlife habitats, they can play a positive role in maintaining biodiversity. For example, Wild Asia’s Stepwise Support Programme serves to increase RSPO awareness that leads to proper planning; while its Natural Corridor Initiative helps rehabilitate rivers for improved wildlife passage in plantations.
- 5) Corridor Campaign – Secondary linkage sites may not require a full programme of events and activities if there are no existing special natural features or tourism attractions. Kenong Rimba State Park and Taman Negara may be too remote to use for public awareness activities. Since secondary corridors pertain more so to smaller animals, it is better to highlight the rich variety of bats, squirrels, and reptiles and possibly birds. In this case, Krau WR is better suited for events and projects. It is already a hub for research and there are facilities nearby to use for environmental education.

For example, it is advisable to organize events with Perhilitan, the Ministry of Tourism and NGO groups like the following:-

- Bat Research Awareness – Krau WR has some of the highest populations of forest bats. Setting up a special programme for students or tourists to go out with field researchers to capture and tag bat species creates awareness about smaller mammals and habitat diversity. Environmental education programmes run by the Malaysian Bat Conservation Research Unit (MBCRU) for EARTHWATCH and corporate groups are good models to emulate.
- Perhilitan Programmes – Enhancing programming at Kuala Gandah and the Biodiversity Centre in Lanchang can be used to engage the public to understand issues related to the CFS. These could include special events on visiting ecological corridors, programmes on tiger conservation, teaching students about museum collection techniques and other informative activities.
- Outdoor Education Programmes – With Special Interest Groups for birds, reptiles and amphibians, flora and even photography, the Malaysian Nature Society is a key partner to bring awareness on biodiversity to school groups and the public. Special events at Krau WR can easily promote the natural history value of this secondary link. Information and photographs from event outings could then be used to develop displays for information kiosks.
- NGO Research – Already active in the Belum-Temenggor area with large mammal surveys, WWF can be used to assist Perhilitan with small mammal surveys to better understand the movement of these animals among the forest reserves.

09

Environmental cost and benefits

Role Of Economic Value Of Protected Forest Areas (PFA) And
Opportunity Cost If Connectivity Of PFA Is Reduced
Case Study Economic Valuation Framework

Introduction
Total Economic Value Of Ecological Corridors And Forest Areas In PL 2, Grik
District
Conclusions



CFS I



9.0 ENVIRONMENTAL COST AND BENEFITS

9.1 ROLE OF ECONOMIC VALUE OF PROTECTED FOREST AREAS (PFA) AND OPPORTUNITY COST IF CONNECTIVITY OF PFA IS REDUCED.

Government agencies have to make decisions on how to allocate public investments between the establishment of infra-structures and public facilities in promoting economic development projects, and in reinforcing efforts at protecting and restoring natural ecosystem, including forest areas. Planners and forest resource managers will have to incorporate ecological, environmental, social, economic and administrative considerations in making such decisions. This will raise accountability as the bio-physical impacts are assessed and their values estimated. A more comprehensive approach could be obtained, as both benefits and costs of the project decisions could be compared. Although, the price and value of environmental goods and functions of protected forest areas are difficult to obtain because much of these goods and services are not traded in the marketplace, but economic valuation methods are now available to provide estimates of these functions including on the opportunity cost if connectivity of PFA is reduced.

But it should be noted that protecting forest areas also has trade-offs. State governments need financial resources to meet its annual developmental and operational expenditures. Economic valuations could assess the foregone revenues when areas with matured timber stands are left without extraction. A trade-off analysis could shed needed information on the opportunities that are foregone from either action, protection versus extraction or a balanced approach between these land uses.

Economists generally depend on market prices to indicate the value of goods and services. For a good and service exchanged in a well-defined market, information on prices and quantities are readily available. But much of the environmental services of PFAs have no market prices, thus their values would have to be estimated through non-market valuation methods. This is particularly true for environmental services such as water, recreation, wildlife, wild fruits, genetic resources, carbon sequestration and nutrients cycling, among others.

Typically, the benefits derived from PFAs could be measured in terms of:-

- a) The willingness to pay (WTP) of users or consumers for using and experiencing the goods and services. An approximation of users' WTP for a particular recreational opportunities, for instance, can be developed from a demand curve which indicates the quantity of use that users in a market would be willing and able to purchase at each price.
- b) Expenditures on preventive measures taken by consumers or users to avoid a future loss. Thus, investing and making expenditures to managing PFAs could be seen as a form of WTP for current, as well as, future benefits.

9.2 CASE STUDY ECONOMIC VALUATION FRAMEWORK

A case study of the economic valuation in CFS I was conducted to illustrate the significance of connecting an ecological forest corridor in this site. This is done by attempting to estimate the economic values generated by the Primary links and the opportunity cost if connectivity of PFA is reduced. The case study site is **Primary Linkage 2 : Temenggor FR (Main Range) – Royal Belum State Park (Main Range)**

9.2.1 Case Study Economic Valuation Framework for CFS I

The economic valuation approach is to assess the conservation values of the above protected areas (national/state park) for their potentials in eco-tourism, bio-diversity conservation, local community dependence and as wildlife habitat function. Of interest is the valuation of avoiding human-wildlife conflicts which would provide a direct illustration of the opportunity cost if connectivity of PFA is reduced.

The framework of analysis are as follows:-

No	Functions being Valued	Economic Valuation Approach
1	Eco-tourism values	Contingent valuation method
2	Conservation of Bio-diversity values	Contingent valuation method
3	Local community dependence	Market-based (Residual Method)
4	Wildlife habitat function and human-wildlife conflicts: property damages, replanting, loss of income opportunities, trauma,	Change in productivity method, replacement cost approach, opportunity cost approach, and contingent valuation approach
5	Financial budget required for rising number of staffing and support services	Direct cost approach

In conducting the above valuation exercise, field surveys to obtain relevant data were obtained from:-

- a) Tourist/visitors to the Temenggor Lake / Banding Island and Belum Forest site
- b) Local communities
- c) Villagers affected by human-wildlife conflicts
- d) Non-use conservation values of the Belum Forest Reserve
- e) Officers of relevant government agencies



9.3 INTRODUCTION

Environmental economists have developed a classification of values of the various goods and ecological services provided by the forest. Forests, including the ecological corridor suggested in this report, could benefit society directly when consumptions are made while others are obtained indirectly. The eco-tourism attributes is a direct use value obtained while the avoided losses from human-wildlife conflicts are an indirect use value of forest as habitat for wildlife. There is also a time dimension to the benefits derived. In most cases people acquire these satisfactions in the current period, but there are also circumstances where they derive satisfaction from protecting the flora and fauna species now to ensure that future generations also have the opportunity to appreciate them.

In other cases, the benefits are obtained without making any actual consumption now or in the future. For instance, the mere presence and protection of wildlife and biodiversity resources, may generate emotional satisfaction of our role as the protector and trustee of the natural forest. This is a non-use value that society gains from the mere presence of the wildlife simply by knowing that it exists. This existence value captures people's desire to see wildlife conserved and as a nation's natural heritage, even though they never intend to see them. This act can be seen when people pay money to conservation organisations to protect special species or ecosystem, although they may never see or visit them. The satisfaction and benefit that society derives from this act signify the availability of the non-use values of natural forest including wildlife and biodiversity, either as existence values or as heritage value.

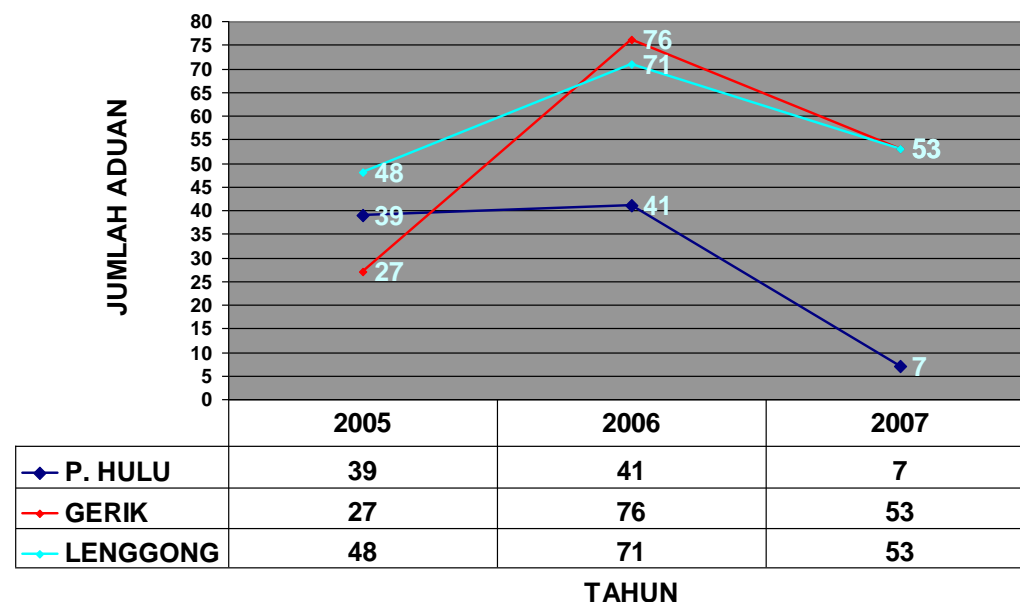
9.3.1 Economic Value of Losses from Human Elephant Conflicts that could be avoided

9.3.1.1 Forest as Habitat for Wildlife

As resource extraction and forest conversion expanded that deprives the wildlife of their home range and confined them into areas that are too small to be viable, and deny them of their ancestral migratory routes. Wildlife, especially elephant herds in the wild, follow well defined seasonal and traditional migration routes, between wet and dry seasons. When human settlements and farms are found in these old routes, confrontations could occur which often lead to damages to crops and properties as well as injuries and deaths to both species.

Natural forest areas plus the ecological corridors that could reduce forest fragmentation, play an important wildlife habitat function. Elephants are one of the main sources of human wildlife conflict (HWC) in Malaysia including the Gerik District. Each elephant family group requires a home range (ranging from 200 – 800 square km) and seasonally uses various parts of their home range. As their habitat shrinks, they face a problem of insufficient food and they head to the nearest source of food which is usually the farms of the local farmers. The trend in reported cases of elephant disturbance peaked in 2006 but have declined in 2007 (**Figure 9.1**)

Figure 9.1: Trend in Human Elephant Conflict in Gerik District 2005 - 2007



Source: Perhilitan Gerik District

The direct approach of valuing the function of forest as habitat for elephant is difficult but there is an alternative approach. This method relies on the assumption that the impact of habitat disturbance would encourage the elephant herds to encroach into agricultural farms or orchards and human villages. This situation would create human elephant conflicts such as elephants damaging the fences of farms and feeding on young rubber tree shoots.

The mere rumours of elephant wandering in the rural areas, not to mention actual intrusion into farms, would have created a fear and trauma throughout the affected village. This fear and trauma are not limited to households having their farms attacked only, but almost to all the households in the village concerned. These fear and trauma have further psychological and economic impacts, such as the fear to be outdoors at night and much time spent to collectively guard palm oil and rubber smallholdings at night. The latter further affects the ability to tap rubber trees in the early mornings and the collection of latex following the night guards. All in all, substantial economic losses and psychological fear would be incurred by villagers. Hence, valuing the losses faced from human elephant conflicts (HEC) that could be avoided with the protection of natural forest and the elephant migrating routes undisturbed could serve as an indirect approach of valuing this habitat function of the forest and suggested ecological corridors.

The above losses, either economic or psychological, would not have occurred had the ability of the forests to provide adequate habitat to the elephants were not jeopardised. The value of the losses and fears would have been avoided, had the forests been intact and their functions as habitat for elephants unimpeded. Hence, an alternative approach to assess the value of forest as a function of elephant's habitat could be proxied by the avoided losses that society would have to incur owing to the disturbance of the tranquil environment provided by forests. Hence, the value of the ecological forest corridor is the value of avoided losses from HEC.

The Perhilitan District of Gerik, Perak was selected to undertake a survey of the occurrence of HEC. The ecological corridor to be established is located to an elephant herd that are in frequently in conflict to the Orang Asli villages at Kampung Banun and to the Tali Kail island in Temenggor Lake. In 2007 there were 54 incidents of reported HEC cases in the Sub-District of Gerik.

9.3.1.2 Value of losses from damaged crops that could be avoided

On average the mean economic values of damages were dominated by losses from damaged rubber trees value at RM1,309 per affected villager or 50.8% of the mean economic loss by a villager affected by the HEC incident (**Table 9.1**). The estimate included not only current losses, but also future losses of latex until the tree reaches maturity age. These values were high if no replanting was undertaken or if the villagers have given up hope that any replanting effort could survive future elephant attacks. If replantings were undertaken and the trees survived, the losses were small covering only the losses in yields until the replanted trees could be tapped. The other major crop losses were from damages to cempedak fruit trees worth about RM359 or 13.9% of the total economic loss per villager and from damages to tapioca cultivation valued about RM291 per villager or 11.3% and to durian trees valued at RM282 or 10.9% of the total loss per villager. The other crops often attacked were duku, coconut, rambutan trees, and bananas.

Table 9.1: Mean economic values of crop damages per villager affected by the HEC incident (RM)

Crop losses	Present value losses	%
Rubber	1,309	50.8
Tapioca	291	11.3
Banana	13	0.5
Durian	282	10.9
Coconut	1	0
Cempedak	359	13.9
Rambutan	122	4.7
Duku	200	7.8
Total	2,578	100.0

Source: computed from survey data.

9.3.1.3 Value of Other Losses from Human Elephant Conflict that could be avoided

Losses from agricultural crop dominated the average total loss incurred from HEC incident with RM2,578 or 86.6% of the losses (**Table 9.2**). The next big loss was that from damaged properties estimated to average RM377 per villager affected by the incident that contributed 12.7% of the total loss. The properties damaged were mainly water piping system and the cost of repair.

Another loss is the psychological fear of facing an incident of an elephant incursion into the village. The monetary value of this fear is difficult to estimate directly. But there is an indirect approach to gauge this value by assessing the cost that a villager is willing to incur to take away the source of the fear. This was measured from the willingness to contribute into a fund that could possibly facilitate the relocation of errand elephant to a larger sanctuary as a means to avoid future HEC incidents. This study found that affected villagers would be willing to pay RM14 towards a fund that could be used to relocate the errand elephants.

Other losses incurred are expenditures incurred by the villagers on night sentry activities and foregone revenues from fear and trauma incurred during HEC incidents that prevent early morning tapping of rubber trees during the days of the incidents (RM8). There were no cases of death and health effects.

Table 9.2: Sources of average economic losses incurred by villagers from HEC incidents in Rompin District (RM/villager affected by HEC incidents)

Sources of Economic Losses	Value (RM)	%
Total discounted loss from agricultural crops	2,578	86.6
Loss from damaged property	377	12.7
Loss from expenditures on night sentry	0	0.0
Foregone revenue from trauma	8	0.3
WTP to avoid future HEC*	14	0.5
Loss from injury	0	0.0
Loss from death	0	0.0
Total loss	2,977	100.0

9.3.1.4 Cost of Capture and Relocation of Wildlife That Could Be Avoided

With the reestablishment of ecological forest corridors, and if these corridors could provide the needed habitat for the elephants, there would not be a need for a capture and relocation of elephant operation. The budget could now be used for other more essential activity. There would then be a cost saving. The reestablishment of the corridor would provide an economic value in terms of the value of the expenditures not spent.

Table 9.3 shows the total cost of capture and relocation of a wild elephant. The total amount of RM40,614 is composed of the cost of capture with RM17,962 (43.9%) and cost of relocation with RM22,952 (56.1%). The bulk of the cost of capture goes to staff

allowances, which accounted for 30.8% of the total cost. Although the number of staff required is 8, but the number of man-days spent in monitoring the targeted elephant is 21 days. For cost of relocation, staff allowances which amounted to RM8,540 accounted for 20.9% of the total cost, followed by fuel and maintenance of vehicles used in the relocation (9.9%) and elephant securing utensils such as high tensile chains and u-shackle (7.3%). The high fuel and maintenance bill is the result of the ferrying of two working elephants to the site as two 10-wheels lorry are used. The total number of manpower required is also 8, but the number of the man-days required is shorter, 7 days. A tug-boat is usually used to ferry the wild elephant to the new area to be released.

Table 9.3: Cost of capture and relocation

Particulars	RM	%
Ammunitions and darting equipments	1,200.00	2.90
Drugs	1,150.00	2.80
Elephants securing utensils	1,580.00	3.90
Fuel and vehicle maintenance	1,432.00	3.50
Staff allowances	12,600.00	30.80
Total Cost Of Capture	17,962.00	43.90
Food supplies for 2 working elephants	2,800.00	6.80
Fuel and vehicle maintenance	4,064.40	9.90
Drugs	1,168.00	2.90
Ammunitions and darting equipments	1,500.00	3.70
Elephants securing utensils	2,980.00	7.30
Cost of hiring a tug boat to National Parks/trip	1,900.00	4.60
Staff allowances	8,540.00	20.90
Total Cost Of Relocation	22,952.40	56.10
GRAND TOTAL	40,614.40	100.00

Source : Nasharuddin b Othman, DWNP

9.3.1.5 Other losses from human elephant conflict

In October 2008, the Tali Kail island resort, Banding was encroached by a herd of elephants that destroyed the kitchen portions of several chalets. The cost of repairs are being estimated. Several chalet bookings had to be cancelled or delayed. There were losses in foregone revenues from rental amounting to RM3,400 during that period (**Table 9.4**). Cost of repairs on the chalets are estimated ranging from RM15,000 to RM51,750 (**Table 9.5**). The total loss that could be avoided if there was no conflict with the elephant would range from RM38,400 to RM55,150.

Table 9.4: Losses from elephant encroachment at Tali Kail Island, Banding

Losses from cancelled reservation from (17 Oct - 05 Nov 08)			
No.	Booking / Reservation from	No. days	Cancelled revenue collections
1	Border 303 Regiment Camp Pengkalan Hulu	3	690
2	Youth Office Batu Gajah	3	735
3	State Secretary Perak Office	3	480
4	Contractor Services Centre Perak	3	735
5	Syariah Court, Ipoh	2	320
6	Secondary School Teluk Bahang	3	440
TOTAL			3,400

Table 9.5: Damaged properties at Tali Kail Island, Banding Lake

No.	Properties and Repairs	Loss (RM)	%1	%2
1	Infrastructural repairs including Chalet A and village house walls, kitchen broken doors, toilet walls	6,090	11.77	40.6
2	Replacement of water tanks	1,485	2.87	9.9
4	Replacement of toilets	5,775	11.16	38.5
4	Replacement of lamps and wiring installation	1,650	3.19	11
5	Permanent loss of one village house (foregone rentals)	36,750	71.01	
	Total ¹	51,750	100.00	
	Total ²	15,000		100

Note: 1 - Total cost including of permanent loss of village house
 2 - Total cost of direct property damage and repairs

9.3.1.6 Aggregate Value of Wildlife Habitat Functions of Ecological Corridors and Forests

With the reestablishment of ecological forest corridors, and if these corridors could provide the needed habitat for the elephants, the aggregate value of potential avoided losses from HEC could be estimated. This aggregate value for this ecological corridor site could be estimated by multiplying the average annual value of avoided economic losses per villager (RM2,977) by the number of villagers routinely affected by HEC incidents. According to the villagers surveyed at Kampung Banun, a majority of them have been affected by HEC incidents. Using an estimated number of 150 households, then the aggregate value is estimated as RM0.45 million per year. This aggregate value could be added to the avoided cost or cost

saving from a capture and relocation operation of RM40,614, and the avoided loss on Tali Kail Island of RM55,150 to give a total value of RM0.54 million per year .

9.3.2 Economic Values of the Royal Belum State Park for Ecotourism

The Royal Belum State Park is located in the northern region of Perak State is bristling with fauna and flora, a rich national heritage. The 130-million-year-old forest, which has been divided into Upper Belum (to the north) and the Temenggor Forest Reserve (to the south), following the construction of the East-West Highway linking Ipoh to the East Coast, is home to more than 100 species of exotic mammals. Among them are the Asian elephant, Malayan tiger, leopard, sun bear, Sumatran rhinoceros and Malayan tapir, ten hornbill species can also be found within the forest complex, including the endangered plain-pouched hornbill. There are also places to catch glimpses of exotic plants such as the rafflesia. The main activity available is trekking and fishing as the area is part of the Temenggor Dam or also known as Banding Lake. A questionnaire was framed highlighting the recreational services offered by the park. To elicit the WTP the payment mode selected was a user fee. The advantage of this payment mode is that the respondent can easily relate to it. A user fee per visit is deemed appropriate since a fee is hypothetically sought directly from the user. Hence, a hypothetical situation is created that the park management intends to introduce an entrance fee as a means of raising funds to maintain the quality of the above services at the park. This sets up a reason for hypothetically raising payment for the services where no direct payment is currently extracted.

9.3.2.1 Eco-tourism/Recreational Values

The mean and median WTP bids were computed. **Table 9.6** provides the results of the CVM survey on the maximum value that a visitor obtained from engaging in eco-tourism activities at the Belum Forest State Park. The mean WTPs were RM19.50 per trip. This estimated value is within the range for a recreational site that involves multiple attractions including both active participating activities like fishing, camping, trekking and environmental education, and passive activities like picnicking, boating and family day. This estimation is within the range of previous investigations on economic values of jungle trekking and cave exploration at Kenong Rimba Park, Kuala Lipis [RM19/trip Gorhan (1997)] and recreational fishing such as at Matang mangroves, Kuala Sepetang [RM16-28/trip (Mohd Shahwahid 1999)].

Table 9.6: Economic Values of the Ecotourism Experience at the Belum Forest State Park

WTP/entrance	Domestic Visitor
Mean (RM)	19.50
Standard Error (RM)	3.5
Median (RM)	10.0
Range (RM)	0 to 140

9.3.2.2 Total Value of Recreational Opportunities

While all visitors may contribute to the development of tourism, the trend in holiday arrivals perhaps gives the best indication of what is happening in the tourism sector. Holiday arrivals reflected discretionary travelers (compared to business and those visiting relatives and friends) and are likely to make a more direct demand and to value the eco-tourism services generated by the Belum Forest State Park.

In order to estimate the total value for ecotourism provided by Belum, an estimate of the total number of visitors is required. But this estimate is not known since there are many visitors that just spend a few hours enjoying the panorama and on transit, and there is no official registration. Using an estimate of 100,000 visitors and the average WTP of RM19.50, the total value for eco-tourism provided by the Belum forest could be RM1.95 million per year. This is a conservative estimate.

9.3.3 Non-Use Values of Bio-diversity and Wildlife Conservation in the Ecological Corridors

The economic value of the natural forest and ecological corridor to be established includes the non-use values of the forest as wildlife habitat and bio-diversity conservation even though people do not intend to see or be in contact with the wildlife or to use bio-diverse resources, now or in the future. For instance, the mere presence and protection of the elephants or of a certain rare or endangered plant species may generate emotional satisfaction of our ability to protect them. This non-use value is gained from the mere presence of the wildlife like elephants or of unique plants, either as existence values or as heritage value.

The non-use values of the natural forest including of the potential ecological corridors among members of society in general in Perak was estimated using a survey questionnaire of 200 respondents from the districts of Ipoh, Taiping, Kuala Kangsar, Gerik, and Pengkalan. This size is considered large enough to obtain a viable finding.

The most important component of the CVM questionnaire is the hypothetical market question where the WTP estimate is elicited. The respondents were prompt for their level of awareness of the role and function that natural forest and the ecological corridors to be established, can play in biodiversity conservation. Then the payment vehicle for WTP elicitation was introduced by explaining that the task of establishing the ecological corridors could be undertaken by the Forestry Department. To ensure that this task is efficiently implemented using best practice techniques, the respondents were informed that additional funds would be required to acquire land, replant trees. The Forestry Department and PERHILITAN would have to manage the ecological corridors against poaching. An Ecological Corridor Trust Fund could be formed and managed by a board trustee comprising of forest flora and wildlife professionals. This trustee will provide needed funds to the Forestry Department and PERHILITAN to finance the establishment of the ecological corridor and conservation activities including wildlife such as the elephants. From amongst those respondents who felt that the connecting of forests are essential and have an economic value, the list of WTP bids to the Fund was provided for them to select from a range of RM1 to RM100 per person. The WTP bid is a lump sum one payment only.

The mean, median and range of WTP bids that the respondents would be willing to contribute to ensure the establishment of the ecological corridors and flora and wildlife habitat were provided in Table 9.7. The mean WTP bid was RM9.47/person with a median value of RM5/person. The ranges of the WTP bids were from RM0 to RM50/person. This is a one time non-recurrent WTP bid. It should be noted that willingness to contribute to the Fund is a proxy measure of the WTP or value placed by society on the Belum forest ecological corridor and their functions. Refer Figure 9.7.

Table 9.7: Mean and Median Maximum WTP Bids For the Non-Use Values of the Ecological Corridors

Mean (RM/person)	Median (RM/person)	Range (RM/person) Minimum	Range (RM/person) Maximum
9.47	5	0	50

Source : Computed from survey data

9.3.3.1 Estimated Total Non-Use Values of Wildlife and Biodiversity Conservation Played by Ecological Corridors

Citizens have their own perceptions on the role of ecological corridors in wildlife and biodiversity conservation, even though they may not have any direct benefits from the corridors. The aggregate non-use value of the conservation of wild life and biodiversity that could be played by ecological corridors is estimated by multiplying the average WTP with the estimated adult population of Peninsular Malaysia. This value is adjusted to take into account the area of the ecological corridors to be established in this ecological corridor in comparison to the total natural forest area. It is estimated that the annual aggregate non-use value of the conservation of wild life and biodiversity that could be played by the ecological corridor in PL2 is only about RM4.17 million per year.

9.3.4 Local dependence on the forest resources

The assessment on local dependence on the forest resource relied on a field survey on local community villages in Kampung Banun located off the Gerik – Jeli Road. These villages included Kampung Sungai Rebe, Kampung Sungai Air Banun, Kampung Pulau Tujuh, Kampung Sungai Tekam, Kampung Semelor and Kampung Sungai Kijal. The study investigated on the types of non-timber forest products (NTFP) collected and their economic values. These values of the NTFPs to the local communities provided the level of local dependence on the forest resources. Table 9.8 provided a mean value of RM8,810 of NTFPs collected per households.

The highest mean values among households involved were obtained from fishing and gaharu collecting which involved RM3,537/year and RM2,718/year respectively or 40.1% and 30.8% of the total respectively NTFP incomes were also important for those involved in collecting Manau and Mantang rattans (RM1,374), collecting honey (RM818) and petai (RM213).

Fishes that can bring high incomes are Kelah valued at RM2,796/year/household that involved 79.1% of the total value of fished collected (Table 9.9). The other types of fish collected are Sebarau, Keli and Tengalan.

Table 9.8 : Mean Value of Incomes from NTFP Collection among All Households Sampled

NTFPs	RM/household	%
Petai	213	2.4
Gaharu	2718	30.8
Medicinal	145	1.6
Honey	818	9.3
Rattan	1374	15.6
Bamboo	5	0.1
Fishing	3537	40.1
Total	8810	100.0

Source: computed from survey data

Table 9.9 : Value of Various Kinds of Fish Caught By the Orang Asli Communities in Kampung Banun and Surrounding Villages

Fish sp	Average (RM)	%
Kelah	2,796	79.1
Lampam	11	0.3
Sebarau	185	5.2
Keli	144	4.1
Tengas	38	1.1
Baung	79	2.2
Siak	1	0.0
Kirai	84	2.4
Toman	62	1.7
Tengalan	137	3.9
Total	3,537	100.0

Source: computed from survey data

9.3.4.1 Total Economic Value of NTFPs Collected by Local Communities

Taking into accounts the number of households involved in NTFPs collection, estimated about 150 households, it would be possible to assess the importance of NTFPs collection to the livelihood of Orang asli communities near the PL2 Central Forest Spine program. Multiplying the average economic value from NTFP collection per household of RM3,537/year with the number of households in the locality suggests that the total economic value provided by the forest resources as RM1,321,557.

9.4 TOTAL ECONOMIC VALUE OF ECOLOGICAL CORRIDORS AND FOREST AREAS IN PL2, GRIK DISTRICT

Aggregating the estimated economic values of the establishment of ecological corridors and the conservation of forest areas provides a total economic value (TEV) estimate for the PL 2 Ecological Corridor site, at the District of Gerik (**Table 9.10**). From the TEV estimate of RM7.98 million per year, 6.8% is contributed from the wildlife habitat function and 16.6% by local communities dependence on NTFPs collection. The non-use value of the conservation of biodiversity resources provided 52.2% of the TEV followed by eco-tourism services provided by the lake and forest ecosystem (24.4%)

Table 9.10: A Total Economic Value Estimate of the Establishment of Ecological Corridor And The Conservation Of Forest In The District Of Rompin

No	Function of Ecological Corridor and Forest Areas*	RM million/year	%
1	Wildlife habitat functions	542,314	6.8
2	Eco-tourism and recreational services	1,950,000	24.4
3	Local communities dependence on NTFPs collection	1,321,557	16.6
4	Conservation of bio-diversity resources	4,166,800	52.2
	Total	7,980,671	100.0

Note : *Timber harvesting function is not included as it is incompatible to the main objectives of ecological corridors of wildlife habitat, conservation of bio-diversity resources and eco-tourism services.



9.5 COST OF ESTABLISHING ECOLOGICAL CORRIDORS IN THE CENTRAL FOREST SPINE PROGRAM

Many agencies have to be involved in the establishment of ecological corridor. Even at the macro planning stage, much expenditure had been allocated by the Department of Town and Country Planning in studying the need to include the Central Forest Spine program in the National Infra-Spatial Plan and in the current two studies of Central Forest Spine I and II.

Based on the recommendations of the above two CFS 1 and CFS 2 reports, several Government agencies would be directly involved in implementing the suggested primary and secondary linkages (PL and SL). Forest resources being the domain of the Department of Forestry (DOF), it is anticipated that this department would have to play a central role in this implementation phase. The DOF has made plans towards their role in the establishment of the CFS by taking heed of the recommendations in the National Physical Plan. DOF has undertaken this responsibility at two fronts: planning at the DOF headquarters in Kuala Lumpur and implementation at the relevant District DOF offices.

9.5.1 Department of Forestry Headquarters

The DOF has proposed to conduct several activities subject to availability of financial resources. These proposed activities were lined up from a series of workshops and meetings undertaken with their staffs, scientists, relevant government agencies, non-governmental organizations and other stakeholders. Among the activities proposed included:-

- a) Identification of area and forest management data
- b) Restoration and rehabilitation of annexed forest land
- c) Enforcement
- d) Inventory on Fauna and Flora
- e) Treatment and supervision of areas planted
- f) Socio-economic activities survey to raise socio-economic potential of forest corridor
- g) Dissemination and publication of information

The amount and its breakdown of required financial resources to undertake these activities is estimated at RM0.9 million in 2009 and RM0.4 million in 2010. It should be noted that these figures are required financial resources and it is not known whether the full amount is available.

The tasks of identification of area for ecological corridor, Restoration and rehabilitation of annexed forest land, and monitoring the ecological corridor would most likely be placed to the Forestry Department. The task of acquiring non-forest reserve lands for tree planting corridors would have to be handled by another agency. The first activity task involves field visits to identify potential area and the final selection by staffs from the Central Forest Spine committee and task force from the Forestry Department Headquarters. This is anticipated to cost RM9,825. The breakdown of the required budget would comprised of 84.7% on travel allowances, 9.2% on fuel and the rest on vehicle maintenance



The task of restoring and rehabilitating annexed land involves restoration and rehabilitation of the land into ecological corridor. The budget required for this task involves an allocation for the procurement of planting stock and replanting of land with forest species and fruit species which are suitable for the acquired degraded land or an existing state land forest. The replanting activity would require a budget for the purchase of planting and other related planting equipments and transportation. If the plantings are done on bare land, the budget required would be RM15,600/ha while for enrichment planting on degraded land would be RM7,800/ha.

Apart from tree plantings, there may be a need to construct overpasses of highways and viaducts for large mammals to pass through the highways. These tasks would fall under the Public Works Department. Land acquisition, overpass and viaducts construction would require extra budgeting that would be difficult to estimate as they would vary greatly with location and designs of the infra-structure.

9.5.2 District Department of Forestry, Gerik , Hulu Perak

With the added responsibility, the District Forest Office of Gerik would require the following new field staff involving foresters, a general worker, a driver and support facilities at a annual budget of RM273,438.

9.5.3 District Perhilitan, Gerik

Similarly, the District Wildlife Department (Perhilitan) would have to conduct frequent enforcement visits to monitor and prevent illegal poaching activities. These would require further extra budgeting.

The District Wildlife Department would require further upgrading of its staff involving an assistant district wildlife officer, wild life rangers, a general worker and a driver, and support facilities with a budget of RM284,000. The budget includes allocation for a new four wheel drive vehicle, allowances, petrol and vehicle maintenance.



9.6 CONCLUSIONS

This chapter has highlighted the economic valuation of several environmental services provided by the establishment of ecological corridors and the conservation of natural forest in the District of Ulu Perak. The total economic value is estimated about RM16.82million annually. In establishing and monitoring these corridors, substantial infra-structural and operational activities have to be undertaken. The national planning for the Central Forest Spine program has been conducted by the Department of Town and Country Planning. For the implementation at the various primary linkages (PL) and secondary linkages (SL) would have to be undertaken primarily by the Forestry Department (headquarters and district levels) and by district offices of the PERHILITAN. These activities would require new financial resources and their estimates are provided.

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