Rainforest Alliance SmartWood Program
High Conservation Value Forest (HCVF) Assessment Report

for:

Siak District

PT Arara Abadi, Asia Pulp & Paper / Sinar Mas Group

Date of Final Report: 30 June 2005
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Dates of Assessment: 4 February to 12 February 2005

DISCLAIMER: This report is NOT for the purposes of Forest Stewardship Council (FSC) certification nor has it been reviewed or approved by the FSC in any manner. The presentation herein is based on the Rainforest Alliance SmartWood Program's adoption and use of some principles, models, or tools developed for the identification and assessment of HCVF, based on FSC definitions.

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ACRONYMS

AA	PT. Arara Abadi
AAC	Annual Allowable Cut
adat	Customary or Traditional Law
APL	*Areal dengan Penggunaan Lain* /Area of Other [non-forestry] Use
APP	Asia Pulp and Paper
CITES	Convention on International Trade in Endangered Species
CR	Critically Endangered Species
dbh	Diameter at Breast Height
dusun	Sub-village community unit
ES	Endangered Species
FMP	Forest Management Plan
FMU	Forest Management Unit
FSC	Forest Stewardship Council
GIS	Geographic Information Systems
GPS	Global Positioning System
HCV	High Conservation Value
HCVF	High Conservation Value Forest
HK	*Hutan Konservasi / Conservation Forest*
HPH	*Hak Pengusahan Hutan* / Production Forest Concession Right
HTI	*Hutan Tanaman Industri* / Industrial Timber Plantation
IBSAP	Indonesian Biodiversity Strategy and Action Plan 2003 – 2020
ILO	International Labor Organization
IUCN	The World Conservation Union
Kab.	*Kabupaten* / District or Regency
Kec.	*Kecamatan* / Sub-District
KK	*Kepala Keluarga* / Head of Family or Household
kuda kuda	Wood rail system for transporting logs out of peat swamp forest
KSDA	*Konservasi Sumber Daya Alam* / Natural Resource Conservation agency
MDF	Mixed Dipterocarp Forest
MGI	PT Multi Gambut Industri, oil palm plantation adjacent to Pulau Muda concession
MHJ	PT. Mitra Hutan Jaya
MTH	Mixed tropical hardwoods
MAI	Mean annual increment
MoF	Ministry of Forestry
NCAP	National Conservation Plan for Indonesia
NTFP	Non-timber forest product(s)
PA	Protected Areas
P&C	Principles and Criteria
PSF	Peat Swamp Forest
PT.	*Persero Terbatas* / Limited Liability Company
RDB	Red Data Book
RKPH	*Rencana Karya Pengusahaan Hutan* / Forest Concession Master Management Plan
RKT	*Rencana Karya Tahunan* / Annual Workplan
SAP	Sustainability Action Plan of APP.
SFM	Sustainable Forest Management
Sg.	*Sungai* / River
SMG	Sinar Mas Group
SPA	PT. Satria Perkasa Agung
TNC	The Nature Conservancy
TPTI	*Tebang Pilih Tanam Indonesia* / Indonesian Selective Logging System
VU	Vulnerable species
WWF	World Wide Fund for Nature

1. Introduction

This report presents the findings of an independent assessment of High Conservation Value Forests (HCVFs) in an industrial timber plantation (*Hutan Tanaman Industri, HTI*) in Riau Province, Sumatra, Indonesia. From February 4 to 12, 2005, the Rainforest Alliance's SmartWood program conducted an independent HCVF assessment of Asia Pulp and Paper's (APP) Siak District, a 47,023 hectare forest management unit (FMU). The Siak FMU is one of APP's industrial timber plantations in Riau Province (Sumatra, Indonesia), managed by PT. Arara Abadi (AA), a company related to APP by common shareholding. The HCVF assessment was conducted by a team of specialists representing the SmartWood Program of the Rainforest Alliance.

APP requested this assessment as it was necessitated by company commitments made to customers and to export credit agencies, and as specified in forestry-related environmental covenants between APP and its creditors. SmartWood was selected as an independent conservation organization with expertise in forestry auditing and evaluation to undertake this HCVF assessment, following a similar approach as it had for HCVF assessments done in November 2004 and July 2004 for the APP concessions Serapung Unit and Pulau Muda District.

1.1 Objectives

The objectives of the present HCVF assessment were a) to identify High Conservation Values (HCV) within the defined FMU of the Siak District managed by PT Arara Abadi, b) to propose a boundary delineation for High Conservation Value Forest within this FMU, and c) outline basic management and monitoring implications for maintenance of identified HCVFs.

This assessment did not evaluate nor verify APP legal compliance, the standard or quality of forest practices, or any aspect of APP forest management other than what is described herein.

1.2 Approach

The approach adopted by SmartWood for this assessment followed the methodology applied for the two previous SmartWood HCVF assessments of the Pulau Muda District from July 19 to 31, 2004 and the Serapung Unit from November 1 to 12, 2004.

The present HCVF assessment also follows the guidance provided in the document prepared by Proforest and Rainforest Alliance, *Identifying, Managing, and Monitoring High Conservation Value Forests in Indonesia: A Toolkit for Forest Managers and other Stakeholders, Version 1, August 2003*, hereinafter referred to as the 'Indonesian HCVF Toolkit', 'HCVF Toolkit, or simply the 'Toolkit'.

The concept of High Conservation Value Forests was developed by the Forest Stewardship Council (FSC) in 1999 (Refer Appendix 4 for the FSC HCVF definitions as adapted by the HCVF toolkit). Central to the determination of HCVF within a forest management unit is the assessment and identification of High Conservation Values. The HCVF toolkit takes the FSC definitions of HCVs and describes a series of steps to conduct a systematic evaluation of the conservation values that exist in a forest area, and to establish a rationale for those values that are particularly significant and for which conservation is of critical importance. The Indonesian interpretation of the HCVF toolkit has been applied on other forest and palm oil concessions in Indonesia.

1.3 HCVF Assessment Team

SmartWood assembled a team of assessors with expertise in ecology and social sciences to conduct the HCVF assessment and delineation. The team's specialized scope covered habitat

and species ecology in tropical forests, the socio-economics of village communities, Geographic Information Systems (GIS), and the application of independent forest certification methods.

The background experience and competencies of the team are summarized in the following bio-sketches, and table 1 indicates the HCVs that they focused on.

Table 1. Assessment Team Expertise and HCVF Assessment Focus

Name	Fields of Expertise	HCV Aspect
Jeff Hayward	Forest Management	Project Manager
Anthony Sebastian	Wildlife Ecologist	HCV 1
Mark Leighton	Forest Ecologist	HCV 2, 3 & 4
Chris Bennett	Social Scientist	HCV 4, 5 & 6
Martin Hardiono	GIS	GIS analysis & Mapping
Aisyah Sileuw	Social Scientist	HCV 4, 5, & 6

Jeff Hawyard, Msc.
Mr. Hayward is Asia Pacific Regional Manager, of the Rainforest Alliance SmartWood Certification Program, based in Jakarta, Indonesia. He has conducted over 20 forest management assessments, scopings, and/or audits and over 60 chain of custody assessments and/or audits. He has conducted silviculture and ecology research for the B.C. Ministry of Forests and UBC Alex Fraser Research Forest in Canada. In Oregon State, he worked for the federal government in the U.S. Bureau of Land Management in forest inventory and timber sale administration. For three years he worked with the U.S. Peace Corps as a community forester in Guatemala, providing technical extension services to an agroforestry and conservation of natural resources program. His private forestry consulting has been for the B.C. Ministry of Forests, the FSC and IIED. Publications include research on forest certification and forest silviculture.

Anthony Sebastian, BSc.
A wildlife ecologist by training, he is a natural resource management consultant with Aonyx Environmental, an international specialist consultancy based in Kuching, Malaysia. Mr. Sebastian has 13 years experience in species and habitat management in Southeast Asia, with specific experience with floodplain and tropical peat ecosystems. He has worked in almost all the remaining peat swamp forests on the Malay Peninsula and Borneo. He brings considerable wetland conservation and management experience, particularly from a protected area management planning perspective, to the team.

Mark Leighton, PhD.
Dr. Leighton is a tropical forest ecologist with 27 years of research experience in basic and applied rainforest ecology, mostly focused in Indonesia, and especially Kalimantan. For over 20 years he has taught courses in rainforest ecology, vertebrate ecology, and forest management systems while on the faculty at Harvard University. He has directed research programs that span tropical plant ecology, vertebrate ecology, plant-vertebrate ecological interactions, conservation biology, and financial and ecological appraisals of sustainable forest management systems. He founded the Gunung Palung Research Station in 1984, which has supported nearly 200 research publications by himself and his colleagues and students. He has advised policies for the Indonesian Ministry of Forestry, numerous conservation initiatives and UNESCO and UNEP. His consulting work includes work on tropical landscape conservation planning, forest certification and the design of mixed function sustainable forestry enterprises that incorporate conservation objectives.

Chris Bennett, MSc.
Over the past 20 years, Mr. Bennett has worked mostly in Indonesia, but also in Laos and Malaysia, on forestry and agroforestry development and broader issues in natural resource management. In recent years, he has carried out policy and institutional analysis linked to broad-based dialogue through shared learning for good governance of decentralized natural resource management. This has included national policies and regulations, participative decision-making for land management and village-based co-management of public forestry land resources. Much of his policy analysis has been through consultancies for organizations such as the Harvard Institute for International Development (HIID), World Bank, United States Agency for International Development (USAID), U.K. Department for International Development (DfID), F.A.O., Centre for International Forestry Research (CIFOR), the Ford Foundation, SmartWood (Rainforest Alliance), The Nature Conservancy (TNC), and Birdlife International. An Adjunct Professor at the University of British Columbia with the Food and Resource Economics Centre, he teaches a course on rural development.

Martin Y. Hardiono, BSc.
Mr. Hardiono has been working in the field of GIS and Remote Sensing for the past 10 years mainly in conservation, which he has chosen as his field of interest for the past 15 years. He has intensive field experience in Indonesia, and also worked in Sabah, Cambodia and Lao PDR. He has worked as an independent consultant for almost 6 years since he left WWF Indonesia in 1999. He has worked for various conservation and research organization including The Nature Conservancy, World Wide Fund for Nature, the East-West Center, the Yale University field study in West Kalimantan and numerous Indonesian organizations. He contributed to the production of GIS overlays, maps, and spatial analysis of all HCVs.

Aisyah Sileuw, BSc.
Ms. Sileuw graduated from Bogor Agricultural University and was a SmartWood staff member and auditor for over two years. She has ten years experience in certification issues, particularly focused on social and community aspects of forest management. She has participated in several SmartWood certification scoping evaluations and full assessments of forest management and chain-of-custody in Indonesia.

1.4 Report Availability and Peer Review

This entire written report will be made publicly available upon finalization, as agreed to by APP and SmartWood. The report will be posted to the Rainforest Alliance website where readers can also find the final reports, appendices, and technical annexes of the HCVF assessments for Serapung and Pulau Muda. The URL for the reports is:

http://www.rainforest-alliance.org/programs/forestry/smartwood/app.html.

This report was peer reviewed by Dr. Darrell Kitchener, a wildlife zoologist with over 30 years experience in conservation of biological diversity. The final report does not necessarily reflect the views of Dr. Kitchener.

2. The Forest Management Unit

2.1 Overview

2.1.1 Licence

The Siak District is an Industrial Timber Plantation (HTI, Hutan Tanaman Industri) operating under a license issued by the Minister of Forestry (MoF) in 1999. The FMU supplies wood to the PT Indah Kiat Pulp & Paper mill in Perawang, Riau Province. Before HTI development, the FMU area was selectively harvested by an unrelated company under the Indonesian Selective Logging and Planting System or *TPTI*, approved by the Minister of Forestry. Covering a total licensed area of 47,023 ha, the Siak District FMU is managed from the on-site base camp of PT. Arara Abadi (AA), a forest management company related to Asia Pulp & Paper (APP) by common ownership.

The current HTI licenses under AA management permit land clearing of the logged-over forest areas, the establishment of canals and drainage ditches, and the planting of *Acacia crassicarpa* for pulpwood production. Timber obtained from the land clearing is Mixed Tropical Hardwood (MTH), supplying PT Indah Kiat Pulp & Paper mill in Perawang, Riau Province. Small volumes of larger-diameter logs are supplied to PT Murini Timber Sawmill.

2.1.2 Location

The FMU is located at the confluence of the Siak river with the Selat Panjang coastal straits, Siak District, Riau Province, Indonesia. Roughly shaped like an arrowhead, its triangular shape tapers in a northern point (1° 00' 59.7464 N, 102° 15' 35.8610) towards where the river Siak and coast meet at an acute angle. The "arrowhead's shaft" is aligned in a south easterly direction to a point 0° 42' 36.5964 N, 102° 19' 23.8819 E and is bounded on its western side by the Rawa river that meets the FMU boundary at 0° 50' 33.2729 N, 102° 19' 42.8125 E. To the east of the FMU is a large expanse of natural forest classified as state production forest (*Hutan Produksi*) within which is HTI licenced to RAPP. To the south, along an east-west axis from its western limit at 0° 46' 30.7148 N, 102° 04' 44.0849 E, FMU Siak is bounded by the Danau Pulau Besar Wildlife Reserve (also locally referred to as the Zamrud state wildlife reserve). The western limit of the FMU forms part of a small hook-shaped area of agricultural land within the FMU. Agricultural land occupies a 3 to 10 km strip between the FMU's western and eastern outer boundaries that taper north towards the river - coast confluence. (See Figure 1, section 2.2.1 or Figure 2, section 2.4.1 below).

2.1.3 Contact information

FMU Name: Siak District
FMU Manager: Ko Kok Pin, Senior District Manager, PT. Arara Abadi (AA)
FMU Contact: David Nicoll, General Manager, Asia Pulp and Paper
Address:
APP, c/o Plaza BII, Tower II, 22nd Floor
Jl. M.H. Thamrin No. 51
Jakarta, Indonesia
Tel: +62-21-392-8842
Fax: +62-21-392-9531
E-mail: *david_nicoll@app.co.id*

2.2 Forest Management System

2.2.1 Forest Land Classification

The FMU is primarily designated under the HTI licenses for production forest involving clear-felling and replanting with industrial timber species. There are three other land uses mandated under all HTI licenses, depicted in figure 1, namely:

- *Kehidupan* (land management for local community livelihoods),
- *Unggulan* (forest management for high-quality local tree species)
- *Konservasi* (natural forest areas for conservation).

Figure 1. Siak FMU Boundaries and Land Uses

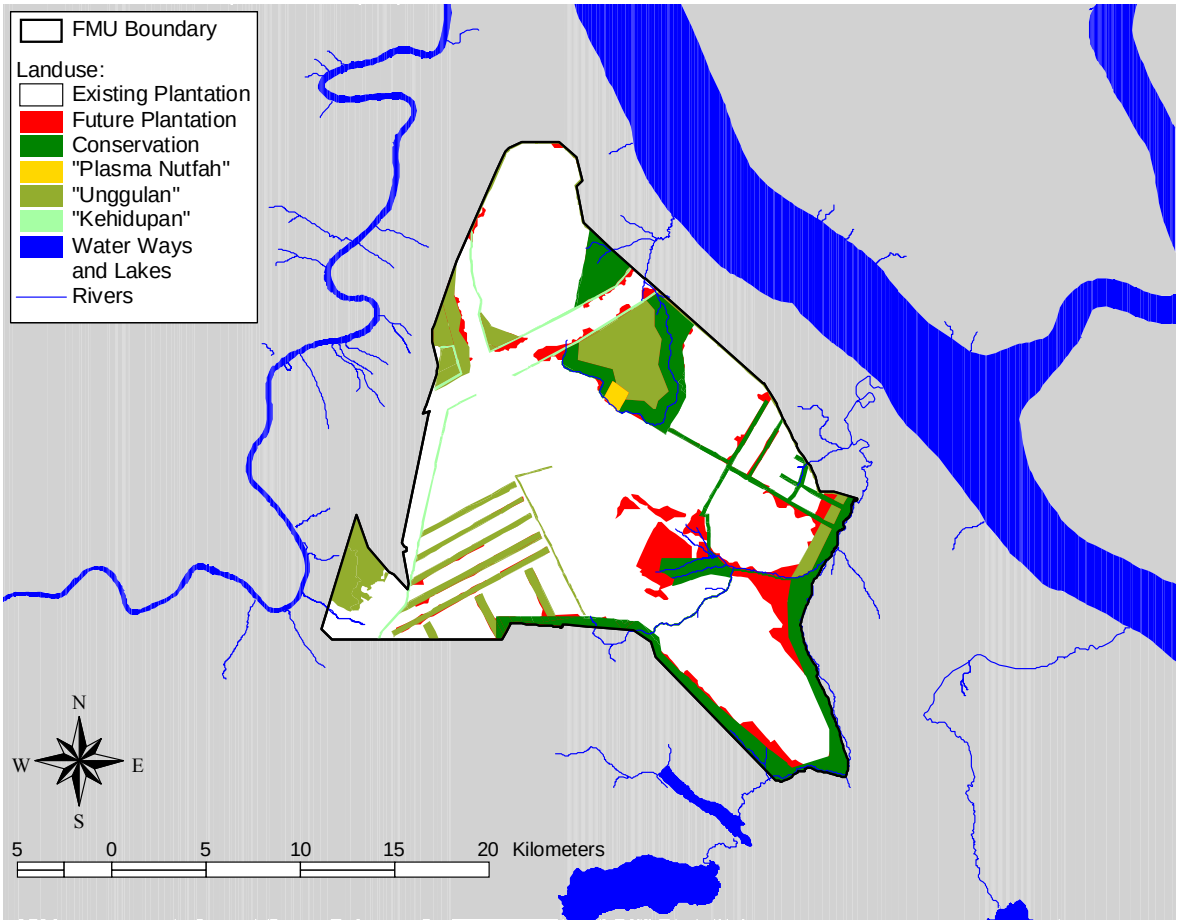


Table 2 summarizes the land use status in the FMU in February 2005, about three months after harvesting ceased in the FMU as agreed to between APP and SmartWood as part of the HCVF assessment process. Twenty-seven percent of the FMU, including 2,510 ha of the production forest area was still natural forest, 46% of the area planted with *Acacia crassicarpa,* and 12% or 5,567 ha was cleared in preparation for planting in 2005.

About 22% of the FMU area is recognized by the company as *Kehidupan, Ungulan* and *Konservasi* and in February 2005 were natural forest. However, much of this remaining natural forest was lightly to severely-degraded as a result of selective but unauthorized timber harvesting by outside loggers, as well as fire and wind-throw.

Some of the areas originally classified as *Kehidupan, Unggulan* and *Konservasi* are used by smallholder farmers. Some of the farmers were present before the HTI licence was issued, while others arrived after. In addition, following local government regulations that 500 metres either side of the road must be allocated for local community agriculture, some 3,024 ha have been set aside accordingly. About eight percent or 3,716 ha of the FMU is now recognized by the company as being managed by local farmers as smallholdings.

Table 2. Land Use in FMU Siak as of end January 2005

Type of Forest Land Use		Area (ha)	%
Production Forest (*Hutan Produksi*)	Natural Forest /3/	2,510	5
	Cleared for planting	5,567	12
	Planted with *Acacia*	21,351	46
	Scrub	1,455	3
	Infrastructure (roads, canals)	737	2
	State oil infrastructure	542	1
Multipurpose (*Tanaman Kehidupan*)		1,150	2
Indigenous Trees (*Tanaman Unggulan*)		4,283	9
Conservation (*Konservasi*)		5,352	11
Other /4/		360	<1
Smallholder Agriculture /3/		3,716	8
	Total Natural	**13,295**	**27**
	Total Other	33,728	73
	TOTAL	**47,023**	**100**

Notes:
/1/ Source: Arara Abadi data presented to the nearest whole number. .
/2/ Informal smallholder agriculture inside the FMU either began before or after the FMU licenses were given., mostly occurring inside areas formally classified as *Unggulan, Kehidupan* or *Konservasi.*
/3/ Shade = area classified as natural forest.
/4/ Other = unspecified

2.3 Ecology

2.3.1 Landscape Setting

The Siak FMU occupies the northeastern corner of a large forest area that in this report SmartWood refers to as Danau Pulau Besar - Tasik Serkap landscape forest[1], after the names of two of its four small protected areas. This landscape forest is the second largest contiguous block of peat swamp forest (PSF) within what will be referred to in this report as the East-Central Sumatran PSF ecoregion. The six largest contiguous blocks of this ecoregion are depicted in Figure 2.

Although the remaining natural forests of the Siak District are all Peat Swamp Forest (PSF), the FMU sits at the transition zone between mineral soils and peat swamp soils. The exposed low hills at this transition point indicate that the original vegetation was mixed dipterocarp lowland rainforest on well-drained mineral soils. These forests formerly extended to the west towards the central mountains, while the PSF extended to the east and comprise what remains of this forest block.

[1] This landscape is also referred to elsewhere as the Siak – Pelawan landscape.

Figure. 2 Large landscape level forests in Riau, Sumatra

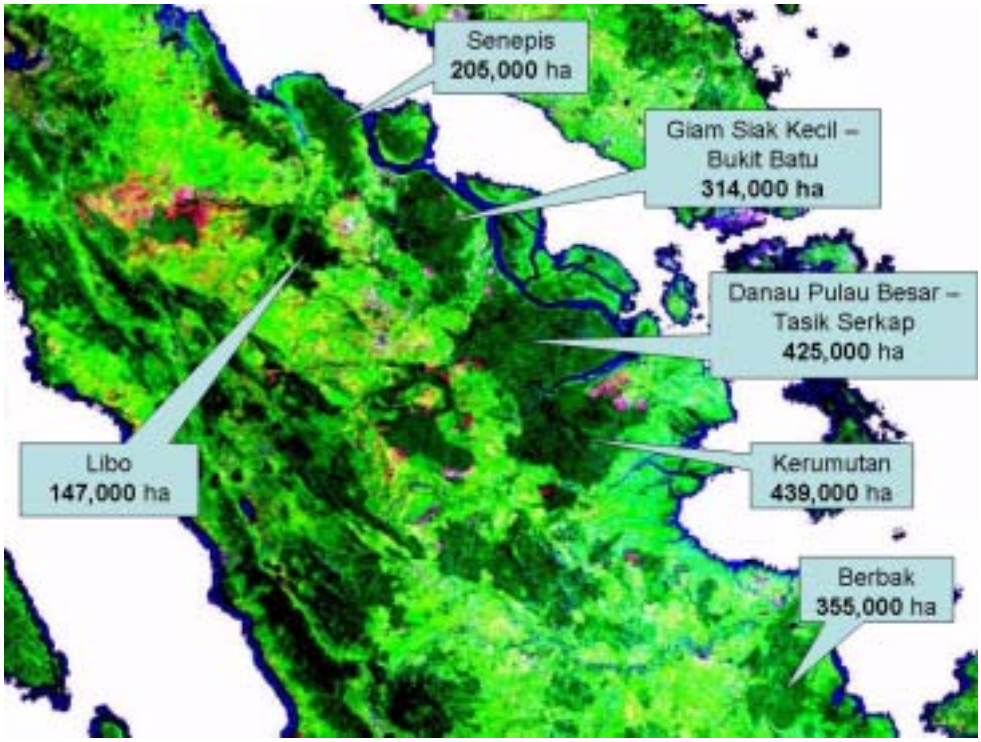


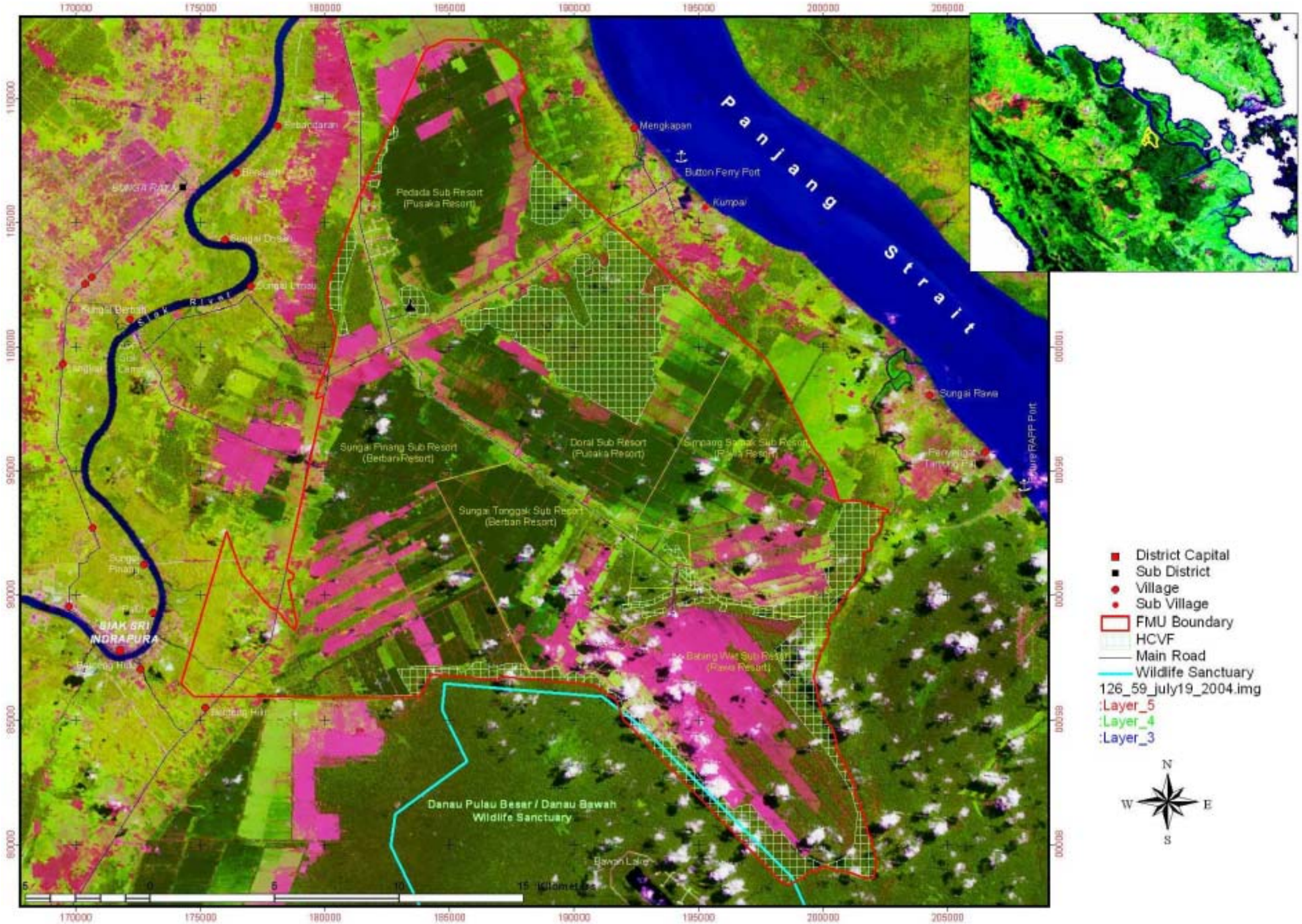
Figure 3 is a Landsat 7 satellite photo taken July 19, 2004 that shows the context of the FMU within the local landscape. The FMU sits in the corner defined by the junction of the Siak River on the west and the saltwater straits dividing the landscape forest from a set of offshore islands. The largest protected area in the surrounding lanscape forest, the Danau Pulau Besar Wildlife Reserve, borders the FMU on the south.

No dry lowland forests remain in the immediate area. The hardtop road along the southern half of the western border of the FMU traverses low hills of 20-40 m elevation on lateritic soils, and continues to the west, indicating that the original forest here was lowland rainforest. All areas of natural forests that begin 5 km or so to the east within the FMU are on peat. The forests on the mineral soils of these low hills and on the alluvial soils bordering the Siak river have been converted to agriculture in the past.

The Siak FMU is located on a coastal plain where peat has been accumulating over marine sediments. Peat soils are typically water-logged and extremely nutrient-poor, and their low pH (typically 3.5-4.5) inhibits vegetative decomposition by microorganisms, causing nett peat accumulation and correspondingly increasing peat depth over time (Reiley, Ahmad-Shah & Brady, 1996). The soil profiles exposed in the drainage canals of the FMU clearly display un-decomposed limbs, twigs and roots that are characteristic of acidic, anaerobic peat. Large accumulations of peat act like a sponge, absorbing and holding water at a level about 50cm below the surface.

The nutrient-poor, and often waterlogged, peat soils present extreme physiological challenges to plants. Under normal rainfall conditions and short dry periods, the sponge action of peat keeps the water table high, however, in extreme dry seasons the water table falls and plants must be adapted to these drought conditions. Leaves are leathery and tough to resist desiccation and crowns are small relative to tree height and diameter.

Fig. 3: The Siak FMU and surrounding areas, situated at the northwest corner of Danau Pulau Besar – Tasik Serkap landscape forest.



2.3.2 Habitats and Species in the FMU

The tropical PSF of Southeast Asia exhibit a close correlation between forest structure and peat depth (Rieley & Ahmad-Shah 1996; Tie, 1990; Anderson, 1964; 1983). This relationship is based on three primary factors: Peat depth, nutrient availability and water-logging. Peat formations typically form domes in cross-section which rise from the levees of rivers, reaching their maximum depths towards the center, or furthest from the rivers. Plant communities typically differ along these concentric gradients, forming distinct "bands" around a dome.

The flora is comprised mostly of plants endemic to peat swamps, and this flora is the most habitat-restricted among tropical rainforest vegetation (Cannon & Leighton 2004; Rieley & Ahmad-Shah 1996). Although the peat flora is species-poor in trees relative to upland lowland mixed dipterocarp rainforest it is nonetheless a species-rich rainforest vegetative formation at a global scale. Peat tree diversity is mostly at the generic level, with most tree genera of nearby lowland forests on mineral soils contributing one or two endemic peat swamp species to the unique flora.

Due to periodic land contiguity during the sea level drops associated with the recurrent ice ages over the last two million years, the extensive peat swamps of west and central coastal Borneo, east-central Sumatra and southern Malay peninsula share many species. However, the species assemblages, or peat plant communities vary regionally. The Sumatran PSF are a distinctive forest type, and their biodiversity is characteristic of the habitat (Rieley & Ahmad-Shah 1996).

The East-Central Sumatran peat swamp forests form a unique ecoregion representing the PSF along the eastern coast of Sumatra (Wikramanayake *et. al., 2001*; Jarvie *et. al.,* 2003a). Although few peat forest plant species endemic to Sumatra have been noted in the literature, the flora has not been sampled to identify rare endemics, (Rieley & Ahmad-Shah 1996), which are likely to occur. Because of barriers formed by river systems, and limited dispersal, species assemblages of peat swamp forest vary between the large landscape forest blocks within an ecoregion.

SmartWood identified three habitat types present within and in immediate proximity to the FMU: Tall PSF, Mixed PSF, and Secondary Habitats. These habitats are relatively easy to distinguish on the ground and from the air both by stature and indicator species. However, this classification corresponds only roughly to other published studies. Each study of a PSF ecosystem has defined distinct habitats based on criteria of structure and floristics, but each classification is idiosyncratic to some degree (see the review of Reiley & Ahmad-Shah & Brady 1996).

Tall peat swamp forest (Tall PSF)

Tall PSF, almost all degraded by logging, occupies the western side of the FMU. Tall PSF occurs on peat depths of roughly 2 - 8m, and is not permanently inundated. If undisturbed by logging, the continuous canopy is at 15-20m with scattered large trees (50-80 cm dbh). Emergent trees are most commonly two *Shorea* spp. (*S. uliginosa* and *S. teysmanniana*), *Parastemon urophyllum*, and *Palaquium burkii*, whose coppery crowns assist identification of this habitat from the air. Tree species diversity in Tall PSF reflects the gradient of forest structure from the edges of peat domes towards the centre. The edges, closest to rivers, exhibit the richest diversity, decreasing towards the lowest in the short PSF on the central domes. Large woody climbers, characteristic of dry lowland forests, are typically absent, or uncommon, in Tall PSF. Fast-growing light-loving *Campnosperma* spp. can be locally dominant, particularly in areas where the canopy structure has been opened up by logging activities, or natural fires (Rieley & Ahmad-Shah 1996).

The Tall PSF at Siak, classified similarly to the Serapung and Pulau Muda FMUs assessed earlier, appear to match that described from the Kerumatan Wildlife Reserve by Momose & Shimamura (2002). Based on the data they present, however, their subdivision of the tall PSF at Kerumatan into subtypes was in our opinion not justified. The slight differences in relative abundance of different species in the single plots they enumerate at different distances from the river could easily fall within the normal range of variation for Tall SPF and therefore is inconclusive[2].

Forest avifauna was found to be representative of Tall PSF found in this ecoregion, with typical differentiation between canopy, middle and understorey species. Green Pigeons *Treron* spp., Malkohas *Phaenicophaeus* spp., Fiery Minivet *Pericrocotus igneus*, Blue-crowned Hanging Parrot *Loriculus galgulus*, barbets *Megalaima* spp. Black-winged Flycatcher-Shrike *Hemipus hirundinaceus* typified the upper canopy, while Black-and-Yellow Broadbill *Eurylaimus ochromalus*, Leafbirds *Chloropsis* spp, *Malacopteron* babblers and Fantails *Rhipidura* spp. were representative of the middle storey. Understorey birds were typified by *Trichastoma* and *Macronous* babblers, Malaysian Blue Flycatcher *Cyornis turcosus* and Tailorbirds *Orthotomus* spp.. No ground-living birds were recorded, although in areas where Tall PSF interphases with other habitats (e.g. alluvial and dryland forests), species such as Pittas (Pittidae) and pheasants (Phasianidae) may occur.

The avifaunal composition of the Tall PSF habitat in the Siak area appears to be as rich as that of similar habitat found elsewhere in the landscape. Sixteen additional species were recorded here, not found in Serapung FMU and Pulau Muda FMU. Extensive areas of Mixed PSF along the rivers and broad coastal strip interspersed with tropical heath forests on the leached sandy raised areas resulted in a mosaic of intergrading habitat types that may support higher diversity of species, including birds. Where interphases occur, elements of the different habitat-influenced species compositions extend across habitats, thus resulting in an overall richer species composition within each habitat type.

Mammals recorded suggest that this fauna may be similar to peat swamp forests elsewhere in this ecoregion. The continued presence of large mammals (Asian Elephant *Elephas maximus*, Sumatran Rhinoceros *Dicerorhinus sumatrensis* and Tapir *Tapirus indicus*) was not confirmed, although the elephant and tapir were known to occur in the Siak area in the past. Documentation for Suaka Margasatwa Danau Pulau Besar (Silvius ***et.al.*** 1987) lists elephant and tapir from records dating back to 1987.

Locals and company staff report regular sightings of Malayan Sun Bear *Arctos malayanus* in the remnant forest areas around the FMU, which includes Tall PSF. The Sumatran Tiger *Panthera tigris* still occurs, and occasional sightings by company staff and local villagers attest to their continued presence within this habitat type. Franklin ***et.al.*** (1999) states that although dry lowland, montane and freshwater swamp forests form the primary habitat for tigers on Sumatra, they frequent PSF wherever they occur in proximity to forest types on mineral soils. Wild Pig *Sus scrofa* and Sambar Deer *Cervus unicolor* are present.

Five primate species were recorded: Agile Gibbon *Hylobates agilis*, Long-tailed Macaque *Macaca fascicularis*, Pig-tailed Macaque *Macaca nemestrina*, Banded Leaf-Monkey *Presbytis*

[2] SmartWood acknowledges that six days of field assessment are inadequate to evaluate important variation for sub-structuring within this habitat or to detect rarer discrete peat forest habitats. However, the remaining natural forests within the FMU are mostly small fragments and strips that are highly degraded. Access was limited to many areas because canals are blocked in areas where plantations are in growth phase. Where observed by canal and road, however, the same set of characteristic Tall PSF tree species was present throughout the FMU.

femoralis[3] and Grizzled Leaf-Monkey *Trachypithecus villosus*[4]. *T. villosus* occurs from the coastal mangroves up into the Suaka Margasatwa Danau Pulau Besar.

Small mammals recorded include Mousedeer *Tragulus javanicus*, Black Giant Squirrel *Ratufa bicolor*, Prevost's Squirrel *Callosciurus prevostii* and Slow Loris *Nycticebus coucang*.

Information on herpetofauna is lacking. The Water Monitor *Varanus salvator* was seen frequently in the canals.

Mixed Peat Swamp Forest (Mixed PSF)

Mixed PSF is the common habitat on the eastern side of the FMU. Mixed PSF occurs at the margins of Tall PSF nearest to sediment-bearing rivers where the shallow peat allows trees to root in mineral soil. Although most of the plants here are typical PSF trees, many are restricted to Mixed PSF, and are good indicator species. In this region these include *Koompassia excelsa* and *Durio lowiana*. Mixed PSF on shallow peat soils often form a mosaic with two other distinctive habitats, Freshwater Swamp and Alluvial Bench forest (Rieley & Ahmad-Shah 1996; Cannon & Leighton 2004), however these were not present in the FMU. As rivers like the Sg. Rawa on the southeastern border of the FMU sporadically flood, silt and clay is deposited in backwaters behind river levees. These areas are seasonally inundated and hummocky, with muddy mineral soils and absent of peat. Over time these alluvial soil deposits build up above the flood level, forming flat terraces or benches. The flora here is the same as species-rich lowland rainforest, although distinctive alluvial soils and topography distinguish it as Alluvial Bench Forest.

Mixed PSF and these two associated habitats are essential and recurrent elements of coastal peat swamp forests. Because all three forest types root in mineral-rich alluvial soils, tall trees and more productive forest similar to lowland rainforest are found. Tree species diversity is high and big woody climbers and figs are common and rich in species, unlike other peat swamp forests. A full range of lowland rainforest vertebrates might be found here if this habitat is extensive enough (Leighton *pers. obs)*. The flower, fruit and young leaves eaten by most vertebrate plant feeders, including hornbills, primates, bats, squirrels and many other taxa, are most diverse and most common in Mixed PSF and its associated minor habitats. These areas therefore serve as a refuge habitat, harbouring species at high densities that are relatively rare or only seasonally use the relatively unproductive other peat swamp forests. Because most plant species (ca. 80%) of all peat swamp forest habitats rely on birds and mammals for seed dispersal, and some plants for pollination, Mixed PSF should be viewed as integral to adjacent Tall PSF and Short PSF habitats. That is, the plant species diversity and community integrity of these forests depend on viable populations of these mutualistic vertebrates whose populations might typically be denser in the more productive Mixed PSF. In addition, wide-ranging vertebrates can seasonally shift habitats between these habitat types to take advantage of plant food resources produced at different times by the species in each (Leighton & Leighton 1983).

Mixed PSF supports a more diverse fauna than pure PSF. Its overall increased micro-habitat diversity and more emphasized structural form is reflected in a faunal representation that encompasses most of the species of dryland lowland dipterocarp and peat swamp forests.

[3] Aimi & Bakar (1996; 1992) and Aimi *et.al.* (1986) provide detailed treatments of the *Presbytis* group on Sumatra, and separate *P. melalophos* and *P. femoralis* geographically, with the latter distributed along the coastal habitats of central Sumatra, including the Riau PSF.

[4] Formerly known as the Silvered Leaf Monkey *Presbytis cristata*

The avifauna is consistent with lowland mixed dipterocarp forest (MDF) as well as tall PSF. 12 species of raptors (Accipitridae & Falconidae), five hornbills (Bucerotidae), nine cuckoos (Cuculidae) six bulbuls (Pycnonotidae), eight babblers (Timaliidae) and six Nectariniidae (sunbirds and spiderhunters) were recorded. Three species of hornbills, Wreathed *Aceros undulatus*, Black *Anthracoceros malayanus* and Great *Buceros bicornis* were very common, observed (and heard) in all the forest areas of the FMU.

Many large mammals have been extirpated, with the exception of Sambar Deer, *Cervus unicolor*, Sumatran Tiger, *Panthera tigris*, Clouded Leopard, *Pardofelis nebulosa,* and Malayan Sun Bear, *Ursus malayanus*. Apart from *C. unicolor* tracks, of which were observed in the southern buffer zone, all other species are reported as present in the FMU by locals. The Agile Gibbon, *Hylobates agilis*, the two macaques and Banded Leaf Monkey, *Presbytis femoralis,* occur, but the Grizzled Leaf Monkey, *Trachypithecus villosus,* was not recorded in this habitat.

Secondary Habitats & Farmlands (Including *Acacia* Plantations)

The majority of these transitional vegetation types have been cleared for agriculture in the past, leaving secondary scrubland and herbaceous marshy lands, and small areas of these habitats extend into the FMU.

The outer seaward boundary of the FMU extends along the former interphase between PSF and the transitional stages from alluvial bench forests on the levees, to mangrove forests of varying widths and zonal representation (i.e., back mangrove and Nibong *Oncosperma* forests through to *Rhizophora* to sea-fronting accreting forests of *Sonneratia* and *Avicennia*, and salinity-influenced Nipa *Nypa fruticans* stands).

There are large areas of secondary habitats present within and in the immediate vicinity of the FMU. At the time of surveys, fires were rampant over much of these areas, and therefore little information was obtained. The vegetation is typified by *Melastoma malabathricum*, *Imperata* spp. and extensive areas of bracken fern.

Typical open scrubland birds were present, including the two coucals *Centropus sinensis*, *C. bengalensis*, Magpie Robin *Copsychus saularis*, Yellow-bellied Prinia *Prinia flaviventris*, shrikes *Lanius cristatus* and *L. schach*, common pipit *Anthus novaeseelandiae* and munias *Lonchura* spp.

Wild pig *Sus scrofa* appear to thrive in these areas, probably a consequence of the predominantly Muslim local population, who do not hunt them.

The *Acacia crassicarpa* plantations support a depauperate fauna. Both Long-tailed Macaque *Macaca fascicularis* and Pig-tailed Macaque *M. nemestrina* were recorded in this habitat, probably displaced animals or groups moving between remaining forest patches. Pigs will regularly use plantation areas, though none were observed. Birds recorded here are typical secondary scrub species as described above. A migratory Hodgson's Hawk Cuckoo *Cuculus hodgsoni* was observed in *Acacia*. Some species of birds of prey will include plantations areas within their hunting range, such as Changeable Hawk Eagle and Crested Serpent Eagle. During migration, birds of prey can be seen in almost every habitat, including plantations.

2.4 Socio-Economic Setting

Some 25 settlements flank the western and northeastern borders of Siak FMU along the Siak river and the coastal straits of Selat Panjang. (See Figure 4 Village & Settlements near the Siak FMU). While farming and fishing are major livelihood activities of local communities,

extraction of timber from peat swamp forests by local communities and companies have dominated the local economy in recent years.

Figure 4. Villages (*desa*) and Settlements nearby the Siak FMU

Riparian and coastal land surrounding the FMU borders have long been farmed by local communities in various ways. There is little rice cultivation. Cultivated sago palms have been an important staple in the past and a present source of income, e.g., for sale to sago-flour making enterprises. Historically, rubber cultivation opportunities attracted settlers to riparian areas where alluvial deposits provided sufficient fertility. Coconut cultivation has been typically pioneered by farmers of Bugis origin, who are some of the best local peat canal engineers. In recent years, farmers of rubber and coconuts have been shifting to more profitable oil palm cultivation. Some fruit trees grow well in peat soil conditions, e.g., rambutan, and typically occur in mixed crop housegardens (*pekarangan*). Export crops such as rubber and other local commodities, in particular timber, have increased incomes and the ability to buy produce from outside the area. Meat, vegetables and fish are imported from other areas in Riau and are regular feature of local weekly markets.

Fishing remains a major source of livelihood for cash and subsistence income though catches are widely reported as being much lower than in the past. Fish are caught by line and net in the coastal waters of the straits and the Siak river, as well as in small rivers originating in the FMU and flowing into both water bodies. For example, the Mengkapan river and its tributary the Limau river flowing from two isolated areas of natural forest in the north eastern corner of the FMU; the Rawa river that forms part of the FMU's eastern and southern borders; and a tributary of the Rawa that flows south from within the FMU to Danau Pulau Besar inside the wildlife reserve, itself an important source of fish. Fishermen have observed that debris from canal construction has occasionally been responsible for reduced fish stocks, and that forest loss on either side of small rivers has negatively impacts on fish numbers and diversity of useful species.

Off-farm additional income-earning opportunities for farming households include trading, shopkeeping and employment in agricultural and timber management companies, e.g., the mangrove charcoal processor, the sawmill and a sago flour mill along the Sungai Rawa river, shrimp ponds in the Kumpai area, birds nest enterprises in Sungai Apit and nearby villages along the river Siak close to its confluence with the Selat Panjang straits, and a new oil palm plantation in the vicinity of Pebadaran and Dosan villages further upriver and close to the FMU base camp. Opportunities for wage-based employment include Siak FMU and RAPP's major road and port development to the east of the FMU.

Sand, log and coal barges as well as oil and gas tankers in the straits are a constant reminder of the wider economic setting of the FMU, as are passenger and cargo boats within a few hours of major Sumatran ports and Singapore. Local government is supportive of schemes to increase economic linkages with other areas, e.g., plans for upgrading Tanjung Buton harbour and the building of a bridge across the Siak river. Pressures on dwindling natural forest areas are likely to increase. On the other hand, the Siak district government has expressed interest in increasing the area of the Danau Pulau Besar wildlife reserve to the south of the FMU. Table 3 presents farm and off-farm sources of livelihoods for households in six communities surveyed as part of the HCVF assessment.

Table 3. Income-earning Livelihoods of Surveyed Local Communities

Livelihood Source	**Proportion of Households in Surveyed Communities with Various Income-earning Livelihoods** (%)					
	Tanjung Pal	Sungai Rawa	Kumpai	Mengkapan	Pebadaran	Dosan
FARM	(1)	(2)	(3)	(4)	(5)	(6)
Rice	0	0	0	0	80	0
Sago	100	80	<10	<10	<10	<10
Oil Palm	0	10	15	20	0	>30
Rubber	<1	10	0	<10	80	80
Coconuts	<1	<10	100	<10	<10	<10
OFF-FARM						
Timber	>90	>40	0	>50	<5	>3
NTFPs	<10	<10	0	<1	0	<1
Trade	<1	<10	0	<1	<5	<1
Fishing (lake, river, sea)	<40	40	0	40	60	<20
Civil Service	0	<1	0	<1	0	<1
Company Employment	60	<1	0	<1	0	<1

Notes:
/1/ The vast majority of households have more than one livelihood source.
/2/ Communities numbered as in map of Figure 4.

By way of further illustration of the socio-economic setting of the FMU, its site-specific characteristics as well as its common features, each of the six communities surveyed as part of the present HCVF assessment are described below, numbered as in Figure 4. Communities #1 through #4 along the coastal straits by the northeastern border of the FMU are first described, followed by communities #5 and #6 along the Siak river and next to the western flank of the FMU. More details about villages #1 through #6 can be found in the Appendices to this report.

(1) **Tanjung Pal** village, a coastal settlement located near the eastern end of the FMU, is home to some 310 households of the Akit people and around 10 Javanese and Melayu inhabitants (6 km from the village settlement). The Akit, originally a nomadic sea-faring people, were settled in the area under government support schemes about 20 years ago. They moved from their original settlement when falling peat levels allowed excessive saline intrusion into their water supply. The Christian Akit commonly hunt wild boar or *babi hutan* in natural forests, sometimes traveling far beyond their village in search of boar and other wild game such as *kancil* deer. Most of the Akit harvest timber for sale from inland natural forest outside the FMU. Customary law or *adat* does not limit wood harvesting except very close to burial sites; rituals are required when forest land is cleared for agricultural use. They fish in coastal waters and along the Rawa river at the FMU border as well as in the upstream Danau Pulau Besar, the majority of their catch for sale. The highly-prized *kayangan* or *arwana* found in the lake and sold as an ornamental fish is now rare. According to fishermen, fish catches have fallen in river areas where there has been forest loss or (temporarily) where debris from canal building in the FMU entered the Batang Wat river that flows into to the river Rawa. Sago is a major smallholding crop for most of the inhabitants, both for a staple and sale to the local sago flour mill. Medicinal plants and some wild vegetables are gathered by traditional shaman and midwives from inland natural forest areas outside the FMU. Wild vegetables are generally only harvested as a food supplement for those working in or traveling through the forest for other reasons, e.g., wood harvesters or fishermen traveling upstream to Danau Pulau Besar. Some 30 adults work for RAPP's HTI to the east.

(2) **Sungai Rawa** village, Tanjung Pal's larger western neighbour (about 400 households) and apparently more prosperous, consists primarily of Muslim Melayu inhabitants. 20% of the population is Javanese, Bugis, Minangkabau or Sambas Melayu from West Kalimantan. It is 5 km from the nearest FMU boundary to the village settlement on the coast. Similar to Tanjung Pal, sago palm is widely cultivated. Coconuts, rubber and oil palm cover larger areas, however. A long-established mangrove charcoal processor (utilizing wood from coastal mangrove areas), a sawmill and sago flour mill are located in the lower reaches of the Sungai Rawa river. Like the Akit, local inhabitants fish along the coast and up the Rawa river as far as Danau Pulau Besar. Hunting is rare. Medicinals for midwives are gathered along the Rawa river. Traditional midwives and a government midwife work together to assist most births. Wild vegetables are harvested by those working within or traveling through the forest. Wood harvesting from natural forests is common, if not commonly reported. Significant quantities of fish and meat protein, vegetables, rice and other staples, particularly during weekly market days, are imported into the village from other areas. Generally less concerned about forest loss than the Atik, customary law nonetheless forbids the felling of trees into the river. The village, named after the river that flows through it provides a reminder that not all villagers welcome unauthorized logging. Fishermen's progress upriver to Danau Pulau Besar as well as their lines and nets are seriously disturbed by floating logs particularly during the dry season when log jams are common. They also lament the loss of forest too close to the river's edge associated with falling fish catches. FMU - Village community relations are similarly problematic as in many forestry company-local community settings elsewhere, e.g., villagers report broken promises of assistance from the FMU; and FMU staff point to disruptive behaviour of illegal loggers (supported by senior village officials) operating inside the FMU.

(3) The **Kumpai** community identified for the HCVF assessment is located within a sub-village or *dusun* of Mengkapan village (see below) further up the coast from Sungai Rawa and downstream from the larger of two isolated pieces of natural forest in the FMU classified as *Konservasi* (3 km from the coconut community settlement). Only consisting of an extended family of seven households, the Kumpai community forms a distinct community of Muslim Bugis coconut farmers following a long-established coconut cultivation system in peat soils along the eastern coast of Sumatra. Traditionally skilled drainage engineers, they tend to regulated peat water relations better than other traditional agriculturalists, succeeding with coconut cultivation where others often fail. Once the coconut plantation is established, the house members or entire households may leave, returning every two to three months for the harvest. Located about 3 kilometres from the edge of the FMU natural forest, and arguably influenced by FMU water relations, they have no direct contact with the natural forest and perceive such forest (none of which remains in the area they farm) only as a potential new cultivation opportunity. The comparatively shorter time until first harvest, and more regular and higher value harvests, are persuasive factors for the Bugis to start converting their coconuts to oil palm. They have no economic connection to their neigbours managing industrial-scale shrimp ponds and birds nest production.

(4) **Mengkapan** village (428 households), consisting primarily of Melayu inhabitants (85%), is downstream from the two isolated natural forest areas of the FMU classified as *Konservasi* (3 km from the village settlement). In many ways, Mengkapan resembles Sungai Rawa village in both its size and livelihoods, ranging from wood harvesting to farming and fishing. Its river fishing community, however, is under greater threat because of heavier illegal logging impacts on the smaller river. During the dry season, river fishing all but stops in forested areas because of log barriers formed when water levels fall. A continuously clear-running tributary of the Mengkapan river, the Limau river, flowing out of the smaller of the two isolated natural forest areas is a critical source of drinking water. An alluvial bench has favoured coconut cultivation and the long survival of *durian* fruit trees. Smallholder farmers from Mengkapan have opened forest areas for rubber and oil palm cultivation along the main road inside the FMU from Tanjung Buton to the FMU Base Camp. As a result of local government regulations, the FMU recognizes smallholder agriculture up to 500 metres either side of the main road. Illegal loggers access the FMU's *Konservasi* natural forest through these agricultural areas. Escape fires are common. Mengkapan controls the important harbour of Tanjung Buton for travel to and from other areas along the coast, Kalimantan and Singapore, with a road link through the FMU to the Siak District capital and the main road to Pekanbaru, the provincial capital. The boundary between Mengkapan and Sungai Rawa villages is contested by both communities.

(5) **Pebadaran** village is located along the Siak river, adjacent to the western edge of the FMU (3 km from the village settlement) where a small and dwindling area of natural forest remains. Pebadaran's 80 households are predominantly Melayu, less than 10% consisting of Javanese and other migrants. Again the familiar livelihood pattern of local communities of reliance on fishing for protein and income is evident in Pebadaran. Unlike the other communities, however, its alluvial soils support a significant area of irrigated rice or *sawah.* Rubber is the main and long-established cash crop, though a large proportion of the area now consists of old rubber trees of low productivity. Many farmers are hoping to be able to cultivate oil palm through a government scheme managed by the state company PTPN V between present farmland and the FMU's small western area of natural forest, which may succumb to local pressure for oil palm cultivation. Wood harvesting is now of minimal importance as there is little natural forest area left in the village or accessible in the FMU. An isolated patch of nearby natural forest around a small lake may be developed for tourism by Sungai Apit Sub-District even though within the FMU boundary. Drawing on a tale, apparently of recent origin, the lake is named *Tasik Naga Sakti* or Lake of the Sacred Dragon. It is said the dragon or snake in question is related to a family in Pebadaran village who were interviewed as part of the assessment. Meanwhile, some people from neighbouring Dosan village (see below)

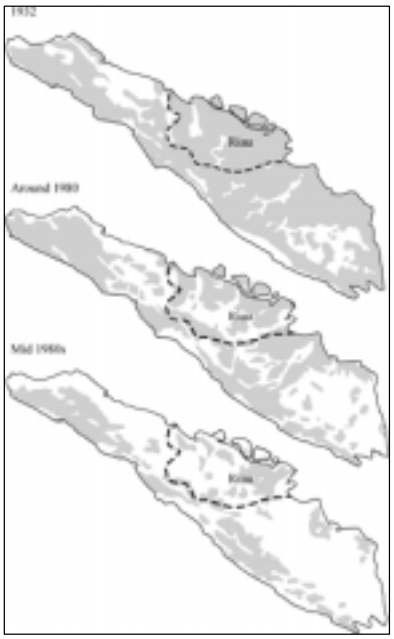
have claimed management rights to the lake and have begun to develop it as a tourist attraction by clearing some vegetation and constructing tables and chairs near the entrance. Forest fire from surrounding agricultural land, however, has reached the lake edge.

(6) **Dosan** village, the upstream neigbour of Pebadaran village has a similar spatial relationship to the FMUs small remaining area of natural forest at its eastern boundary (5 km from the village settlement). Larger than Pebadaran, it has no irrigated rice area, wood harvesting is a minor activity but fishing and rubber cultivation are important livelihood sources. In comparison with the other Melayu-dominant villages, other social groups are more significant, accounting for about a quarter of all households. 25% of all households include labourers hired for the inland PTPN V oil palm development scheme adjacent to the FMU. Like Pebadaran, Dosan village farmers hope to ensure farm management rights to the oil palm development scheme being developed by PTPN V. The village has informally claimed management control of Lake Naga Sakti inside the FMU (see above).

2.5 Natural Resource Impacts within and around the FMU

2.5.1 Landscape Forest Degradation

Figure 5. Forest cover change in Sumatra
(Matthew & van Gelder 2002)



Like other major lowland river basins in eastern Sumatra peat forests along the Selat Panjang coast and rivers that flow into it, such as the Siak, have a long history of natural forest disturbance, degradation and loss. Logging by licensed and unauthorized enterprises, and land clearing for small- and large-scale agriculture and for timber plantations as well as forest fires resulting from these development activities have inexorably eroded natural forest ecosystems and the livelihoods of those who depend upon them directly or indirectly for water resource and fire protection. Conflicting land claims among local communities, concessions and government have frustrated efforts to slow the pace of deforestation.

Deforestation in lowland forest areas generally across Riau province has been frequently reported by a wide range of authors and institutions (CEPF 2003; DtoE 2003; Jarvie *et al.* 2003a, b; MoFr 2003; Obidzinski 2004; Sijabat 2004; Suyanto *et al.* 2004). The root causes of deforestation, though arguably more intense in recent years, have been at work for many years in Riau, and the Kampar river basin, as elsewhere in Sumatra (Matthew & van Gelder 2002).

2.5.2 Impacts on Non-Production Areas

The Siak FMU is a good opportunity to illustrate the consequences of delineating non-production areas (*Unggulan, Konservasi, Kehidupan*) as strips running along the edge of resorts, either between separate resorts or along the FMU external boundaries. The stated rationale for this practice is to provide a buffer from the agricultural practices outside the FMU, or to define the different resorts. In recently established resorts, these forest strips retain some semblance of forest, but operative factors are in place that will ultimately compromise their survival. In an established concession like Siak, this process can be observed.

Almost all these strips of forest that are below, or up to a width of 500m, have been severely degraded. In some parts of the concession, these strips no longer have stands of forest left, just scattered trees.

The factors that lead to this situation are:

- On peat soils, hydrology is fundamental to the continued existence of a PSF. When strips of forest are retained without any means of regulating the hydrological requirements of the soil and the forest, the forest will not survive.

- With drastic alteration of hydrology, the soils begin to degrade and subside over time. Trees lose their supporting substrate, and eventually fall.

- With more tree-falls, the already fragmented forest structure is further subjected to the effects of wind, leading to complete loss of standing forest.

- Contract workers in an established plantation such as Siak build their harvesting camps close to these forest strips, and obtain building materials as well as firewood for their camps from these strips, further degrading the forest.

In summary, Siak FMU demonstrates that the strips of non-production forests within the FMU are not effective in reaching their stated objectives because they have neither a protective nor conservation function. A rethinking of the planning process when a concession is first opened up is clearly required, to ensure productivity of the concession as well as the conservation of its habitats, vegetation types and associated biota.

2.5.3 Unauthorised Logging

There are no areas that could be classified as primary forest within the concession. According to company staff, logging by groups from the villages surrounding the FMU had been very high until recently. It was reported that some of this logging has been conducted by local villagers, but also larger operations that involve logging crews from outside this area. Hand logging is selective, leaving behind a patchy canopy but a nearly continuous forest understory. Areas with relatively little remaining canopy cover are classified as “severely degraded.” The Landsat image did not allow reliable distinction between lightly logged versus heavily logged areas, and no overflights were conducted that might have enabled us to distinguish these areas. Secondary forest areas are located near the border with coastal agriculturalists and may include fallow scrub vegetation regenerating from previous agricultural clearing.

The canal network has enabled access to all areas of the concession over the past several years, so no areas were exempt from logging. From observations and interviews, logging gangs use newly opened canal systems to systematically penetrate adjacent forest blocks with kuda-kuda “rail lines” to move logs to the canal bank by hand, then via the canal system in long booms of two rows of logs tied end to end. The logs are then either moved to the coast via rivers or trucked from where roads meet the canal system. Such unauthorized logging is restricted mostly to a small set of four commercial species above 30-40 cm dbh in the Tall PSF: Meranti bunga (*Shorea teysmanniana*), Suntai (*Palaquium burkii*), Punah (*Tetramerista glabra*) and Ramin (*Gonystylus bancanus*). In the Mixed PSF, the major species removed is Kempas (*Koompassia excelsa*) and Meranti bunga (*Shorea teysmanniana*). Large trees of these species were retained in the residual stand apparently because of stem/trunk defect. The dominant canopy emergent *Shorea uliginosa* (Meranti batu) is a heavy “sinker” log that is difficult to move along canals, and is seldom cut.

2.5.4 Canals and hydrological alteration

A final land use feature, worthy of separate consideration because of the way it fundamentally alters the hydrology of the area, is the network of major and minor canals and drainage ditches, of the existing canal system that provides access to most of the FMU land area. The primary function of the canals and associated infrastructure is to control (and reduce) water table depth at an optimum for both plantation growth, for management access into the plantations, and for transport of logs. Main canals are on average 12m wide and 3.5 - 4m deep, while secondary canals are on average 9m wide and 2 - 3m deep. Canals are usually blocked to conserve water once planting and early maintenance operations are completed, and the main transport route may be closed off temporarily with water-gates. Most areas of this FMU are already planted, so that much of the canal system is now blocked.

The tendency is for water to overflow canals downslope into the forests or agricultural lands bordering the *Acacia* planted areas inland. Flooding into the natural forest can be severe, causing death of trees. For example, forest in the east-central area of the FMU has suffered canopy tree dieback due to prolonged flooding. The FMU canals do not threaten draining of the peat forest dome during drought periods because the peat dome is far to the south of the FMU (approximately 20-30 km southeast). However, there remains the potential serious risk that acute drought periods might lead to drying out of the peat and even the canals, creating the conditions for wild fires. Fires in peat areas drained by canals are especially damaging, because the peat layer are flammable, lowering the ground surface to below the wet season water table, leading to anthropogenic standing pools of water or lakes that no longer support plantation or natural forest.

3. *Assessment Methodology*

The following sections describe the manner by which SmartWood applied the Indonesian HCVF toolkit to identify HCVs and delineate HCVF(s) in the FMU of Serapung.

3.1 Continuation of an Assessment Methodology

The current assessment of Siak District is the third HCVF assessment SmartWood has conducted for APP. The Siak assessment followed a similar methodology as the previous two assessments at Pulau Muda District and Serapung Unit.

Pulau Muda: SmartWood began the HCVF assessment for the Pulau Muda district on 19 July and concluded the field work on 30 July 2004. Report writing took place between 2 and 23 August 2004, when the draft report was submitted to APP and the two independent peer reviewers. The report was also reviewed by Richard Donovan, SmartWood Director and Chief of Forestry, Rainforest Alliance. The report was revised to incorporate the comments from all reviewers and APP. After technical clarifications, the report was finalized by SmartWood. A publicly available version of the final report was published on the SmartWood website on October 10, 2004.

Siak: SmartWood did not make significant changes to the assessment checklist, report format, or other elements of the assessment process. The same team of assessors was used as before. SmartWood began the field HCVF assessment for Serapung on 1 November and concluded the field work on November 8. Report writing took place between November 10 and December 10, 2004. The draft report was submitted to APP and one independent peer reviewer on December 13, 2004. The report was finalized on February 4, 2005.

3.2 Identifying High Conservation Values

To assess and determine the presence of conservation values that would be considered HCV according to these definitions requires highly trained ecological and social experts; further consultation with relevant stakeholders (communities, government bodies, forest managers, scientists, and NGOs); access to baseline inventories, data sets, maps, and spatial imagery; and professional judgment based on field evaluation. The steps taken to perform these assessment tasks are described below.

Step 1. Preliminary Assessment and Preparation for Field Assessment

Preliminary assessment of spatial data and literature supported the decision to proceed with an HCVF assessment, as it was evident that some, and potentially all, HCVs were present.

⇒ Recent satellite imagery was reviewed. It was evident that this landscape is one of a few remaining tracts of large landscape forests of the East-Central Sumatran peat swamp forests.

⇒ The forest within the FMU, located at the northwest corner of the Danau Pulau Besar - Tasik Serkap landscape, is contiguous with the forest of the Danau Pulau Besar wildlife reserve, and part of a large landscape of peat swamp forest, as shown by satellite imagery.

⇒ GIS overlays of concessions already licensed by the government for conversion indicated that planned land use changes for the landscape will further reduce the area of contiguous forest.

⇒ The preliminary HCVF assessments of the Riau PSF by WWF (Jarvie *et al*. 2003a, c) were evaluated and indicated the potential HCV presence in the natural forests within the FMU as related to other PSF areas.

⇒ Literature research included consultation of indices and databases of endangered and threatened species, maps, government legislation, and definition of various PSF habitats within the East-Central Sumatran peat swamp forest ecoregion.

Step 2. Field Observations and Data Collection

The SmartWood HCVF assessment checklist identified information to be acquired from the company and other sources, and that from direct field observations. Due to the limitations of company ecological data, the assessment would rely greatly upon the expertise of the team to collect primary data.

⇒ Data were gathered through meetings with APP/SMG and AA staff and workers at their Jakarta and Siak offices. Data were acquired firsthand by meeting with members of local communities.
⇒ Observations, ground-truthing, and rapid survey of conservation values were conducted for species, ecosystems, forest services and community resource uses (basic needs and cultural). These were obtained through field visits to locations within and surrounding the FMU on foot, motorbike, speedboat, and small boats.
⇒ Baseline spatial information on forest cover and landscape features was obtained from remote-sensing imagery (Landsat7, July 2004).
⇒ Vegetation and habitat mapping of the FMU was not available, and thus required primary data from aerial reconnaissance and preliminary ground-truthing
⇒ Species inventory baselines were developed through anecdotal information, available literature on the Kerumutan Wildlife Reserve, and from the company timber cruising reports. [Data were sparse and/or inaccurate, requiring primary data gathering at accessible locations.]
⇒ Background information on species and conservation status was gathered from literature searches and documents provided by APP, from interviews with local people and staff / workforce [although turnover of the largely immigrant workforce meant few sources of reliable local knowledge], and from conservation organizations. In addition, the botanists with Dinas Kehutanan in Pekanbaru were interviewed to review species distributions and conservation plans for the landscape forest that includes the FMU.
⇒ No aerial overflights were possible due to the extreme haze conditions during the assessment.

Step 3. Data analysis to determine potential HCV areas

The data analysis instrumental for the determination of HCV areas required significant professional expertise from the ecologists and social scientists working in the forest and villages. The comparative analysis of different key data sources is outlined here to support the rationale for HCV identification presented in section 4.

Habitat

⇒ Evaluation of topographic maps to determine soil and hydrological conditions to assist in defining habitat distinctions. However, the topographic map provided by the company was not accurately oriented on the concession map, so had to be interpreted with care.
⇒ Analysis of recent satellite images to delineate remaining forest areas and their contiguity or condition within the FMU.
⇒ Comparison of natural forest types sampled at a few locations to characterize structure, indicator plant species, species diversity and abiotic conditions within the FMU.
⇒ Analysis of timber cruising data using vernacular tree names to evaluate habitat distinctions, and comparing these with new samples gathered at other locations.

(Botanical names had been established during HCVF assessment at the Pulau Muda and Serapung FMUs.)

⇒ Collecting leaf samples to verify botanical names and document uniqueness of tree morphospecies in tree disversity plots; and consultation with botanical references, published studies and colleagues to verify identities of peat swamp species.

⇒ Classification of forests and riparian areas into habitat types defined by vegetative structure and floristics, and combinations of peat depth and drainage.

⇒ Observations of vertebrates to establish indicative representation of faunal communities in relation to vegetation types or habitats.

⇒ Reviewing ecological data collected in 2004 from the Pulau Muda and Serapung FMUs.

⇒ Analysis of satellite imagery of the larger area of the Kampar and Siak estuary to determine potential ecological hotspots and habitats of significance to migratory waterbird and raptor species

Species

⇒ Analysis of available information and published sources to establish a baseline for the FMU.

⇒ Evaluation of globally significant species in terms of habitat requirements and ecological behaviour through published sources of ecological knowledge on these species.

⇒ Analysis of habitat requirements provided the first layer for each target species, which was then correlated with presence of preferred habitats within the FMU, and ground-truthed where possible.

⇒ Consultation with individuals and institutions for reference information on vertebrate species.

Social

⇒ Data on the importance of FMU forest areas to local community values primarily relied upon interviews with various village groups (e.g., village executive and council, hunters, fishermen, traditional mid-wives (*bidan kampung*), healers (*dukun*) and *tiger shamans*, to fill out data sheets on the significance of FMU forests as sources of basic needs or as areas of cultural value.

⇒ Social data included estimates of livelihood production trends, alternatives and sustainability.

⇒ Watershed, river, well and canal observations were used to determine whether there were HCVs related to water resource protection.

3.3 Mapping of identified HCVs

The occurrence and distribution of all identified HCVs were mapped using GIS. The use of GIS was necessary to take data collected from multiple locations within the FMU and place them on a map. However, the specific location of a particular value (e.g., endangered species) does not immediately translate to a hard HCV boundary on a map. Rather, the team had to interpret species and habitat information to best estimate the real world occurrence and extent of the forest in which the HCV was present. For example, the HCV boundaries for species were delineated based on presence and extent of their identified or predicted preferred habitats, both inside and outside the FMU. Some HCVs were more straightforward to map, such as protected areas within the concession or cultural sites that village elders could describe.

Once the team had classified and ascribed where the HCVs occur within the FMU, a spatial GIS overlay for each HCV definition was produced. Since this would enable putting one GIS layer on top of the other, the technology could facilitate further review and understanding of the final HCVF area.

Overlays represent approximate locations of HCV boundaries and are therefore indicative not prescriptive. Actual demarcation on the ground would be guided by the mapped borders and be subject to ground-truthing but is not expected to deviate markedly from the indicated borders.

3.4 Delineating HCVF Boundaries

The final step in the process was to analyze whether the HCV areas mapped in the multiple overlays should become the proposed HCVF bondaries or whether they should be modified further as a result of analysis.

The team analyzed interacting and other contributing factors and conditions to delineate the HCVF boundary with respect to whether the forest area could be expected to maintain the identified HCVs.

The following basic precepts underscore important considerations used in this judgment process:

- Each HCVF area is a viable and functional ecosystem unit itself or has the realistic possibility of future management practice allowing it to become a functional unit, or is part of a functional unit.

- Contiguity is paramount in identifying HCVFs. Single large areas of habitat, or mosaics of different habitats, are of higher value and priority than a series of smaller, isolated forest areas. Albeit some smaller, isolated forest areas may be very important to buffer or protect an HCV.

- Each HCVF protects a significant portion of overall biological diversity and/or safeguards significant local community dependence on forests in the FMU.

- Each HCVF assumes company and local community commitment to effective management, resources and appropriate research to ensure optimal short- and long-term conservation while providing opportunities and knowledge for future improvements within the FMU.

The HCVF (s) arising from the integration of the HCV evaluation were indicated on a single HCVF map of Siak, presented in section 5 of this report.

3.5 Application of the Precautionary Approach

The FSC (2000) recognizes the Precautionary Principle (PP) for decision-making processes about HCVs in the absence of adequate scientific knowledge on the consequences of human impact on forest areas. FSC Principle 9 states that “decisions regarding high value conservation forests shall always be considered in the context of a precautionary approach”. The definition of the precautionary approach used by the FSC was ratified during the FSC General Assembly in June 1999. The term is defined as: “Tool for the implementation of the precautionary principle. The term ‘principle’ is defined as: An essential rule or element; in FSC’s case, of forest stewardship.

While there are multiple definitions of the PP in circulation, probably the most widely accepted is from the Rio Declaration, “In order to protect the environment the Precautionary Approach shall be widely applied by states according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.”

An IUCN evaluation into the application, effectiveness, and controversy surrounding the PP in natural resource management, and Cooney (2003) has concluded that "considerable ambiguity remains regarding the meaning and context of the precautionary principle … [its] meaning and application are unclear in situations where sources of risk are complex and multiple, which is frequently the case in the context of natural resource management and conservation".

The clearest guidance in the Indonesian HCVF Toolkit on the precautionary approach is with respect to *managing* HCVF. The guidance itself comes from the FSC: "Planning, management activities and monitoring of the attributes that make a forest management unit a HCVF should be designed, based on existing scientific and indigenous/traditional knowledge, to ensure that these attributes do not come under threat of significant reduction or loss of the attribute and that any threat of reduction or loss is detected long before the reduction becomes irreversible. Where a threat has been identified, early preventive action, including halting existing action, should be taken to avoid or minimise such a threat despite lack of full scientific certainty as to causes and effects of the threat" (FSC Principle 9 Advisory Panel, 2000).

For the *identification* of HCVF, the toolkit states that "where doubt exists as to whether an attribute, or collection of attributes, are sufficient to signify HCVs, then the forest manager will treat these attributes as HCVs, until information proves otherwise." Given the current limited state of knowledge about biodiversity attributes in tropical PSF, a presumptive interpretation of the precautionary principle might conclude that all such forests hold HCV and hence all should be assigned HCVF status. SmartWood has found through its experience in conducting certification assessments in Indonesia that many stakeholders, especially forest managers, perceive the FSC HCVF definitions to imply that all natural forest in Indonesia is HCVF. While the Toolkit does not state this, the present assessment team felt it was important to emphasise herein that the use of a precautionary approach does not begin with a foregone conclusion, but works to fill knowledge gaps wherever possible.

There are two kinds of knowledge gaps surrounding an HCVF assessment, which would probably be similar to other areas in Indonesia.

- First, the lack of full scientific knowledge on Sumatran PSF *per se* that will take many years of research to elucidate.
- Second, the lack of available but readily obtainable baseline inventory data on flora, fauna, human uses, etc. as well as the limited time or resources to conduct comprehensive biodiversity surveys, e.g., in the case of the present assessment, limited current landscape appreciation because an overflight by helicopter was not possible in the severe haze conditions. Subsequent surveys and research undertaken by a FMU can close this knowledge gap and possibly reduce large set-asides demanded by application of the precautionary principle (see Section 6.3 on research).

This HCVF identification process applied by SmartWood aimed to introduce as much measurable, observable and objective data analysis through the field assessment and consultation to close the first kind of knowledge gap and require less 'fallback' on the PP when making decisions concerning the presence of HCVs. Nevertheless, there were situations in determining the presence, or extent of the areas considered as HCVs, where the combined knowledge of the team and other expert sources were not sufficient to make a completely informed decision and a precautionary approach was invoked.

4. Findings

This section covers observations and analysis of ecological and social conservation values (i.e., HCVs) within the FMU, including their relationship to the surrounding landscape forests, according to the assessment criteria. Each HCV (and their components) is described within the context of the site and rationale is given for the forest area delineated which pertains to these HCVs.

4.1 High Conservation Value 1

Forest areas containing globally, regionally or nationally significant concentrations of biodiversity values (e.g. endemism, endangered species, refugia).

Four sub-categories (components) have been set to assess the presence of such forest areas, and each are treated separately below.

4.1.1 HCV 1.1 Protected Areas

Definition

The Indonesian HCVF Toolkit states that all protected areas and proposed protected areas are considered HCVs.

HCV1.1 relates to legally constituted protected areas[5] within the country, and how they contribute to conservation of biological diversity in the context of forest management. The objective of this HCV as "gazetted or proposed protected areas within, adjacent or in the immediate vicinity of the FMU are identified as HCVs and protected from any potential impact of FMU operations".

Any protected area within the FMU automatically qualifies as a HCV. Protected areas immediately adjacent to the FMU, in the immediate vicinity or having physical and ecological connection with the FMU are HCVs. Those forests or habitats within the FMU that contribute to protecting the values for which a protected area was established, are given due consideration as HCVs.

HCV 1.1 Site Context

The Danau Pulau Besar Wildlife Reserve[6] (*Suaka Margasatwa*), covering an area of 28,237ha[7], lies immediately south of the FMU. This is the largest protected area within the landscape between the Kampar, Selat Panjang and Siak rivers[8]. The Reserve comprises primarily PSF with some representation of freshwater swamp forest, surrounding two lakes, Danau Atas and Danau Bawah, the latter also referred to as Danau Pulau Besar after the largest of four islands, Pulau Besar. These islands appear to be the tops of large hummocks, which have remained after subsidence of the peat created the lakes. Pulau Besar may be what remains of the bank of the former river course which has since disappeared.

[5] Protected areas are defined as areas legally gazetted under national laws, and include those equivalent to IUCN categories I-V. Areas proposed for protected area status by the relevant statutory body, but not yet gazetted, are also included.
[6] Reserve is gazetted under SK Menhutbun No. 668/KPTS-II/1999 and SK Mentan No. 846/Kpts/Um/11/1980
[7] The exact size of the reserve is unclear. The Indonesian Wetland Database gives its size as 23,750ha. However, despite this discrepancy, this remains the largest protected area in the landscape, and the third largest wetland reserve in Riau after Giam-Siak Kecil and Kerumutan.
[8] The four protected areas within this landscape are Suaka Margasatwa Danau Pulau Besar (28,237ha), SM Tasik Belat (2,529ha), SM Tasik Besar / Tasik Metas (3,200ha) and SM Tasik Serkap / Tasik Sarang Burung (6,900ha).

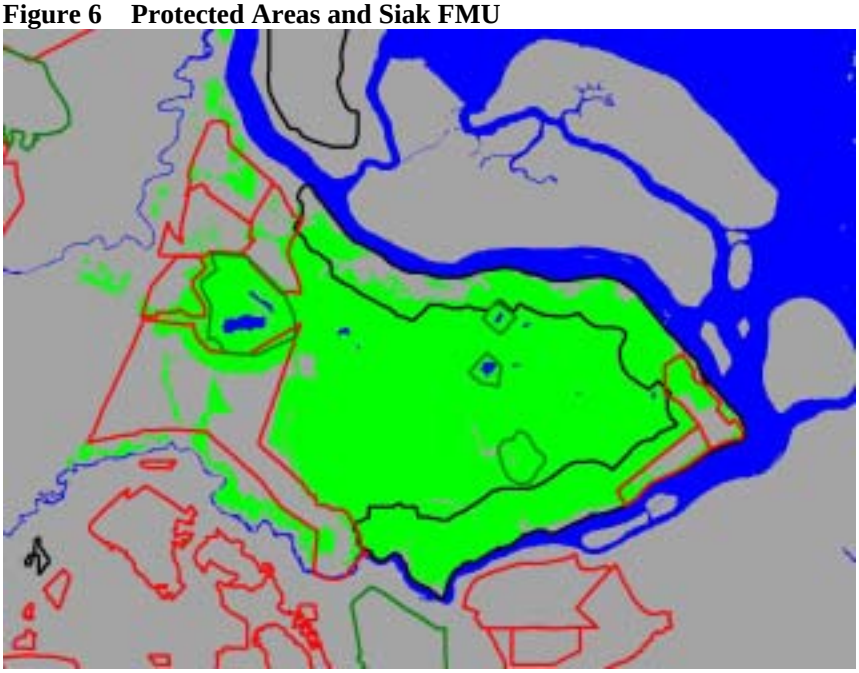
There remains a dearth of information on this reserve despite its being gazetted in 1980. Silvius *et.al.* (1987) provided the initial information on species, albeit cursory, and the Indonesian Wetland Database lists 36 bird and 20 mammal species, updated in 1993 presumably from observations made during a study of the vegetation types (Haryanto, 1993).

Apart from its protecting representative examples of Sumatran PSF habitats, including the lakes, the Reserve provides habitats for some globally significant species, Sumatran Tiger *Panthera tigris*, Tomistoma *Tomistoma schlegelii* and the Asian Bonytongue *Scleropages formosus* (also called the Arowana). Records of Sumatran Elephant *Elephas maximus* and Malayan Tapir *Tapirus indicus* date to the initial gazettement documentation in 1987 (Silvius *et.al.*, 1987) and there has been no recent data to confirm their presence[9].

The FMU shares its southern boundary with that of the Danau Pulau Besar Reserve. This underscores the importance of management practices of the FMU with regards to the conservation of the ecological integrity of the Reserve. All remaining natural forest (within the FMU) along this boundary serve a vital buffering function for both sides – eliminating or reducing the impacts of plantation operations upon the Reserve and avoiding potential impacts upon the FMU from the Reserve, e.g. preventing human-wildlife conflicts with large mammals.

The Reserve is facing serious threats to its long term viability. The conversion of forests around its boundary is isolating it from the existing forested landscape.

Figure 6 Protected Areas and Siak FMU



[9] Elephants evidently used to occur east of the Siak river, with anecdotal information of two individuals shot at Mengkapan village in the early 90s. The former presence of riverine terrace forest along the banks of the Siak river, including areas of dryland mixed dipterocarp and tropical heath forests would have provided habitat for elephants in the past. Any populations, resident or transient, are unlikely to persist today given the drastic habitat changes in this area. Tapirs have been known to persist in isolated but large blocks of PSF on the Malay Peninsula (Sebastian, 2002), and therefore their continued presence within the Danau Pulau Besar Wildlife Reserve cannot be discounted.

Conversion has already taken place around the northern, western and southern sides of its roughly spherical shape (Refer Figure 6). It retains contiguity to the larger landscape only along its eastern boundary. A further threat is the ecological and hydrological integrity of the Sg. Rawa, the primary outflow from the two lakes into the straits. The Sg. Rawa flows out to the southeastern corner of the FMU and then along the entire eastern length of the FMU. A major tributary of Sg. Rawa lies entirely within the FMU, and the forest along its lower reaches has been delineated as protection forest. However, plantation development surrounding this narrow strip of natural forest has impeded water flow, and caused extended inundation of the forest, resulting in die-off.

According to Riau KSDA sources, the Bupati of Kabupaten Siak has approved a proposal to link up the four protected areas, including Danau Pulau Besar, into a single, large protected area[10]. The creation of a large contiguous protected area would have immense value for biodiversity conservation, particularly for this landscape currently under immediate threat of being lost forever. A further supporting rationale is it being one of a limited number of forest blocks in this PSF ecoregion that might harbour one of a limited number of viable tiger populations (Tilson *et.al.*, 1994). However, there is no active effort to make this a reality. KSDA officials state their support for such a landscape-level conservation area, but this would be dependent upon a government and/or NGO partner initiative to propose and implement this.

The Indonesian Important Bird Area (IBA) Directory (Holmes & Rombang, 2001) identifies the area between the Siak and Kampar rivers as an IBA, listed as Site No. 15: Hutan Rawa Gambut Siak-Kampar, covering 550,000ha. The global IBA programme aims to identify, document and conserve a network of globally important areas for the conservation of birds and their habitats using standard, internationally-agreed criteria, through national and local level consultations involving NGOs, experts and government agencies[11]. The premise is that birds may be excellent indicators of overall biodiversity, these areas will be important for other fauna and flora. The five species of threatened birds listed under this IBA (Storm's Stork, Lesser Adjutant, Wallace's Hawk-Eagle, Large Green Pigeon & Hook-billed Bulbul) are all likely to be present within the Reserve.

The FMU contributes significantly to the long term integrity of the Reserve, and therefore all the remaining forest contiguous with the Reserve qualify as HCV1.1. Additionally, given the integral ecological and hydrological connection between the Reserve and the Sg. Rawa, the forest along the true left bank of the Sg. Rawa can also be categorized as HCV1.1.

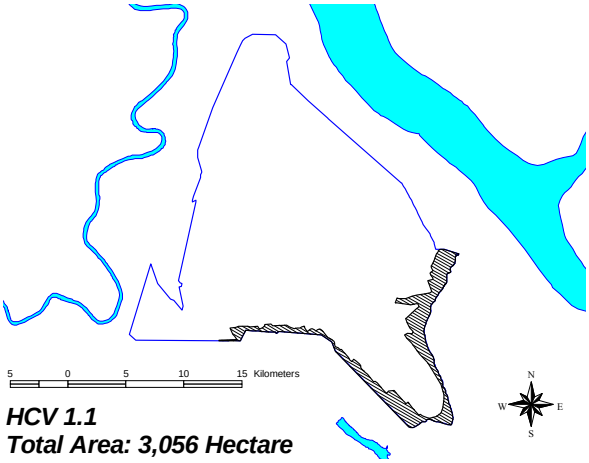
HCV 1.1 Rationale for Boundary Delineation
This HCV was identified within the FMU.

[10] The Directory of Asian Wetlands described Danau Belat, Besar Sekak and Sarang Burung, Sumatra wetland site No. 17 (Scott, 1989) as small vulnerable sites, and it been suggested in the National Conservation Plan for Indonesia (MacKinnon & Artha, 1982) that all three be incorporated into a much larger reserve, and linked with Danau Pulau Besar Reserve.

[11] The objectives of the Asian IBA programme are (Birdlife International, 2004):

1. *To provide a basis for the development of national conservation strategies and protected areas programmes;*
2. *To highlight areas which should be safeguarded through wise land-use planning, national policies and regulations, and the grant-giving and lending programmes of international banks and development agencies;*
3. *To provide a focus for the conservation efforts of civil society including national and regional NGO networks;*
4. *To highlight sites which are threatened or inadequately protected so that urgent remedial measures can be taken;*
5. *To guide the implementation of global conservation conventions and migratory bird agreements.*

The boundary for HCV1.1 includes all remaining forest along the southern boundary from the westernmost point, around the southeastern tip, following the Sg. Rawa to where the boundary leaves the river's edge. All the natural forest within this boundary (including the Kawasan Unggulan strip along the southeastern boundary) contributes towards the long term survival of the Reserve and the species contained within.



HCV 1.1
Total Area: 3,056 Hectare

Although the contribution is small in area size, this is a contribution nevertheless, and given the landscape-level loss of habitat, and the isolation of the Reserve from the larger landscape, any additional area of forest becomes of high value for conservation.

Additionally, the forest functions as a buffer for the Reserve, and although narrow in certain areas, still retains this buffering function.

HCV 1.1 Rationale for Exclusions

In the western part of the delineated HCV boundary, two spurs of severely-degraded forest extending away from the buffer zone, into the FMU. Both these spurs have been excluded by delineating the HCV boundary along a straight horizontal line. The reason for this is that these two spurs do not contribute to the buffering function of this HCV, and are unlikely to remain as forest in the near future. The effects of the canals, and the effects of fire, have degraded these two blocks severely, possibly to the extent that regeneration will probably turn them into secondary scrubland in time.

The forest along the tributary of the Sg. Rawa flowing within the FMU has also been excluded. The boundary has been delineated to exclude the areas of dead flooded forest, based on the reasoning that these areas no longer contribute ecologically to the Reserve, and neither do they contribute towards the buffering function of forest along the Sg. Rawa. The boundary cuts off vertically the riverine strip heading westwards to the centre of the FMU.

Along the eastern boundary of the FMU, the HCV delineation follows the remaining forest along true left bank of the Sg. Rawa, including kehidupan / unggulan areas, to the northern boundary of the FMU.

HCV 1.1 Assumptions

The extent of the forests that encapsulate the values that contribute to an adjoining protected area has been defined here based on certain assumptions. These assumptions are factors that are not necessarily within the power or jurisdiction of the FMU manager to influence or control. It is deemed relevant to outline these assumptions here, on the basis that these identified HCV may not remain such in the future if certain actions take place.

- The southern HCV1.1 (referred to as HCVF block 1in Section 5) is not consistent in width. Towards the west, canals have intruded into the buffer strip, and blocks of forest have been cleared behind these canals (on the FMU side), thus reducing the width of the buffer to within 20m of the protected area boundary. The

assumption made here is that the company will retain this buffer strip in its entirety, and actively control any activities that might further degrade, or result in further loss of, remaining forest.

- Another assumption relates to the HCV to the east (referred to as HCVF Block 2, Section 5), buffering Sg. Rawa. The team understands that the forests east of the Sg. Rawa may in the future be converted to HTI by another company. If this becomes a reality, the viability of Sg. Rawa will be further, and possibly irreversibly, compromised. This has been taken into account when delineating the HCV's boundary, i.e. it is assumed that the area will be converted to plantation in the near future. If this does not happen, then the boundary of the HCV within the FMU might be re-evaluated in terms of its contribution to the Danau Pulau Besar Reserve.

4.1.2 HCV 1.2 Critically Endangered Species

Definition

The Indonesian HCVF Toolkit states that any species listed as critically endangered by IUCN or on Appendix I of CITES that is actually or potentially present within the FMU is an HCV.

HCV 1.2 relates to critically endangered[12] species known to occur within the FMU, their habitat requirements and ensuring their continued existence and viability is not compromised by operations. The objective of this HCV is that critically endangered species dependent upon, or using, the FMU are identified and their ecological requirements protected and managed.

HCV 1.2 Site Context

There is little remaining natural forest within the FMU. The areas that remain have been excluded from plantation development for at least 7 years. Over this period, these areas have deteriorated both in terms of their habitat structure and quality and their ability to support populations of species. With the exception of the tiger, almost all the vertebrate species categorized as critically endangered on Sumatra (and in Indonesia) are highly unlikely to be present within such an environment.

The Sumatran Tiger is apparently still present within the FMU. The assessment team found no direct evidence of tigers within or outside the FMU, but information from company staff and from local residents indicated their continued presence. The information gathered during discussions and interviews during the assessment period are presented in the Table 4 below.

Table 4. Reports of tigers in Siak FMU

	SOURCE	DESCRIPTION OF ENCOUNTERS
Direct sightings of tigers	Fisherman from Mengkapan village	1996 - Single tiger seen at night from car traveling to Buton, about a kilometer from the Sg. Mengkapan bridge. The tiger crossed the road, walked along the side of the road for a short distance (in the headlights of the car) before disappearing into the underbrush.
	Machinery operator, related by Sub-Camp Manager	Feb 2004 – two adults with two cubs seen at forest edge along the northern boundary somewhere between the Sub-resort Doral and the strip of forest (Kawasan Lindung) separating Sub Resort Simpang Samak.

[12] Refer to Appendix 4 for IUCN Red List Categories

	Driver	November 2004 – single tiger seen along Jalan Barbari close to the Oil Company block (Areal CP). The individual had an injured front leg, and was limping. It was seen on subsequent days by other company workers, but has not been seen since.
Seen tiger spoor (foot prints)	Pak Sobar, Survey & Planning Unit	January 2005 - Footprints observed along canal next to the forest block (Kawasan Unggulan) at the southwestern corner of the FMU, Sub-Resort Sg. Pinang.

The Tiger is listed as Endangered globally (IUCN, 2004), but the Sumatran sub-species of the Tiger *Panthera tigris sumatrae*, endemic to the island of Sumatra, is listed as critically endangered (IUCN, 2004). Any species listed as critically endangered is automatically an HCV. Although this HCV would appear to be present within the FMU, there are two factors which are relevant towards the considerations of whether there is forest area within the FMU that will maintain or enhance its potential as habitat for tigers, and be considered HCVF:

a. The status of the tiger within the FMU has to be established. The assessment of the conditions, habitat availability, extent and ecological integrity in relation to tigers concludes that the forests within the FMU are unable to support a tiger population. There is no single block of forest that is sufficiently intact to be able to provide the ecological requirements of tigers, i.e. habitat cover and contiguity to provide the necessary ranging area and cover for tigers and the ability to support a prey base (population of prey species able to sustain a tiger, e.g. wild pigs and deers) in the long term. Therefore, the status of the tiger within the FMU is interpreted as consisting of displaced (or stranded) animals. The animals seen occasionally within the FMU are likely to be wandering individuals, displaced by forest clearing within and in the greater surroundings of the FMU. Large cats like tigers are known to wander extensively once displaced, often becoming transient in secondary, and even rural, environments, until they either die from starvation, get killed, or find another area of suitable habitat.

b. The contribution of any portion of the remaining forest within the FMU to the survival of a tiger population has also to be established[13]. The assessment of the remaining forest areas within the FMU is that they do not contribute to, or form an integral part of, the range of a particular tiger population in the general area.

The areas delineated under HCV1.1 potentially have a contribution to a tiger population within the Reserve, but this contribution is heavily slanted towards the physical protection of the Reserve's habitat rather than making a significant contribution to the survival of a tiger population.

HCV 1.2 Rationale for Boundary Delineation

In conclusion, the presence of the tiger within the FMU in its current setting does not justify assigning a high conservation value to the tiger. No other species fulfilling the criteria for HCV1.2 were identified.

This HCV is not present within the FMU.

[13] The *Indonesian Tiger Conservation Strategy* (Ministry of Forestry, 1994) emphasizes the need for conservation measures outside protected areas, and particularly in Production Forests.

4.1.3 HCV 1.3 Concentrations of threatened or endangered or endemic species

Definition

The Indonesian HCVF Toolkit states that a forest containing a concentration of threatened or endangered species or a concentration of endemic species, as recognised by national and international experts, is an HCV. The HCV relates to areas which support concentrations of significant species. This implies a comparison between such areas, or habitat types, and other habitats present. These HCVs will be areas of exceptional importance to more than one globally significant species.

HCV 1.3 Site Context

The globally significant species known to occur within the FMU are listed in Table 5 below. Definitions of the categories of threat according to IUCN are provided in Appendix 5.

Table 5. Globally-significant species occurring in the FMU

	CR	EN	VU	LOW RISK			TOTAL
				Nt	Cd	Dd	
Mammals	1		2	3		3	9
Birds			2	20			22
Reptiles & Amphibians				1			1
Total	1		4	20		3	***28***

Refer to Appendix 5, Glossary of Terms for definitions of criteria of threat.

Although 28 species have been recorded within (and in immediate proximity to) the FMU, the forest areas and habitats within the FMU are unable to support viable populations of any of these species. In relation to this HCV, an area of forest qualifies as HCVF only in the situation where they are integral to the survival of more than one species.

In the case of Siak FMU, the forests on the eastern side of the FMU contribute significantly (and integrally) to the integrity and natural functioning of the Sg. Rawa, which in turn is integral to the survival of two threatened species: the Tomistoma *Tomistoma schlegelii* and the Asian Bonytongue *Scleropages formosus*. A brief summary of their conservation status is given below.

Tomistoma (Malayan False Gharial)

The Tomistoma is one of the highest priority crocodilian species in Asia (CSG Steering Committee, 1992). Sebastian (1994) provides a detailed account of the ecology and conservation priorities for this species, and lists the lakes and river systems within Riau province as the last stronghold for the Sumatran population. This large, exclusively fish-eating crocodilian is confined to blackwater streams and lakes, and consequently its conservation is integrally linked to the conservation of river systems, and the aquatic life and fish they support. Refer Section 6.1 for guidelines for riverine management requirements for the species. The Tomistoma listed as Endangered (IUCN, 2004) and is also listed under Appendix I of CITES (UNEP-WCMC, 2003*a*).

Asian Bonytongue (Arowana)

This medium-sized Osteoglossid fish is confined to slow-flowing rivers and lakes, primarily but not exclusively blackwater (Kottelat *et.al.*, 1993). It is listed as Endangered (IUCN, 2004), mainly because of habitat degradation throughout its range and the demand for wild caught specimens for the aquarium trade. This negative impacts of this

flourishing trade[14] in Bonytongues has resulted in the species being listed under Appendix I of CITES (UNEP-WCMC, 2003*b*).

The Arowana exhibits distinct colour variation across its range in Asia, and recent research has shown that these colour variants are in fact distinct monophyletic entities. Therefore, what was formerly treated as numerous "varieties" of *Scleropages formosus* is now known to be four distinct species, three of which are new to science (Pouyaud *et.al.* 2003). Given this new taxonomic information, it is likely that populations on the Malay Peninsula, Kalimantan and Indonesia constitute separate species, and this would probably result in some of these populations being classified as critically endangered.

Table 6 below elaborates on those threatened species that have been recorded either directly or from local sources of information. A brief summary of their conservation status is given below.

Table 6. IUCN Status of Species Occurring (or potentially occurring) within the FMU

SPECIES	STATUS	DESCRIPTION
Sumatran Tiger *Panthera tigris*	**CR**	Critically endangered and facing imminent extinction on Sumatra. Remaining distribution related to habitat and prey availability. Primarily occurs in lowland, montane and freshwater swamp forests, but frequently occurs in PSF where contiguous with primary habitats (Franklin *et.al.* 1999). **No direct observations or sign by team during surveys, but locals and FMU staff indicate they are present. Categorised by assessment team as probable presence in the general area, and possibly present within FMU as well.**
Tomistoma *Tomistoma schlegelii*	**EN**	Sumatran populations are vital to the maintenance of this crocodilian throughout its already constricted range (Malay peninsula, Sumatra and Borneo). The species is confined to eastern and southeastern Sumatra (Sebastian, 1994), extending furtherest north to the Bukit Batu / Giam-Siak Kecil reserves. **No direct observation of the species within the FMU, and almost certainly no longer occurs within the FMU boundaries. However, forests within the FMU contribute significantly towards the preservation of vital habitat outside, including the Danau Pulau Besar Reserve.**
Asian Bonytongue *Scleropages formosus*	**EN**	Highly-prized aquarium fish, occurring primarily in blackwater rivers and lakes. The Sumatran population is probably a distinct, yet un-described, new species to science (Pouyaud *et.al.*, 2003). **Local fishermen in Sg. Rawa and within the lakes of the Danau Pulau Besar Reserve regularly catch Arowanas. Larger specimens are eaten, smaller individuals are sold to aquarium traders in Pekanbaru.**
Pig-tailed Macaque *Macaca nemestrina*	**VU**	This predominantly ground-living social primate is still relatively common on Sumatra, but is listed as vulnerable due to the threat to its lowland forest habitat. Groups require large areas of forests, and landscape fragmentation has compromised the viability of populations throughout southeast Asia. **Sightings of troops were obtained from numerous parts of the FMU in forest, along canals next to forest areas and within the *Acacia* planting.**
Clouded Leopard *Pardofelis nebulosa*	**VU**	A large, shy primarily arboreal cat of southeast Asian forests. Populations are threatened by deforestation and fragmentation of suitable areas of habitat. **No direct observations or signs obtained during surveys. Contract workers, drivers and local fishermen report occasional sightings of this long-tailed large cat along the Sg. Rawa.**

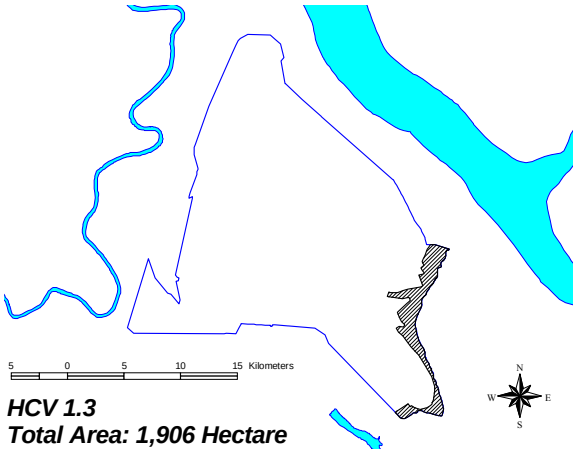
[14] The Bonytongue, or Arowana, is prized for its positive feng shui and gold-coloured specimens can fetch market prices in excess of US$20,000.

SPECIES	STATUS	DESCRIPTION
Lesser Adjutant *Leptoptilos javanicus*	**VU**	A large, colonial-nesting stork of coastal mudflats and mangroves, extending up large rivers. During the fires within the FMU in July 2004, up to eleven birds were seen daily by the fire-fighters feeding close to the burning areas, evidently attracted to the area by the carcasses. **Three individuals were observed (on two separate days) in the Sg. Rawa Resort, roosting at the forest edge, close to the burnt forest. The storks were observed feeding in open, recently-planted areas.**
Wallace's Hawk Eagle *Spizeatus nanus*	**VU**	An extreme lowland specialist (Wells, 1985). Widespread conversion of lowland forest has constricted the distribution of this species, and it is today most commonly recorded in PSF (Sebastian, 2002). **Two pairs observed along Canal 6 and Babari Resort, hunting in open ground close to forest edge. Single individuals were also observed in numerous locations within the FMU, all in close proximity to forest stands.**

The forest along the eastern boundary of the FMU provides a vital function of maintaining the ecological function and integrity of the Sg. Rawa. This strip of forest therefore is of high conservation value for at least two globally significant species (Tomistoma and Bonytongue) concentrated and confined to the Sg. Rawa and its riparian habitats. Additionally, this HCVF also contributes to the conservation of six other threatened species listed in the Table above. This HCV is therefore present within the FMU.

HCV 1.3 Rationale for Boundary Delineation

This HCV follows the true left bank of the Sg. Rawa from the southeastern corner of the FMU, along its entire length along the FMU's eastern boundary to the northeastern corner where the FMU boundary ends. The strip of Kawasan Unggulan in the northeastern corner is also included within this HCV.



HCV 1.3
Total Area: 1,906 Hectare

The rationale for the inclusion of the entire strip of forest is to provide the maximum possible protection for the riverine ecosystem of the Sg. Rawa. While it is accepted that a riparian zone extending more than a kilometer from a small river will not serve a riparian-protective function at distances beyond the most extreme influences of the river (e.g. flooding limits), this HCV is designated for more than the species confined to the river (i.e. aquatic species), but serves as a refuge for non-aquatic species which utilize river systems as cover, foraging and ranging habitat, and as a source of water, during periods of drought.

HCV 1.3 Rationale for Exclusions

Where the tributary of the Sg. Rawa flowing from within the FMU enters the Kawasan Lindung, there is a triangular patch of flooded forest. This area has been excluded because all the trees are dead, and the area will become herbaceous marshland when the trees eventually fall, or are removed to avoid this area becoming a fire hazard during periods of drought.

HCV 1.3 Assumptions
The area of forest that forms an integral part of the Sg. Rawa, and protects the habitat required to preserve populations of Tomistoma, Bonytongue has been defined here based on the following assumptions:

- If the area outside the FMU to the east of Sg. Rawa is converted to plantation, the constricting effects of artificially controlled drainage on either side of the river will have potential impacts on its ability to support populations of Tomistoma and Bonytongue. As evident from the situation with the tributary of the Sg. Rawa within the FMU, where severe flooding has killed off large areas of the forest, this is likely to occur along the Sg. Rawa itself. If this occurs, and the tomistoma population disappears, this HCV will need to be re-evaluated.

4.1.4 HCV 1.4 Critical Temporal Concentrations

Definition
The Indonesia HCVF Toolkit states that a globally significant concentration of migratory species or a nationally significant temporary concentration or migration route is an HCV.

This HCV relates to values involving the temporal usage of specific locations or habitat types by significant numbers of species or individuals of a species, and which are critical to their continued survival. The objective is that areas which play a crucial role in the life-cycles (i.e., breeding, migration) of certain species are identified as HCVs.

HCV 1.4 Site Context
The FMU is part of the coastal wetlands along the Malacca Straits, and therefore it falls within two recognized migratory flyways[15]: The East Asian – Australasian Flyway, used by migratory waterbirds and the East Asian Flyway, used by migratory birds of prey (raptors).

The FMU does not have habitats that support migratory waterbirds (shorebirds in particular), and there is no evidence that the lakes within Danau Pulau Besar are used in any significant level by migrant waterbirds such as ducks. Migratory raptors do extend across a broad swathe of the coastal forested and non-forested (modified) habitats, including that within the FMU. Of the fourteen raptor species recorded, five were migrants: Black Baza *Aviceda leuphotes*, Oriental Honey-Buzzard *Pernis ptilorhyncus*, Eastern Marsh Harrier *Circus spilonotus*, Japanese Sparrowhawk *Accipiter gularis* and Chinese Sparrowhawk *Accipiter soloensis*. *A. leuphotes* were observed within the Acacia planting. No significant concentration was determined, and it is concluded that these are over-wintering individuals, spread across the coastal lowlands.

The Barn Swallow *Hirundo rustica* is an abundant migratory bird in the equatorial tropics. A total of approximately 11,000 individuals were estimated congregating along the electricity wires and open habitats close to burning areas. This interesting behaviour is consistent with the knowledge that insectivorous birds will congregate opportunistically in areas where insects are abundant, such as termite booms (seasonal explosions from colonies of winged termites). The effect of the widespread fires across the wider area of the FMU results in the flushing of large numbers of insects, and the swallows congregate

[15] Flyways are broad pathways taken by groups of migratory birds during their annual movements. These mass movements of birds of many species and families follow the flyways first during autumn migration, heading south to escape the northern winter and then back north (spring migration).

in response to this easily accessible food source. This is a behavioural response to food availability, and is not considered a critical temporal concentration of species.

HCV 1.4 Rationale for Boundary Delineation
This HCV was not identified or considered to be present within the FMU and no boundary was delineated for the HCV.

4.2 High Conservation Value 2

Forest areas containing globally, regionally, or nationally significant large landscape level forests, contained within, or containing the management unit, where viable population of most if not all naturally occurring species exist in natural patterns or distribution and abundance.

Three sub-categories (components) have been set to assess the presence of such forest areas, and these are treated separately below.

4.2.1 HCV 2.1 The FMU is a large, landscape-level forest

Definition
The Indonesian HCVF Toolkit states that a FMU which is a large landscape forest is considered an HCV.

For the island of Sumatra a large landscape level forest on its own would need to be greater than 50,000ha.

HCV 2.1 Site Context
The FMU includes many isolated small blocks of degraded natural forest separated from one another by *Acacia* plantations, and narrow forest strips along the east and south borders connected to the Danau Pulau Besar-Tasik Serkap landscape. Each of these natural forest blocks is less than 5,000 ha and are smaller than the area threshold.

HCV 2.1 Rationale for Boundary Delineation
This HCV was not identified or considered to be present within the FMU and no boundary was delineated for the HCV.

4.2.2 HCV 2.2 The FMU is an integral part of a large landscape-level forest

Definition
The Indonesian HCVF Toolkit states that a FMU which is an integral part of a large landscape forest is considered an HCV.

HCV2.2 relates to areas that critically enhance the conservation functions of a landscape-level forest that is outside, adjacent, or contains the FMU. The forests of the FMU must be contiguous with forests of this larger landscape so that dispersal is possible within the forested block.

In addition, the objective of this HCV should be that the forests of the FMU contribute to maintaining the conservation of one of a limited set of ecosystem replicates within the ecoregion, so that loss of this landscape forest or its decline in size and integrity would increase the risk of species extinction.

HCV 2.2 Site Context

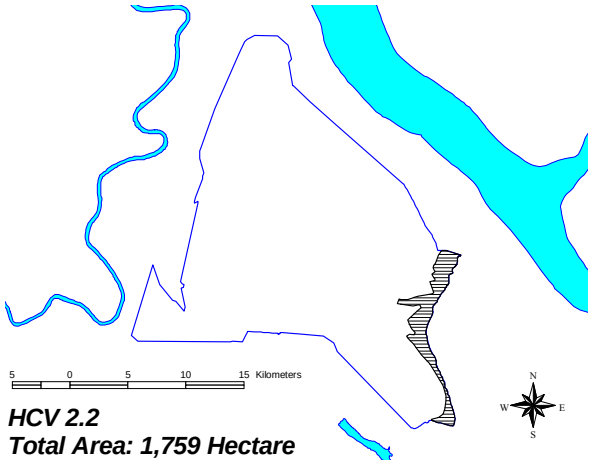
The Siak FMU is connected to one of a limited number of such landscapes remaining that represent the diversity of habitats and species of the East-Central Sumatran Peat Swamp ecoregion (Reiley & Ahmad-Shah 1996; Jarvie *et al.* 2003a). The Danau Pulau Besar - Tasik Serkap landscape comprises the second largest continuous block of this landscape in the ecoregion (see Fig. 3). Its 425,000 ha of contiguous forest make it second only to the Kerumatan block (439,000 ha) to the south across the Kampar River. A total of 211,000 ha of the Danau Pulau Besar - Tasik Serkap landscape forest is classified as protection forest, including four small wildlife reserves of 37,000 ha. An aerial overflight on a transect running west from the Serapung FMU during the November 2004 SmartWood HCVF assessment indicated that much of the landscape level forest is Tall PSF, with centrally located areas of Short PSF. A large area around and between the nature reserves appeared to be primary forest with adjacent areas of lightly hand logged Tall PSF.

The largest and most important of these protected areas is the Danau Pulau Besar Wildlife Reserve, directly abutting the FMU along its southern border. Unlike the heavily logged natural forest blocks remaining within the FMU, the forests of the wildlife reserve are apparently pristine, judging from its isolation, our trip to the lake, the landsat image, and interviews with reserve staff. Although the natural forest strip along the southern border of the FMU is contiguous with the reserve, it is both heavily logged and comprised of the Tall PSF that predominates within the reserve and the wider landscape forest. Therefore this strip and the isolated and heavily degraded fragments of forest within the FMU are not integral to this reserve and the wider landscape level forest.

In contrast, the riverine forests bordering the small Sg. Rawa, which forms the eastern border of the FMU along its southern end, is integral to the ecosystem protected by the wildlife reserve. The central feature of the reserve, and the rationale for this protected area its two lakes, Danau Pulau Besar (2,060 ha) and Danau Bawah (420 ha). The Sg. Rawa originates in the former, runs north into the smaller lake, and then into the ocean, draining both lakes. This is a unique feature in the landscape.

HCV 2.2 Rationale for Boundary Delineation

The forest bordering the Sg. Rawa was determined to be HCV because it critically supports the riparian fauna and flora connecting the lakes of the wildlife reserve to the ocean. The remaining natural forest contiguous with the river, which is mostly <1-2 km wide, has been designated HCV to preserve the integrity of this unique ecosystem. It bears mention that most of this riparian forest is Mixed PSF, a habitat absent from the wildlife reserve. This habitat might be seasonally important to wide-ranging birds and mammals of the wildlife reserve, but this HCV is treated under HCV3.1, below.



HCV 2.2
Total Area: 1,759 Hectare

HCV 2.2 Rationale for Exclusions (if applicable)

Other natural forest blocks within the FMU were not assessed as HCV because they were either:

- Small fragments isolated from the contiguous forest landscape, and heavily degraded by intensive hand logging.
- Forest habitats well represented by larger areas of pristine forest within the adjacent nature reserve; this pertains to the degraded Tall PSF strip along the southern border of the FMU.

4.2.3 HCV 2.3 The FMU maintains viable populations of most naturally occurring species

Definition
The Indonesian HCVF Toolkit states that a FMU which contains viable populations of most naturally occurring species is an HCV.

HCV2.3 relates to the importance of FMU areas in maintaining viable populations. To be HCVs, the area must critically contribute habitat or resources that lower the risk of extinction. The distribution of species among habitats and total area of each habitat within the larger forested landscape must be considered in determining whether areas within the FMU are HCV because they are needed to maintain viable populations.

HCV 2.3 Site Context
The natural forest of the FMU is Tall PSF and Mixed PSF degraded by logging. Tall PSF exists as isolated fragments on the scale of 100-1000 ha, small relative to the adjacent large areas of Tall PSF to the south and east. Tall PSF might comprise 300,000 ha (75%) of the contiguous the Danau Pulau Besar - Tasik Serkap landscape forest and a similar proportion (20,000 ha) of the adjacent Danau Pulau Besar wildlife reserve. Therefore the degraded small fragments of Tall PSF within the FMU are not critical in maintaining viable populations within the adjacent landscape forest. However, the Mixed PSF is a rare habitat within the larger landscape forest, and is evaluated under HCV3.1.

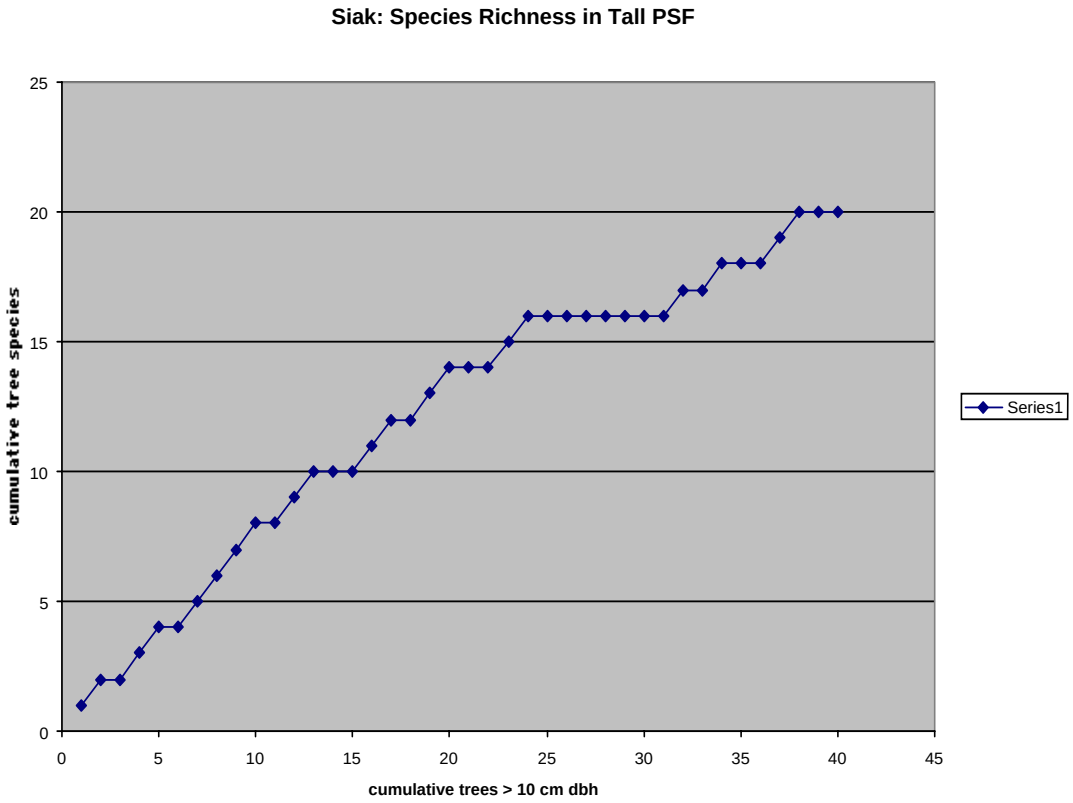
Deep peat apparently covers the Danau Pulau Besar wildlife reserve, and Mixed PSF is not expected to occur there. We presume that much of the forest of the wildlife reserve is Tall PSF, similar to that surveyed within the FMU along its southern border. However, the relatively well structured forest bordering the lake is a variant of Tall PSF characterised by a surprisingly different species assemblage, forming a distinctive sub-habitat. Dominant trees are species of *Durio* (durian), *Shorea teysmanniana*, and unknown species of Sapotaceae and Anacardiaceae. However, the Tall PSF of the FMU is redundant with vast areas of the landscape level forest and is not HCV.

The Tall PSF of the FMU was sampled for species richness in the strip along the southern border, adjacent to the wildlife reserve. Most species were identified to at least family or genus. Although this seemed to be one of the better structured forest areas within the FMU, it had been disturbed by prior selective logging approximately 5-6 years earlier and featured a broken canopy. In addition, notes were taken on the canopy species composition (trees roughly 25-50 cm dbh) of forest in other areas of the FMU. This survey of several distinctive areas indicated that the Tall PSF was homogenous

In the transect sample of Tall PSF, 20 species were encountered among the first 40 individuals of the sample (Figure 6). Dominant trees of > 50 cm dbh were *Palaquium burkii* (Suntai) and *Shorea teysmanniana* (Meranti bunga), as elsewhere in Tall PSF within the FMU. This is demonstrated by a mix of species similar to Tall PSF sampled in Pulau Muda District, and as previously reported from research in Kerumutan Wildlife Sanctuary. We do not know of any other species-area curves measuring tree species richness from this ecoregion. However, from comparisons elsewhere (Cannon &

Leighton 2004), this diversity is not unusual for Tall PSF occurring in Southeast Asia. This is similar, for instance to the diversity sampled in the Tall PSF at the Serapung FMU, at the far southeastern corner of the landscape level forest (SmartWood 2005).

Figure 7. Species area curve for trees (>10 cm dbh) in remaining logged Tall PSF within the FMU.



It is noteworthy that the species composition of this Tall PSF was distinctive from that sampled at both the Serapung and Pulau Muda FMUs. The latter are near one another, although separated by the Kampar River. Siak is roughly 50 km away to the northeast. The most distinctive difference at Siak was the relative unimportance of *Shorea uliginosa* (Meranti batu), a dominant species at the other two FMUs in this habitat type. In addition, rare species of several genera were encountered at Siak FMU for the first time. This indicates geographic variation in species composition over space within the same habitat type.

HCV 2.3 Rationale for Boundary Delineation

This HCV was not identified or considered to be present within the FMU and no boundary was delineated for the HCV.

Adequate areas of Tall PSF exist in the adjacent wildlife reserve that could fulfill the role of maintaining most viable populations within this habitat.

The major area of Mixed PSF within the FMU was determined to be HCV under HCV2.2 and so was not evaluated further here (see also HCV3.1).

HCV 2.3 Assumptions for Boundary Delineation

The enumeration of distinctive habitats assumes:

- A comprehensive inventory. However, not all natural forest blocks within the FMU are accessible, and if so, could not possibly be assessed in this time frame. Therefore, distinctive habitats or sub-habitats, as indicated by unique assemblages of plant species for instance, would go unnoticed if they occur in limited patches. The Landsat image is a useful guide, as are direct classification of flora from trips along canals and from examining company cruising data. Compared to previous HCV assessments, the team was limited by not having a reliable topographic and soil map.
- Accurate information on the typology of peat forest vegetation types or habitats for this ecoregion, and their relative rarity and status of endangerment. No serious scientific survey has been conducted for this task. Important geographic variation in habitat types within this ecoregion, and within this landscape level forest, could be easily overlooked.

4.3 High Conservation Value 3

Forest areas that are in or contain rare, threatened or endangered ecosystems

HCV 3.1 Forest areas that are in, or contain rare, threatened or endangered ecosystems

Definition

The Indonesian HCVF Toolkit states that where a FMU contains a significant area of these rare, threatened, and endangered forest types and has been identified as a conservation priority area by an independent organization, then the forest type is an HCV. Any rare, threatened or endangered ecosystems that are located outside the FMU that are impacted heavily by FMU activities is also an HCV.

The Indonesian HCVF Toolkit guidance relates HCV3.1 to rare, threatened or endangered ecosystems that have been identified within national conservation plans. The Toolkit provides further guidance as "there may be cases where conservation plans do not reflect current forest condition, threats, and trends. Experts should be consulted to identify if there are gaps in these plans and if the FMU should be considered critical to the protection of the ecosystem type." Thus, the present assessment would consider as HCV areas within the FMU that are rare, threatened, or endangered ecosystems for the ecoregion or nation based on expert judgment, especially if the available national conservation plans had overlooked ecosystems that were poorly represented in protected areas in the ecoregion.

HCV 3.1 Site Context

To assess the contribution of the FMU to conserving ecosystems, the following official sources were consulted:

- The National Conservation Plan for Indonesia (Vol 3D- Riau Province, MoF 1995) defines a 500,000 ha block for a proposed Danau Belat Besar – Linau (BBL) Wildlife Reserve (Suaka Margasatwa) that includes most of the landscape between the Siak and Kampar rivers. This proposed reserve includes the already gazetted Danau Pulau Besar wildlife reserve, of course, and the large forested areas to the east, including the area to the east of the Sg. Rawa along the eastern border of the FMU. According to interviews with KSDA staff in Pekanbaru, no further steps had been taken to implement this proposal, but local environmental NGOs support the plan.
- The Sumatra section of the Indonesian Biodiversity Strategy and Action Plan 2003-2020 includes this proposed BBL wildlife reserve for conserving the Siak-Kampar peat swamp forest ecosystem (p. 24).

The rough-drawn proposed boundaries are set back 10 km or so from the river and coastal margins, and have not been advised yet by definition of important habitats and ecosystems within this landscape. For instance, shallow peat soils and alluvial soils would support rare Mixed PSF and lowland forest, and be limited to coastal and riverine areas. These forest types would be rare ecosystems in comparison to the vast areas of Tall PSF and Short PSF habitats expected throughout most of this landscape wherever peat was > 2-3 m deep.

The Sg. Rawa and the coastal areas are associated with just this type of setting encompassing a rare ecosystem within this larger landscape forest. Areas adjacent to the Sg. Rawa, roughly from where it becomes the border of the FMU as it flows to the north from the lakes of the wildlife reserve, are Mixed PSF on relatively shallow peat underlain by mineral soils. This is readily observed along the canals that enter this zone, as dredging has deposited muddy mineral soils along their banks. The tall open crowns of the dominant tree *Koompassia excelsa* (Kempas) are a reliable indicator of this habitat.

All natural forest remaining near the eastern border of the FMU that could be viewed by road or canal were noted to be Mixed PSF. Two isolated blocks were identified: along the western bank of the Sg. Rawa, and the eastern portion of the triangular-shaped forest towards the northeast. In both these settings, seasonal flooding in the past deposited mineral soils and the overlying peat is shallow.

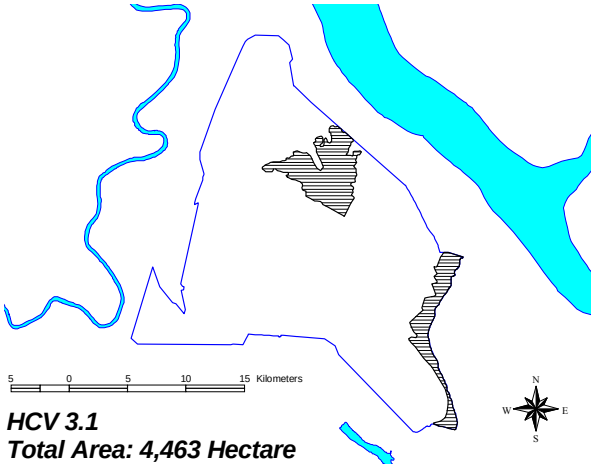
In examining the overall landscape level forest still extant between the Siak and Kampar rivers, this area of Mixed Peat swamp forest might be one of the most extensive. Although we could not conduct an aerial overflight, a map of the peat depth we viewed in Pekanbaru showed that an extensive shallow peat area extended to the east of the Sg. Rawa. If true, this Mixed PSF would be important to incorporate into future conservation plans for the landscape. The upstream portions of the Sg. Rawa drain deeper peats and so are bordered by Tall PSF.

Similarly, deeper peat apparently covers the Danau Pulau Besar wildlife reserve, and Mixed PSF is not expected to occur there. We presume that much of the forest of the wildlife reserve is Tall PSF, similar to that surveyed within the FMU along its southern border. However, the relatively well structured forest bordering the lake is a variant of Tall PSF but with a surprisingly different species assemblage, forming a distinctive sub-habitat.

HCV 3.1 Rationale for Boundary Delineation

The two blocks of Mixed PSF within the FMU have been determined to be HCV3.1 because they represent a rare vegetation type within the landscape level forest.

Given the increasing depth of peat moving upstream from outlet to source, it is likely that this habitat is absent from the Danau Pulau Besar reserve itself. However, this Mixed PSF forms an important part of this ecosystem. Not only does it have a different plant species



HCV 3.1
Total Area: 4,463 Hectare

assemblage, but wide ranging species, such as hornbills, tigers and other felids, bats and other birds might seasonally switch habitats concentrating feeding in this habitat in preference to the more abundant Tall PSF.

The boundaries for the Mixed PSF are delineated to encompass as much natural forest as possible of this type. The 1,760 ha in the block along the Sg. Rawa include 130 ha of highly degraded forest, judging from the landsat image. The remainder has mostly been selectively logged, especially for *Koompassia*. The second block containing Mixed PSF is 9 km away on the northeast boundary and encloses approximately 2,800 ha. The true border between Mixed PSF and the adjacent Tall PSF on the west is unknown. Although these two blocks are not contiguous, and are also degraded from logging, they represent rare and important habitats in this landscape, and need to be protected despite their current degraded condition. If protected, they will recover towards primary forest structure and conservation value over the coming decades. In addition, the company could, at minimal cost, promote a corridor of vegetation between them, expanding the blocks of natural forest already there. This would at least provide vegetative flyways for birds and bats to help integrate these two blocks.

HCV 3.1 Assumptions for Boundary Delineation
In the absence of an overflight of the FMU, boundaries enclosing Mixed PSF are based on extrapolating from topographic maps and proximity to streams. Although only one location was sampled in detail, a transect walked from the FMU to the banks of the Sg. Rawa indicated that the Mixed PSF contained a mosaic of other minor habitats, including seasonally flooded swamp forest. This habitat mosaic also argues for its conservation value of harboring higher species diversity.

4.4 High Conservation Value 4

Forest areas that provide basic services of nature in critical situations (e.g. watershed protection and erosion control)

Four sub-categories (components) have been set to assess the presence of such forest areas, and each are treated separately below. Spatial and temporal considerations are important in determining HCV 4 and its components.

4.4.1 HCV 4.1 Unique sources of water for daily use

Definition
The Indonesian HCVF Toolkit states that where forests provide the only source of water for daily use to a community, this will be an HCV.

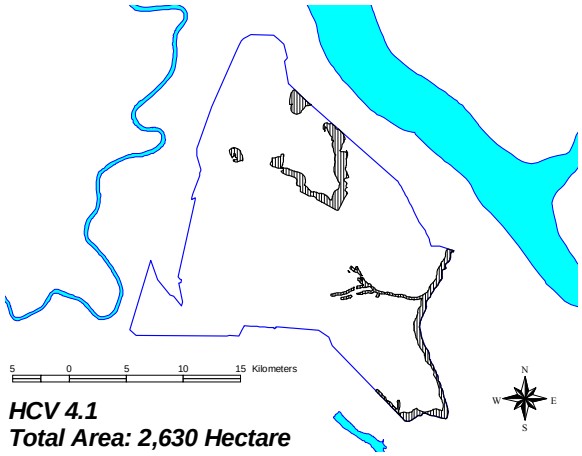
HCV 4.1 Site Context
Steams important for drinking and other the daily needs of people living adjacent to the FMU drain from the northeastern side of the FMU and run downslope into the river or ocean. People may prefer to use rainwater during wet seasons, but during dry seasons, it is expected that these streams provide critical water sources for drinking, bathing and flushing sewage. These streams nonetheless provide critical sources when they are there, and are not substitutable by hauling water from other sources.

The forests upstream along these streams moderate the seasonality of streamflow, especially important in prolonging water availability during dry seasons. However, we would expect that forests also help mitigate damage from flooding from nearby canals during wet seasons.

HCV 4.1 Rationale for Boundary Delineation

HCV 4.1 was designated for any natural forests remaining within 100 m either side of the small streams draining the northeastern side of the concession, but was extended to a 500m width for the much larger Sg. Rawa that forms the southeastern boundary.

This width along small streams is not based on case studies comparing how different widths of forest greenbelts moderate streamflow, but 100m to either side of the stream seems a reasonably conservative, albeit arbitrary, width. The much larger river should have a concomitantly larger forest belt. Note that because water flows laterally through peat more rapidly and extensively than through mineral soil horizons, it is reasonable that these forest buffers extend further than those for forest on non-peaty soils. The forest patches so designated were identified from the Landsat satellite image, and include any significant natural forest patches within these streamside buffer zones. Even highly degraded forest provides this hydrological function compared to converted plantation or agricultural lands.



HCV 4.1
Total Area: 2,630 Hectare

HCV 4.1 Rationale for Exclusions
Small, highly degraded forest remnants were excluded because these cannot be reasonably monitored and protected as HCVF. These excluded remnants appeared from the Landsat images to be less than a few ha in size.

HCV 4.1 Assumptions for Boundary Delineation
The main assumption underlying this HCVF delineation is the true extent that forest enhances the lateral flow of water through peat. That is, is reduced dry season flow mitigated by forest 100, 500 or 1000 m away? There is currently no scientific formula to relate this to stream size.

4.4.2 HCV 4.2 Forests with critical impact on water catchments, and controlling erosion

Definition
The Indonesian HCVF Toolkit states that forests that are designated as DAS Super-Prioritas and Prioritas, other significant DAS and Sub-DAS areas designated by relevant experts, as well as cloud forests, will be HCV4.2. This HCV relates to the critical role forest areas may play in protecting water catchments, downstream water quality, and preventing erosion.

HCV 4.2 Site Context
The FMU does not contain important designated water catchments. The watersheds of the FMU, the Sg. Rawa and smaller streams drain directly into the marine channel to the northeast.

HCV 4.2 Rationale for Boundary Delineation

This HCV was not identified or considered to be present within the FMU and no boundary was delineated for the HCV.

4.4.3 HCV 4.3 Forest providing a barrier to the spread of fire

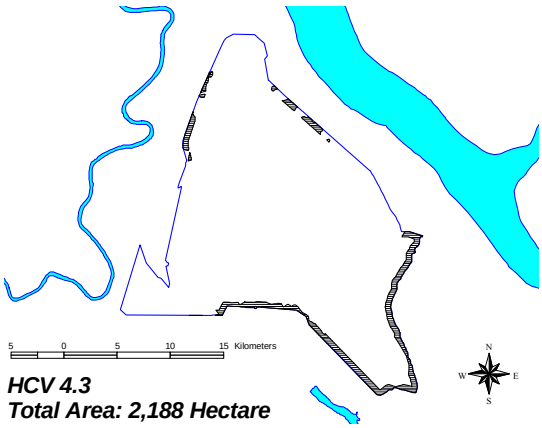
Definition
The Indonesian HCVF Toolkit states that any forest boundary that protects against large scale fire is an HCV.

HCV4.3 relates to the critical role forest areas may play as a buffer to the spread of forest fires especially in PSFs where the consequences of fire can cause irreversible damage.

HCV 4.3 Site Context
Fires originating within the FMU could escape into bordering agricultural lands or into the Danaur Pulau Besar wildlife reserve to the south. Several fires have occurred within the FMU. Although the most likely fire damage might occur from fires set in agricultural zones, forest greenbelts can be effective in stopping or slowing fire progressing towards the borders of the FMU. These forest edges will suffer blowdowns and other sources of higher tree mortality, narrowing the effective width of the forest that might impede fire.

HCV 4.3 Rationale for Boundary Delineation
A 500m buffer is proposed inside the FMU border wherever there is natural forest bordering lands designated for agricultural use and along the southern border adjacent to the wildlife reserve.

The 500 m width serves two functions: it allows a reasonable response time for fire control measures, and a buffer of green, wettish vegetation to suppress fires from either side. It is likely that these greenbelts are less effective in this particular FMU because the forests have been logged and currently have increased amounts of flammable woody debris that would fuel encroaching fires.



HCV 4.3
Total Area: 2,188 Hectare

HCV 4.3 Rationale for Exclusions (if applicable)
The natural forest blocks bordering the agricultural zone along the government hardtop road that traverses the FMU has not been delineated as HCV4.3. The agricultural lands interdigitate into the natural forest and it would be impossible to implement and monitor an irregular fire boundary of set width in this zone. Further, the distance from the road that can be used for agriculture is under dispute. The company carries out aggressive fire control monitoring in any case, and arbitrarily delineating an HCVF fire control strip here will just confuse conditions for compliance.

HCV 4.3 Assumptions for Boundary Delineation
The critical assumption underlying this HCVF delineation is the true extent that peat forest impedes fire. It seems logical that at some times of year this forest will facilitate wet peat soils and a wet microclimate and impede fire. However, during dry seasons, the degraded condition of most of these designated greenbelts will burn, as amply demonstrated from the fires that have raged through Indonesia's logged peat forests in

recent years. The 500m width is arbitrary, as there is not scientific data suggesting what width effective forest greenbelts for fire control might be in peat swamp forests.

4.4.4 HCV 4.4 Forests with critical impact on forest services that agriculture, aquaculture, or fisheries are dependent upon

Definition

The Indonesian HCVF Toolkit states that any forest that has a critical impact on the forest services that agriculture or aquaculture is dependent upon are an HCV4.4. Similar to HCV4.2, the assessment is whether any forest areas are critically responsible for water quality and supply, albeit focused on agriculture or acquaculture.

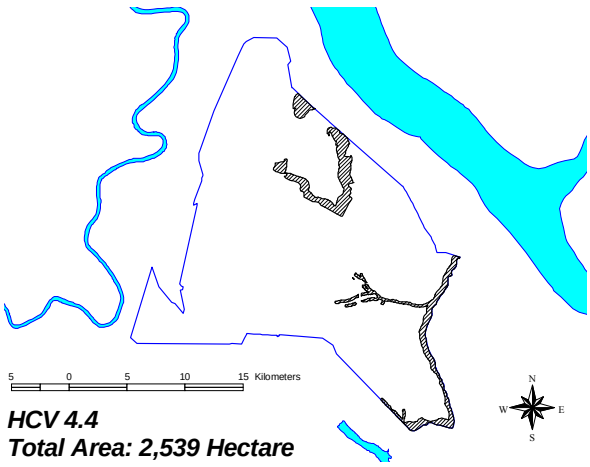
HCV 4.4 Site Context

FMU natural forest areas are critical to maintaining water resource services in downstream agricultural areas along the riverine and coastal land strips between the FMU and the estuary waters on the northeastern side of the FMU. Streams do not drain from the FMU into the Siak river on the western side of the FMU. Forests bordering streams upslope from the coastal agricultual zones will moderate water supply into the agricultural peat soils. These forests help prevent flooding into agricultural areas from upslope canals during wet seasons, and supply sustained water laterally into the peat during the dry season. Especially important is the function of upslope forest and the peat profile in maintaining hydrostatic pressure of fresh groundwater throughout the agricultural soil zone, and the groundwater recharge function to maintain this. This prevents saltwater incursions into agricultural peat soils in this tidal environment.

HCV 4.4 Rationale for Boundary Delineation

HCV 4.4 was designated for any natural forest extending within 500 m of the two small streams issuing from the FMU on the northeast side, and within 1 km on the west bank of the larger Sg. Rawa that forms the eastern boundary at the southeast corner of the FMU.

All three streams service villages and associated agricultural areas along the coast. The 500 m width is considered reasonable and prudent to sustain lateral water flow into small streams during the dry season. The width of this forest buffer should be adjusted to the size of the stream; hence, 1 1km band of HCVF is recommended for the Sg. Rawa. The village near the mouth of the Sg. Rawa includes an important industrial plant for producing export quality sago palm flour, which also relies on sustained water flow.



HCV 4.4
Total Area: 2,539 Hectare

HCV 4.4 Rationale for Exclusions (if applicable)

This buffer is not extended along the upper reaches of a tributary of the Sg. Rawa where seasonal canal flooding has apparently interrupted stream drainage and caused forest mortality.

HCV 4.4 Assumptions for Boundary Delineation

No research has established the rate or lateral water flow through peat, and how dry season flows are sustained by different widths of forest buffer zones. These buffers err on the conservative side in the absence of better scientific research.

4.5 High Conservation Value 5
Meeting Basic Needs of Local Communities

Definition

The Indonesian HCVF Toolkit states that if local communities obtain essential fuel, fodder, medicines, or building materials from the forest, without readily available alternatives, then the forest is an HCV. HCV5 applies only to basic needs.

In this HCVF assessment, SmartWood has applied a threshold at greater than a quarter (25%) of a local community (generally households) must be dependent on the FMU forests in this way. Local communities may include sub-groups within village areas that form a distinct community of their own. For example, the coconut-growing community of Bugis in Kumpai.

HCV 5 Site Context

Out of the 25 local community settlements encircling the FMU's western and eastern flanks, six were chosen for HCV assessment because they,

(1) had the closest and most significant relationship to any remaining natural forest area inside the FMU,

(2) were representative of the two main agroecological landscapes (Siak river and coastal straits),

(3) were representative of the major social groups actively or passively affected by the presence of natural forest in the FMU.

The number of communities required for adequate assessment of HCVs approximated the realistic maximum of one day per village for two social scientists to undertake an initial and preparatory visit (field observations and courtesy calls to village representatives), returning for pre-arranged interviews and data collection with specific groups and individuals including formal village administration, informal leaders, and those dependent upon diverse livelihoods ranging from farmers, fishermen, hunters, forest harvesters, company labourers and civil servants to shaman and midwives. The selected six communities were as follows:

Communities #1 through #4 along the coastal straits along the north eastern flank of the FMU from its eastern limit, namely,

#1 Tanjung Pal village, a predominantly Akit community, once a nomadic sea-faring people, settled for the past 20 years, with strong ties to natural forest areas as sources of fish, wild meat, timber and medicinals.

#2 Sungai Rawa village, consisting primarily of Melayu inhabitants, for whom natural forest areas are most important as sources of fish, medicinals and timber.

#3 Kumpai, a small community of Bugis coconut growers only accessing natural forest areas outside the FMU and only to establish coconut farms.

#4 Mengkapan village, consisting primarily of Melayu inhabitants, for whom natural forest areas are most important as sources of fish, medicinals, timber and a river providing drinking water.

Communities #5 and #6 along the Siak river, adjacent close to the western flank of the FMU, namely,

#5 Pebadaran village, consisting primarily of Melayu inhabitants.

#6 Dosan village, consisting primarily of Melayu inhabitants.

Basic subsistence and cash needs in varying proportions obtained from natural forest areas inside and outside the FMU included,

- wood and *nibung* palm trunks for house and other village building construction and commercial wood for sale,
- rattans for twine and fish traps,
- protein from river fish and wild game,
- vegetables,
- medicinal and other healing plants.

Detailed records of each of the six communities' basic needs sourced from natural forests in and around the FMU, as well as from all other important sources are listed in the 'A' tables in Appendix 5. A second series of 'B' tables translates the score to indicate presence or absence of HCV by considering extraction sustainability, readily available and affordable alternatives and production trends.

Table 7 Status of Most Significant Basic Needs from Natural Forest in FMU Siak

Most Significant Basic Needs (1)		**Highest Ranking of Basic Need from FMU Forest Area (2)**	*Harvesting Sustainability S1, s0/1, s0* **(3)**	*Readily Available Alternatives r1, r0/1, r0* **(4)**	*Five Year Production Trends*	**Derived HCV Status** [-/+]
Carbohydrates		0	s1	r1	Stable	[-]
Protein	Fish	2	s1	r0	Decr	[+]
	Meat	1	s1	r1	Stable	[-]
Vegetables and Fruits		1	s1	r1	Stable	[-]
Medicinal Plants		2	s1	r0	Stable	[+]
Construction & other materials	Timber	4	s0	r0	Decr	[-]
	Rattan	1	s0/1	r1	Stable	[-]
Fuelwood		4	s0/1	r0	stable	[-]
Cash Income	Timber	4	s0	r1	Decr	[-]

Note:
(1) Data from tables in Appendices [.11 through 16, Tables A and B.
(2) Minimum threshold for HCV 5 status is basic needs' ranking of 2 (more than 25% of a given basic need from
(3) FMU natural forest sources), harvesting sustainability of 1, uncertain readily available alternative r 0/1 and stable production trend (unless caused by forest loss)
(4) 1 = yes, 0/1 = uncertain, 0 = no

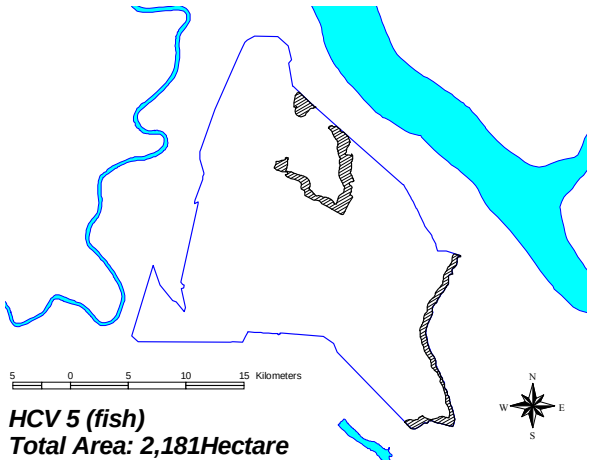
Table 7 shows the highest reliance recorded for FMU natural forest sources of basic needs. A score of 2 (more than 25% reliance) or more is what this assessment is using as a pre-requisite for HCV 5. HCV 5 can then only apply if extraction is likely to be sustainable, there are no readily available and affordable alternatives and production is not declining over time (unless because of forest loss).

In sum, HCV 5 was identified for natural forest in the FMU that was important as sources of:

- Protein from fish catches in rivers with water sources inside the FMU - Villages of Tanjung Pal, Sungai Rawa and Mengkapan.
- Medicinal plants for traditional midwives - Villages of Sungai Rawa and Mengkapan. Medicinals. (Tanjung Pal obtains medicinals from inland natural forest outside the FMU).

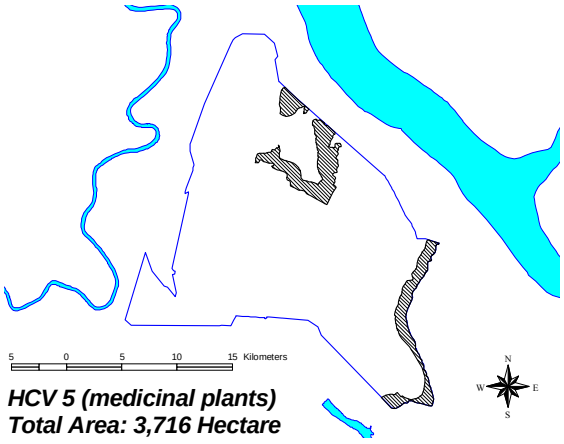
HCV 5 Rationale for Boundary Delineation

Interviews with fishermen produced a wide range of estimates about the area of forest that should be left with minimal disturbance either side of the river to safeguard fish stocks, namely, 1,000 (Tanjung Pal), 2,000 (Sungai Rawa) and 500 m (Mengkapan). Given the imperfect nature of knowledge about lateral water flows in peat and impacts of changes in forest cover on populations of a wide range of fish species (more than 30 species of fish with market or subsistence value were reported from each of the rivers in question), a buffer of 500 m either of the Rawa, Mengkapan and Limau rivers is proposed.



HCV 5 (fish)
Total Area: 2,181Hectare

Interviews with midwives about the amount of intact forest area required either side of the above rivers for the harvesting of medicinal roots, leaves, bark and mushrooms provided limited spatial information. The gathering of some 30 types of common medicinals is usually done by others sent on harvesting errands by the midwives while they are engaged in other activities such as hunting, fishing and wood extraction. Harvesting by the midwives themselves in the Merawang river in AAP's Pulau Muda peat swamp forest FMU indicated the need for 1,000 metres of intact forest either side of the river.



HCV 5 (medicinal plants)
Total Area: 3,716 Hectare

HCV 5 Management Assumptions

For the above delineation to be effective, the following assumptions are made:

- Inside the FMU, no more than minimal impact on the natural forest areas would be permitted and managed to prevent this from occurring;
- Outside the FMU, natural forest on the eastern bank of the Rawa river would be protected. Forest management rights on the eastern side of the Rawa river, once for

selective logging, are apparently now held by RAPP for industrial timber plantation or *HTI* development.

4.6 High Conservation Value 6
Forest Areas of Critical Value to Traditional Culture

Definition
The Indonesian HCVF Toolkit states that if forest areas are critical to the traditional cultural identity of local communities, e.g., restricted-use and reserve forest, ancestral burial, spiritual, religious, and taboo sites, then the forest area will be HCV.

The Indonesian Toolkit does not set a threshold for what would determine a 'critical cultural value'. SmartWood has applied a threshold within this report that to qualify as HCV 6, at least 50% of a defined group (village/sub-village) or defined sub-group (may be gender, ethnic, etc.) consider candidate forest areas as having critical cultural value.

HCV 6 Site Context
No HCV 6 was identified for any of the six communities.

A case for the Atik people of Tanjung Pal village might have been made had their inland forest areas been within the FMU. A relatively small number of grave sites are apparently found in FMU natural forest areas but nowhere near to the extent that would invoke HCV 6.

The legend of Sacred Dragon Lake in the western corner of the FMU initially suggested the possibility of HCV 6 but was found on closer investigation to be of recent origin and being actively promoted for its tourism potential. There was no convincing argument that the lake and its surrounding forest were of critical cultural value to any of the surrounding communities.

HCV 6 Rationale for Boundary Delineation
This HCV was not identified or considered to be present within the FMU and no boundary was delineated for the HCV.

4.7 HCV areas identified in the FMU

HCV area identification is summarized in Table 8.

Table 8. Forest Areas with HCVs Identified in the FMU

	Total (Ha.)	% of FMU Natural Forest	% of HCVF Area	% of overlap with other HCVs
HCV 1.1	3,056	31.1%	44.5%	100%
HCV 1.2	1,906	19.4%	27.7%	100%
HCV 1.3	1,906	19.4%	27.7%	100%
HCV 2.2	1,759	17.9%	25.6%	100%
HCV 3.1	4,464	45.5%	65.0%	79%
HCV 4.1	2,630	26.8%	38.3%	97%
HCV 4.3	2,189	22.3%	31.9%	88%
HCV 4.4	2,539	25.9%	36.9%	100%
HCV 5 Fish	2,181	22.2%	31.7%	100%
HCV 5 Medicine	3,717	37.8%	54.1%	97%

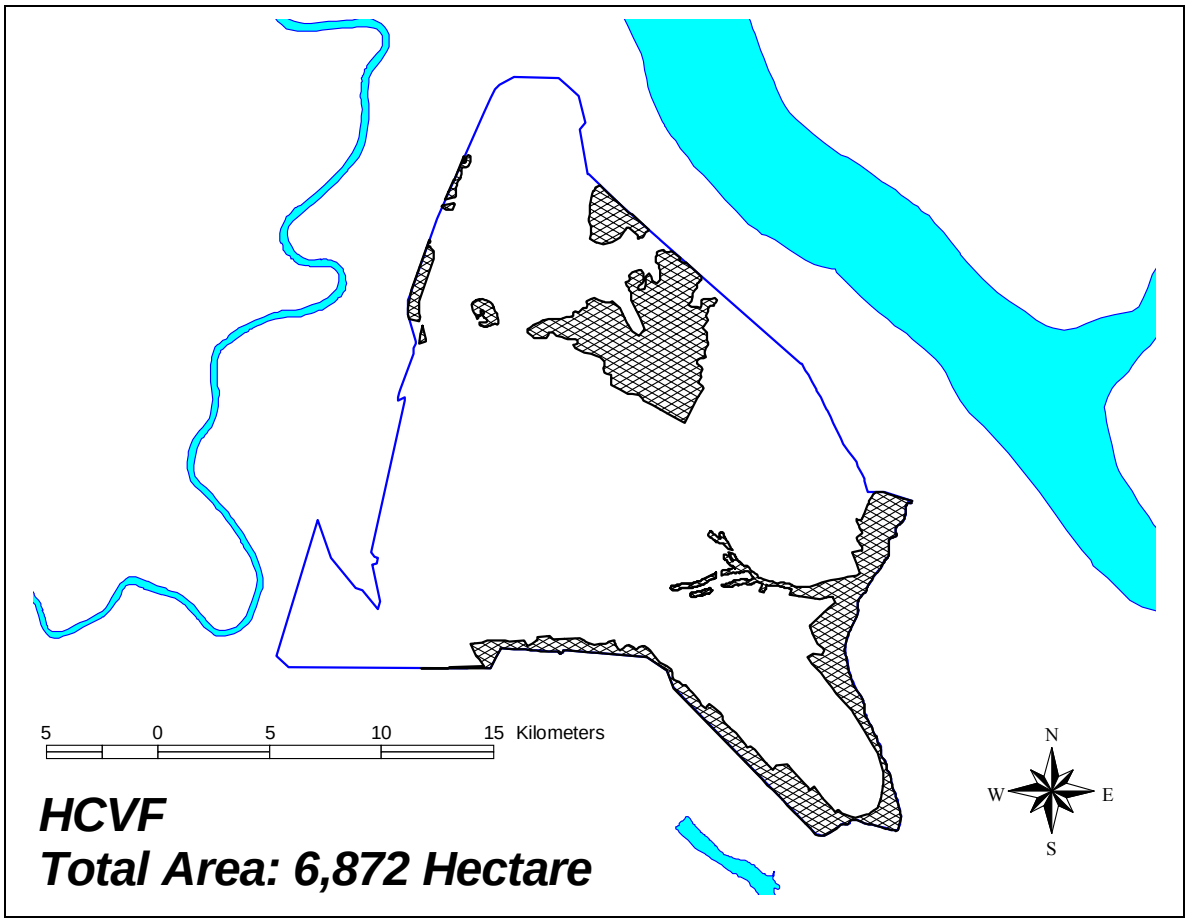
5. Indicative HCVF Boundaries

This section takes forward the process of identifying and delineating HCV areas in the previous section to demonstration of where the indicative HCVF boundary and area that it encompasses should be for the Siak District.

Following the delineation of HCV boundaries through the GIS mapping process, a composite overlay of all identified HCVs and components was produced. The overlays permitted a single HCVF layer with defined areas indicated on a map of the FMU. The HCVF boundary is best represented according to the dominant forest blocks that are described below.

Figure 9 is to be considered the indicative HCVF map for the Siak District as of February 17, 2005.

Figure 9. Indicative HCVF Boundary for Siak FMU



The HCVFs defined within the FMU can be broadly divided into the following areas:

Block 1
This block constitutes the entire southern boundary of the Siak Concession, encompassing all the remaining forest, to the eastern notch in the FMU, where the forested strip is at its narrowest and closest to the Sg. Rawa (bordering Petaks 431 & 432). This area has been classified as Kawasan Lindung, and signage has been erected along the forest edge stating the "buffer zone" status of the

forest. Two spurs of forest, adjacent to Petaks 27/28 and 49/50/51, classified as Kawasan Unggulan, have been excluded (refer Section HCV1.1 for rationale).

HCV 1.1 – This indicative HCVF boundary serves a buffering function between the protected area (Danau Pulau Besar) and the FMU, which a shared boundary. It also makes a minimal contribution to increasing the habitat of the protected area.

Block 2
This block constitutes the entire eastern boundary of the FMU, including all the forest classified as Kawasan Lindung and Kawasan Unggulan. It follows the Sg. Rawa from the corner of Block 1 above (petaks 431/432) downstream to the northeastern corner of the FMU (closest point of reference for this position is Petak 111). The uncut forest bordering Canal 5 at the time of assessment is included in this block (Petaks 304/344/348). The dead forest (Petaks 247/291–298) has been excluded, rationale provided in section HCV1.1. The forest along the true right bank of the tributary is included to the point where the tributary splits into two (ref. point Petak 245), the forest beyond (to the west) excluded from this HCVF. The strip of forest (Kawasan Unggulan) in the northeast, beside Petak 112, has also been excluded.

HCV 1.1 – This indicative HCVF boundary serves a buffering function between the FMU and the Sg. Rawa. The protection of the Sg. Rawa is critical to the ecological integrity of the Danau Pulau Besar Reserve.

HCV 1.3 – the HCVF along the Sg. Rawa protects the river's greater ecological function and viability, thus preserving the two globally significant species confined to it: Tomistoma and Bonytongue.

HCV 4.1, 4.3, 4.4 and 5 – The HCVF blocks described above contain the river systems and forest areas that would buffer the critical water resource HCVs.

Table 9 represents the area delineated as HCVF corresponding to each of the current FMU land use classifications.

Table 9. HCVF area compared to FMU land use

FMU Landuse	HCVF Area (ha)	% of FMU Landuse	Remaining Natural Forest (ha)	Total Area (ha)
Kehidupan	85	16.1%	82	528
Konservasi	3,733	71.4%	3,733	5,230
Produksi	1,025	2.9%	1,000	35,342
Unggulan	1,840	36.4%	1,811	5,054
Plasma Nutfah	112	93.3%	112	120
Used by BoB				
Siak Pusako	49	9.1%	49	540
Total				**46,814**

6. *HCVF Management, Monitoring and Research Implications*

The scope of the SmartWood HCVF assessment of Siak District was to identify HCVs and delineate the HCVF areas. Detailed management and monitoring guidelines will have to be developed by the company, in consultation with stakeholders, on the basis of the identified HCVs and preliminary delineation of HCVF. This chapter outlines some important management (6.1), monitoring (6.2) and research (6.3) implications of the HCVF assessment.

6.1 Management Implications

6.1.1 Managing the Indicative HCVF boundary for HCV 1.1

The indicative HCVF (Block 1) is in a fragile state, and will require careful management effort to prevent its further degradation. Contractors are blamed for the recent clearing of parts of this buffer zone in the west, and re-opening of some of the closed canals. While these actions may have been taken without the consent or knowledge of the FMU manager, the responsibility for the buffer zone ultimately does rest with the company. Stricter control over the actions of contractors must be developed and put into place.

A further implication on management is the intervention and resources required to prevent encroachment into the Reserve through the FMU. There is unchecked access into the Reserve via this long buffer zone, and the FMU will need to allocate resources to the effective closure of this entire HCVF from any form of encroachment. At present, gaharu collection and limited hunting is taking place, but this may increase over time.

6.1.2 Managing the Indicative HCVF boundary for HCV 1.3

Managing an area for a Tomistoma population presents certain challenges. Although the Manager's responsibility might be interpreted as ensuring the protection of the identified HCVF, in this specific case, the conservation value is all species that are confined to the aquatic environment. Such species are vulnerable to factors specific to the river channel (e.g. pollution, over-fishing). Intact forest alone will not necessarily ensure their continued viability. The task placed upon the manager is therefore by necessity broader than the mere protection of the forest. In cases such as this, partnerships and conservation covenants with regular users of the river may be the only way to ensure the values for which the forest has been set aside to conserve remain in good health and viable in the long term. Community relations will undoubtedly play an important part in achieving this objective.

As an indication of the management requirements for species confined to river channels, the following guidelines, taken from Sebastian (1994), are given here. These were recommended specifically for management measures of protected areas for Tomistoma, but are relevant to any river system as well.

- No clearing of riparian zones throughout the reserve. This will ensure sufficient shelter and potential nesting sites for the animals.
- Along stretches of rivers where dense rooted/floating vegetation obstructs navigation, removal to maintain a navigable channel should be supervised to prevent unnecessary clearance or damage to the habitat.
- Regulation of fishing regimes and operations should be undertaken to prevent over-fishing and loss of fry-stock. Poison fishing should be banned.
- Awareness campaigns for local communities should be undertaken. Accidentally caught animals (in nets) should either be released or handed over to the authorities. Such specimens are useful for tagging or radio-telemetry experiments.

6.1.3 Managing the Indicative Boundary for HCV 2.2 & 3.1

HCVF areas that protect HCV 2.3 & 3.1 need to be protected from further disturbance and allowed to recover through natural vegetative succession. The Mixed PSF that are included within these areas will regain their canopy structure and ecological integrity if further logging, hunting and fire are excluded.

To protect HCVF areas, the boundaries need to be demarcated, signposted, and patrolled. Potential hunters and loggers, both from nearby villages and from contract labor operating within the FMU, must be informed about the status of this forest. If necessary, accommodation must be reached with downstream villagers over their traditional rights of access. It may be necessary to negotiate benefits that can be exchanged for foregone forest use. Low, sustainable amounts of limited timber extraction is consistent with maintaining these HCVs, if this is a necessary concession to make for overall compliance.

The company is encouraged to connect the two blocks of Mixed PSF delineated as HCV3.1. The small narrow blocks of forest between these can be expanded into a wider and more continuous belt to provide a flyway for birds and bats. This would help maintain viable populations of these vertebrates and the many tree species whose seeds they disperse. This corridor need not be completed immediately, but after the current crop of *Acacia* is harvested in these designated areas, they can be allowed to remain fallow, and regain vegetative structure through natural ecological succession. This corridor can then be established over the next decade then. The isolated strips of heavily degraded natural forest that remain here and there within the FMU are of little or no conservation value. These can be converted to plantation as a trade off for establishing equivalent areas for this corridor function. There would therefore be no net loss in plantation area.

In general this brings up the broader problem of allocating FMU areas into the three legally required set asides during the planning process. This HCVF assessment, and our earlier ones, offer clear guidelines and principles to follow with regard to this allocation. Most area set aside as HCVF can be drawn from these required allocations, and much better optimize the conservation value of the natural forest if planned at an early stage of plantation development.

6.1.4 Collaboration between the Company and Village Communities

FMU Siak is surrounded on all sides except the southern wildlife sanctuary by threats to conservation of its natural forests and water resource management, primarily from unauthorized logging and agricultural encroachment, both of which seem set to increase. While these deforestation pressures are not always driven by local people, attitudes of adjacent village communities to the company and its operations are a critical determinant of cost-effective and sustained forest conservation. Typically viewed as a threat to be contained, a management problem that grows with the size of natural forest area set aside for conservation, local communities are unquestionably a necessary part of the solution and potential allies against more destructive outside forces. Across Indonesia, the alternative of using crude force to exclude local people from forestry resources has, in the long term, left everyone as losers, including the environment. At present, if one considers village communities at large rather than their formal representatives alone, current company-village relations are distant at best.

There are compelling HCVF management reasons to improve engagement with people living in intimate contact with FMU areas -- creating the right incentives and avoiding the wrong ones -- in ways which are consistent with the company's new community relations' approach. The high number of village communities living in close proximity to the FMU creates formidable challenges to fostering positive community relations that can effectively safeguard protected

natural forest areas. A number of management issues need to be factored in for protection of HCVs. Most are applicable to HCVF management in general, particularly the intractable problem of illegal logging. The right kind of community - company engagement can reduce illegal logging and agricultural encroachment. On the other hand conventional command-and-control and arbitrary payments or public works tend to create them-and-us attitudes that are more combative than collaborative.

Typical reliance on village leaders as the sole conduit for assistance negotiations should be avoided because sub-groups who establish HCVs may not be part of the village government mainstream. Community relations should be given a higher planning and operational profile within the company. Other institutions such as NGOs and local government agencies may have to be brought into the process. And nothing can be lastingly achieved unless the social capital of mutual trust is seen as a sine qua non of community-company collaboration.

Seven strategic management steps are suggested to guide efforts at improving community relations to minimize threats to the ecological integrity of HCVF areas and keep these within manageable limits. Although the steps outlined below are in sequence, in practice the process should be seen as a progressive series of feedback loops as implementation experience leads to appropriate changes. For example, having identified target communities, while working with them it may become evident that further division or merging makes more sense. Over time, experience will necessitate management adaptations, in particular the relationship between Pelalawang and FMU Siak, and within the organisationalstructure of FMU Siak itself.

Each of the seven steps should be informed by one of the key outcomes of monitoring and evaluation.

1. **Company Organisation**. *What organizational changes must be made?* The importance of a dedicated unit in the company at FMU, Pelalawang and Jakarta levels for management of HCVF and other set-aside areas, fully integrated into the company's organization structure (with sufficient human and financial resources), is noted as a general management implication in this assessment. The social dimension of HCVF management will require the following:

    - The HCVF Management Unit should have a distinct Social Section that is an equal partner among other sections of the HCVF Unit.

    - The Social Section should be involved in decision-making about claims and be kept fully informed of claims' processes.

    - Oversight (but not day-to-day management decisions) of the FMU-level Social Section should be the responsibility of the Pelalawang HCVF Management Unit.

    - The Community Development Division of the Company at Pelalawang should develop strategic guidelines for community relations related to HCVF management.

2. **Identification of Communities and Potential Partner Groups.** *Who and where are the communities?* There are various levels of community units that should be taken into account when deciding with whom to engage.

    - Engagement with formal village communities adjacent to the FMU is an obvious starting point. Cautious support to resolve the dispute between Sungai Rawa and Mengkapan over the boundary that separates them and their land

management responsibilities would be both useful and a way to build FMU - village relations, e.g., funding of NGOs with a proven track record of dispute-resolving participative mapping.

- Identification and inclusion in negotiations of different kinds of representatives, not only the village head but also the village council (BPD) and respected senior villagers (*Tokoh Masyarakat*). To further ensure avoidance of elite capture of the engagement process, it is important to identify other social groups and institutions in the village that should be a part of subsequent engagement processes. For some groups, such as scattered pioneer farmers (generally in small numbers), representation may not exist at all and initially individual contacts will have to be made.

- Another identification feature is recognition that some groups may be future allies of HCVF protection, e.g., fishermen in Tanjung Pal, Sungai Rawa and Mengkapan villages whose livelihoods are seasonally severely constrained by log transport and jams in rivers, and in the long term by agricultural encroachment.

3. **Mutual Trust.** *How can trust -- the foundation for lasting collaboration -- between the company and local communities be nurtured?* Without the social capital of mutual trust, community relations must remain in the realm of ad hoc and reactive responses to problems that often invite more of the same kinds of problem. The so-called "trajectory of trust" (*mutual understanding* → *mutual respect* → *mutual trust*) is a participative process for very different institutions to find common interests, culminating in the starting point of collaborative initiatives. Creating trust among pioneer communities and a newly arrived FMU is relatively easy but not an option for FMU Siak where the establishment of local communities long predated the arrival of the FMU, rightly or wrongly feel aggrieved by livelihood changes forced upon them without sufficient compensation, creating ingrained mistrust. A number of steps can be followed to remedy this situation and coopt local communities to work together with the FMU to protect HCVF areas.

   - First, there should be a stakeholder analysis. The interests of both company and communities are estimated, comprising expectations and concerns (hopes and fears), differentiating between interests that are declared and hidden.

   - In an environment in which company and the specific community feel comfortable in (probably not in the AA office or the Village Head's office), the company introduces its intention to demarcate and manage HCVF areas. All parties agree to the need for a better understanding of the implications of this intention, focusing on their interests (expectations and concerns). No agreements or promises are sought at this stage, only dialogue towards mutual understanding. As is well known and documented world-wide for conflict resolution, it is critical to emphasise interests and to avoid creating a platform for promoting (intransigent) positions.

   - Proper facilitation is key. A third party, such as an NGO or other institution, in which both company and community have confidence, is more likely to succeed at moderating the process.

   - With mutual understanding that each party has legitimate (if not always legal) and essential livelihood concerns and that both are willing to seek accommodation with each other rather than to perpetuate the *status quo*, mutual respect is fostered.

- Transforming mutual respect into mutual trust requires the realization that both company and community can gain and some early concrete demonstrations of good faith. Increased transparency is an example, e.g., sharing with communities map information of land use in and outside the FMU, and where feasible and useful, amending maps.

4. **Better Boundaries.** *How can boundaries between the FMU and community areas be mutually acceptable and respected?* Once there is sufficient mutual trust, one of the first collaborative activities between the company and relevant communities should be participative mapping to demarcate the HCVF boundaries identified in the present HCVF assessment. The process itself can build further trust. As the saying goes, "Good fences make good neighbours". Participative mapping is particularly important for establishing a fixed boundary around the set asides for smallholder agriculture on either side of main roads through natural forest areas, most notably the two isolated *Konservasi* areas on the north eastern side of the FMU.

   Participative mapping, however, if not done properly can erode trust and create disputes over land control. Across Indonesia, there are examples of miserable failures (some of them the fault of international agencies) and impressive successes.

   - The company should learn from the Network of Village Mappers or JKPP (*Jaringan Kerja Pemetaan Partisipatif*) and NGOs with wide and successful experience, e.g., Pancur Kasih in West Kalimantan, Watala in Lampung, and Warsi in Jambi. Other useful information sources are DfID's Multi-stakeholder Forestry Programme (MFP) and the Ford Foundation that have supported participative mapping initiatives across Indonesia.
   - HCVF boundary demarcation through participative mapping should be fully aware of the current land claims' situation. Indeed, it may be possible to find solutions to some land claims through participative mapping processes.

5. **Entry Points for Company-Community HCVF Management.** *Where to start?* It probably does not make sense to start on all fronts at once. Ideally, AA should start where the task is most important, namely, Sungai Rawa and Mengkapan on the Panjang Straits where there is the highest proportion of natural forest adjacent to villages.

6. **Enhancing Efficiency and Effectiveness.** *Can community relations processes for HCVF management be made more efficient and effective?* During the early stages of managing the social aspects of HCVF protection, more time and resources will be required than in the kind of conventional community development practiced at FMU Siak. Nonetheless, there are a number of efficiency and effectiveness measures that should be pursued, e.g.,

   - Ensuring effective representation within specific communities, ensuring the voices of typical silent but numerous groups are heard, e.g., women, the landless poor, traditional leaders.

   - *Kehidupan* and *Unggulan* areas could be sustainably managed, without threatening HCVF functions, providing either timber or non-timber revenues to local communities (the alternative may be logging and re-logging by illegal loggers).

   - Focus on benefits with wide reach rather than benefits that are easily captured by the elite or create social jealousy, e.g., high-yielding crop planting material rather than processing equipment, village meeting place rather than village

government offices, or primary health care and school facilities. Any village development funds related to HCVF to be management transparently and audited. As far as possible connect the flow of benefits with verifiable conservation progress, monitoring outcomes together with the community.

- Explore the possibility of employing and training villagers to help persuade other communities of the benefits of collaborative management of HCVF areas.

- The company should work towards the establishment of an association of village communities surrounding FMU Siak in alliance with the company to reduce HCVF threats and sustain direct and indirect benefits. Understandably, there might be concern that such an alliance might backfire and result in unrealistic, even extortionary demands. Certainly the risk is there, but mitigated by the kind of participative and trust-building measures mentioned above, and small in comparison with the failure to provide a more effective defense against future waves of illegal loggers, oil palm plantations and other development activities.

7. **Monitoring, Evaluation and Responses.** *How can monitoring be effective and responses timely?* M&E for the social aspects of HCVF management generally apply to other aspects and are dealt with in Section 6.2, below.

6.2 Monitoring Regime

- Periodic monitoring should have internal and external components.
  - ⇒ Clearly, internal monitoring by the HCVF Unit is important for timely management responses.
  - ⇒ A separate agency within the company should evaluate progress annually before the arrival of the independent auditors.
  - ⇒ Quarterly remote-sensing data of forest cover should be sent to the independent auditors.
  - ⇒ The company should set up a periodically-updated website showing key monitoring parameters such as natural forest cover and HCVF boundaries.

- The emphasis on monitoring should be outcome-based, rather than an administrative exercise of checking on reporting and documentary procedures.
  - ⇒ Monitoring should be able to track the indicators of success and similarly capture failure.
  - ⇒ Protocols for management responses need to be developed.

- Annually, a lessons-learned exercise should be conducted. Lessons means, "*what we thought we knew but experience proved otherwise*".
  - ⇒ Lessons-learned processes involve (i) identification, (ii) learning and (iii) remembering.
  - ⇒ As more APP FMU's establish HCVFs, it will be helpful to institute shared-learning processes among FMUs.

6.3 Research and Development

- There should be support for research that systematically compares across FMUs different incentives and disincentives for local communities to help safeguard HCVFs.

This may be outsourced but there should be company competence to oversee and interpret such work and to use the results to modify management decisions.

- Research to close knowledge gaps about forest areas required to safeguard the habitat of medicinals and to conserve fish populations might reasonably be expected to result in smaller area requirements that do not need to be so conservative. Buffer strips for medicinals may not be required along the entire length of the river nor need to be as wide. Riparian buffers to protect fish stocks might be more finely adjusted according to river width and therefore in some settings be narrower.

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Appendix 1. APP / SMG Contact List

	Name	Division & Position	Office Location	Date met
1	Michael Black	Deputy Chief Executive Officer	HQ, Jakarta	17
2	David Nicoll	General Manager, Corporate Forestry Division	HQ, Jakarta	04, 17
3	John Casey	Community Development (CD)	Perawang, Riau	11
4	Ko Kok Pin	Siak, District Manager *	Siak, Riau	05 - 08
5	Arifin Arief	Siak, Security & Social *	Siak, Riau	05
6	Deni S.	Siak, CD officer, Community & Social *	Siak, Riau	05
7	Nasir	Siak, CD officer, Community & Social *	Siak, Riau	05
8	Arbi S.	Siak, CD officer, Community & Social *	Siak, Riau	05
9	Ibnu Sindar	Siak, CD officer, Community & Social *	Siak, Riau	05
10	Joseph Gomez	Siak, Sub-District Manager, Land Transport *	Siak, Riau	05 - 12
11	P.S. Segar	Siak, Sub-District Manager, Guides *	Siak, Riau	05 - 11
12	Albert Culas	Siak, Sub-District Manager, Water Transport *	Siak, Riau	05 - 12
13	Kusharyadi	Section Head, Planning & Survey *	Siak, Riau	05
14	Mifah Munir	Section Head, GA, Logistics *	Siak, Riau	05
15	Sobar	Surveyor	Siak, Riau	05
16	S. Sihotang	Surveyor	Siak, Riau	05
17	Aswiria	Resort Manager, Pendada	Siak, Riau	05
18	Tabrani	Siak District, speedboat operator	Siak, Riau	05 - 11

Notes:
* = Management team for HCVF assessment

Appendix 2. List of Interviewed Stakeholders and Resource Persons, Siak HCVF Assessment, February 2005

Name	Location, Title	Date met
Zulfahmi	Jikalahari Office, Pekanbaru	05 & 12
Jonotoro	Jikalahari Office, Pekanbaru	05 & 12
Doni	Jikalahari Office, Pekanbaru	05 & 12
Jali	Jikalahari Office, Pekanbaru	05 & 12
Koko	Jikalahari Office, Pekanbaru	05 & 12
Muslim	Jikalahari Office, Pekanbaru	05 & 12
Ahmad Gazali	Jikalahari Office, Pekanbaru	05 & 12
Jaafar	Sungai Rawa, Village Head	06 & 07
Nurdin	Sungai Rawa, villager	07
Arrahman	Sungai Rawa, villager	07
Abdul Muis	Sungai Rawa, villager	07
Ponirah	Sungai Rawa, traditional midwife	07
Zainal	Sungai Rawa, villager	07
Aduar	Sungai Rawa, Secretary	07
Ngahiting	Sungai Rawa, traditional midwife	08
Pak Thalib	Danau Sungai Rawa, fishermen	10
Gimchuan	Tanjung Pal, villager	07
Dim	Tanjung Pal, shaman (dukun)	07
Aris	Tanjung Pal, Ketua RT 01	07
Dome	Tanjung Pal, LKMD chief	07
Dopami	Tanjung Pal, villager	07
Ali	Tanjung Pal, villager	07
Ibu Pah	Tanjung Pal, traditional midwife	08
Ibu Mea	Tanjung Pal, traditional midwife	08
Ibu Nurdiah	Kumpai, farmer	09
Bapak Kelok	Kumpai, farmer	09
M. Dahlan	Mengkapan, village secretary	08
M. Nizar	Mengkapan, BPD chairman	08
Adenan	Mengkapan, tokoh masyarakat	08
Ahmad	Mengkapan, ketua RW 4	08
Wahid	Mengkapan, durian trees owner	11
Hasyim	Mengkapan, durian trees owner	11
Maslamah	Mengkapan, traditional midwife	11
Ibu Atik	Mengkapan, rubber farmer	11
Zakaria	Pebadaran, villager	10
Abdurahman	Pebadaran, villager	10
Nasarudin	Pebadaran, villager	10
Ten children	Pebadaran	10
Bukri Awi	Dosan, village head	08 & 11
Desyunarman	Zamrud, PT. BSP - Pertamina Hulu	05
Bapak Jumah	Zamrud, Danau Besar, Conservation Area guard	10

Appendix 3. Itinerary for HCVF Assessment of FMU Siak in February 2005

Date Day	Sites and Travel	Activities
Feb 4 Fri	SmartWood Office	Meeting of team (JH, CB, AO, AS, MH, ML) /a/ Meeting with David Nicoll, APP.
Feb 5 Sat	Jakarta to Pekanbaru (80 minute flight) JIKALAHARI, Jl. Angsa II No.3A Pekanbaru Pekanbaru via Zamrud to Siak District Camp by road (3 hours)	Team consisting of AO, CB, ML and AS take flight from Jakarta to Pekanbaru. Team met NGOs in Riau. Obtain information on NGO study, including traditional Akit community Stop at Pertamina's Zamrud offices to obtain permission to gain access to lake within the oil mining concession, south of FMU Siak Initial meeting with Siak staff
Feb 6 Sun	From Siak base camp harbour north along the Siak river into the estuary, and south to Sungai Rawa and Tanjung Pal villages back north west by river and coast to Tj. Buton harbour, then by land back to Siak base camp Siak base camp to Sungai Rawa Resort and Berbari Resort, back to base camp	AO and CB make riverside and village observations, preliminary interviews and appointments for follow-up interviews (AO,CB). Observe riverside land use, including sago, timber and mangrove charcoal processors. General recce of the FMU, covering Rawa Resort in the morning and Bebari in the evening. Wildlife obervations conducted, and observations on hydrological flow in canals (AS, MH, ML)
Feb 7 Mon	Base Camp to Berbari to Base Camp, by road and canal Base camp by road to Tj. Buton to lake Naga Sakti to Sungai Limau to base camp. Base Camp to Mengkapan village to Tj. Buton harbour by road, then by river to Tanjung Pal village to Sungai Rawa village back to Base Camp harbour. Base Camp Office	AS to Canal 17 (Km12 start) to recce the southern boundary of the FMU adjacent to SM Danau Pulau Besar. Afternoon accessed the boundary along Canal 17 and located old base camp at Canal 18, within buffer zone with SM. AS then mapped out entry points along Tj. Buton road, notably illegal logging camps, and visited the lake, Tasik Naga Sakti. Observations of local agriculture. AO, CB and MH meet Village Secretary of Mengkapan. Then interviewed people in Tanjung Pal and Sungai Rawa villages. ML analyzed data provided by Planning Section
Feb 8 Tue	Base camp to Mengkapan village to Buton Port by road. By river and coast to Tanjung Pal village to Sungai Rawa village and back to base camp via Dosan village. By road, Tj. Buton to lake Naga	CB and AO interviewed people in Mengkapan village in the morning. AO interviews in Tanjung Pal and Sungai Rawa villages. AO interviewed head of Dosan village. CB, MH and AS visiting areas either side of main road

	Sakti via Sungai Limau village to base camp By road, base camp to Mengkapan village to the main road between Tj. Buton and base camp to base camp. Base camp to end of Canal 6. Also to old base camp on Canal 18.	between Tj. Buton & base camp. Interview farmers and illegal logger. ML sampled mixed PSF, southeast Conservation area. Hiked to Sungai Rawa. AS to old base camp at Canal 18 (within buffer zone) at 1500hrs. Conducted wildlife surveys in evening.
Feb 9 Wed	Base camp to Tj. Buton by road to Kumpai sub-village to Tj. Buton to Base camp. Old base camp – Canal 18 Base camp – Pedada – Base camp Base camp – Berbari resort	CB, AO and MH visit shrimp pond and birds nest enterprises in Kumpai sub-village area. Also interview Bugis coconut farmers. AS. Morning – 3hrs wildlife survey along Canal 18. AS and MH visited Resort Pusako, SubResort Pedada Canal PS1, making wildlife observations at edge of Kawasan Hidupan. Driver absent. ML back to the office to continue analyzing data and information
Feb 10 Thu	Base camp by road to Lake (Tasik Sungai Rawa) observed by boat. Return by road to base camp (ML, MH, AS) or to Siak District harbour (AO and CB) Siak District harbour by river to Dosan village to Pebadaran village to base camp.	MH, ML and AS made wildlife observations in lake located in mining area of Pertamina. AO and Cb made social observations of fishing community including a fishermen from Sungai Rawa village who had been interviewed back in his village two days before. CB interview Pebadaran farmer and family connected to lake Naga Sakti legend. AO interviewed people in Dosan village.
Feb 11 Fri	Base camp by road to Mengkapan to base camp Base camp to southern boundary of conservation areas in Berbari resort to base camp Base camp and office Base camp to APP, Perawang Base camp by boat along Siak river to Sungai Rawa village	AO interviews in Mengkapan village. ML sampled tall PSF. CB reviewed AMDAL documents and collection of harvesting and production area data. AO and CB to APP Perawang. AS & MH conduct boat wildlife and landscape survey of the Siak river to the coast, south east along the straits (Selat Panjang) to Sungai Rawa village. Visit Sago factory in Sungai Rawa village are.
Feb 12 Sat	Perawang to Pekanbaru Base camp to Pekanbaru	CB and AO met NGOs, Jikalahari and WWF in Jikalahari office. Then take flight to Jakarta Helicopter not available. MH, ML and AS depart to Pekanbaru to take flight to Jakarta

Notes:
/a/ Team members referred to as follows in the above itinerary: Jeff Hayward (JH), Aisyah Octavian (AO), Mark Leighton (ML), Anthony Sebastian (AS) and Chris Bennett (CB).

Appendix 4. Glossary of Terms

***Areal Kehidupan* / Livelihoods Area**
According to Minister of Forestry Decree No.70 of 1995, around 5% of the HTI FMU area with non-timber yields of value for local communities.

***Areal Konservasi* / Conservation Area**
According to Minister of Forestry Decree No.70 of 1995, conservation areas are where there is peat, water absorption area, riparian zone, beach zone, next to lake or reservoir, around spring and around mangrove areas.

***Areal Produksi* / Production Area**
According to Minister of Forestry Decree No.70 of 1995, production areas that can be cleared for the establishment of industrial timber plantations.

***Areal Unggulan* / High-quality Local Species Area**
According to Minister of Forestry Decree No.70 of 1995, around 10% of the HTI FMU area is mandated for management of local species of high market value.

Alternatives
In the context of livelihood sources, refers to alternatives that are readily available at a low marginal cost, e.g., market beef instead of deer meat.

Baseline Mapping
Mapping parameters that include: topography, vegetation types and their distribution, and land use and vegetation cover of the surrounding areas. Graphical presentation of all available baseline information forms the basis for planning of surveys, plotting of HCVs, creation of overlays and delineation of HCVFs. Pre-requisite for conducting an HCVF assessment.

Baseline Inventory and Mapping
An inventory of the habitat and species in the FMU. It should cover the following parameters:
- Inventory of species occurring within the FMU: plants, mammals, birds, herpetofauna (reptiles & amphibians) and fish;
- Reports & other literature on gazetted protected areas in the immediate vicinity;
- Ecological literature on species of conservation significance locally, nationally, regionally and globally;
- Reports and other literature on the status of habitats, forest types and vegetation communities of conservation significance locally, nationally, regionally and globally;
- Mapping of: topography, soils, vegetation types and their distribution, and land use and vegetation cover of the surrounding areas.

A baseline inventory and mapping is a pre-requisite for conducting an HCVF assessment.

Contiguity Principle
The application of this principle to HCVF delineation endeavours to minimize boundary lengths, keeping forest blocks as compact as possible. Small tracts of forest should be avoided, reducing fragmentation and edge effects to HCVFs. Where gazetted protected areas occur adjacent to, or close to the FMU, HCVFs should maintain contiguity with these protected areas. Wherever possible, forest corridors should be maintained between HCVFs, their size and shape reflecting the needs of the animal and plant species which use them. Contiguity should also be maximized with other protection forests within forest estates, such as riverine buffers, catchments, steep slopes and buffer strips.

Critical temporal concentrations

Defined by the Indonesian HCVF Toolkit as habitats or locations which have important concentrations of species only at certain times or at certain phases of their life-history, including critical breeding sites and migratory routes or bottlenecks (latitudinal as well as altitudinal). These may be represented by:

- Concentrations of migratory birds;
- Animals such as bearded pig following Dipterocarp masting events;
- Fruit bats, bees and pigeons follow flowering and fruiting patterns of trees;
- Elephant migration between different forest blocks;
- Fish migrating to spawning grounds.

Critically Endangered Species

According to IUCN, a taxon is Critically Endangered when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing an extremely high risk of extinction in the wild:

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of ≥90% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are clearly reversible AND understood AND ceased, based on (and specifying) any of the following:
   (a) direct observation
   (b) an index of abundance appropriate to the taxon
   (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) actual or potential levels of exploitation
   (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2. An observed, estimated, inferred or suspected population size reduction of ≥80% over the last 10 years or three generations, whichever is the longer**,** where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible**,** based on (and specifying) any of (a) to (e) under A1.

3. A population size reduction of ≥80%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.

4. An observed, estimated, inferred, projected or suspected population size reduction of ≥80% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:

1. Extent of occurrence estimated to be less than 100 km^2, and estimates indicating at least two of a–c:
   a. Severely fragmented or known to exist at only a single location.
   b. Continuing decline, observed, inferred or projected, in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) area, extent and/or quality of habitat
      (iv) number of locations or subpopulations
      (v) number of mature individuals.
   c. Extreme fluctuations in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) number of locations or subpopulations
      (iv) number of mature individuals.

2. Area of occupancy estimated to be less than 10 km^2, and estimates indicating at least two of a–c:
   a. Severely fragmented or known to exist at only a single location.
   b. Continuing decline, observed, inferred or projected, in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) area, extent and/or quality of habitat

(iv) number of locations or subpopulations
(v) number of mature individuals.

c. Extreme fluctuations in any of the following:
(i) extent of occurrence
(ii) area of occupancy
(iii) number of locations or subpopulations
(iv) number of mature individuals.

C. Population size estimated to number fewer than 250 mature individuals and either:

1. An estimated continuing decline of at least 25% within three years or one generation, whichever is longer, (up to a maximum of 100 years in the future) OR

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a–b):
a. Population structure in the form of one of the following:
(i) no subpopulation estimated to contain more than 50 mature individuals, OR
(ii) at least 90% of mature individuals in one subpopulation.
b. Extreme fluctuations in number of mature individuals.

D. Population size estimated to number fewer than 50 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild is at least 50% within 10 years or three generations, whichever is the longer (up to a maximum of 100 years).

Data Deficient (DD) Species

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

Degraded forest

Forest no longer in its natural state, its structure being modified by human activity or natural conditions*, either directly, e.g., high-impact logging, or indirectly, e.g., flooding of forests caused by downstream obstruction to rivers by infrastructure development.* The majority of its floristic composition is retained, but opening of the canopy has resulted in colonization, or regeneration, of light-loving species. Depending on proximity to sources of colonization, scrub species (mammals and birds) may or may not occur.

> Also considered is the AMEC definition derived from World Bank, "This is a forest that has been essentially modified by human activity and has reduced the habitat's ability to maintain viable populations of native species. These forests may also be under current threat from local people involved in illegal activities which will continue to degrade the forest structure and its associated hydrology and thereby its habitat values for the conservation of fauna and flora and sustainable livelihood of local people. Degraded forests have been essentially modified through previous logging, indicated by evidence of railway lines and large openings, fires, or extensive networks of canals in peat areas."

Ecoregion

A geographically disctinct area of land that is characterized by a disctinctive climate, ecological, features, and plant and animal communities.

Endangered Species

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

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of ≥70% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are clearly reversible AND understood AND ceased, based on (and specifying) any of the following:
   (a) direct observation
   (b) an index of abundance appropriate to the taxon
   (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) actual or potential levels of exploitation
   (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2. An observed, estimated, inferred or suspected population size reduction of ≥50% over the last 10 years or three generations, whichever is the longer**,** where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

3. A population size reduction of ≥50%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.

4. An observed, estimated, inferred, projected or suspected population size reduction of ≥50% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:

1. Extent of occurrence estimated to be less than 5000 km^2, and estimates indicating at least two of a–c:
   a. Severely fragmented or known to exist at no more than five locations.
   b. Continuing decline, observed, inferred or projected, in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) area, extent and/or quality of habitat
      (iv) number of locations or subpopulations
      (v) number of mature individuals.
   c. Extreme fluctuations in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) number of locations or subpopulations
      (iv) number of mature individuals.

2. Area of occupancy estimated to be less than 500 km^2, and estimates indicating at least two of a–c:
   a. Severely fragmented or known to exist at no more than five locations.
   b. Continuing decline, observed, inferred or projected, in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) area, extent and/or quality of habitat
      (iv) number of locations or subpopulations
      (v) number of mature individuals.
   c. Extreme fluctuations in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) number of locations or subpopulations
      (iv) number of mature individuals.

C. Population size estimated to number fewer than 2500 mature individuals and either:

1. An estimated continuing decline of at least 20% within five years or two generations, whichever is longer, (up to a maximum of 100 years in the future) OR

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a–b):
   a. Population structure in the form of one of the following:
      (i) no subpopulation estimated to contain more than 250 mature individuals, OR
      (ii) at least 95% of mature individuals in one subpopulation.
   b. Extreme fluctuations in number of mature individuals.

D. Population size estimated to number fewer than 250 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild is at least 20% within 20 years or five generations, whichever is the longer (up to a maximum of 100 years).

Forest
Unless otherwise indicated all references to "forest" in the report assume natural forest (regardless of its quality). Plantation forest areas are specified as such.

FMU
The Forest Management Unit of Pulau Muda District I located south of the Kampar river in Kabupatens Pelalawang, Indragiri Hilir and Indragiri Hulu. It does not include the Serapung forest management area.

Forest Fragmentation
In the context of forests, refers to discontinuity in the forest landscape compromising functioning of the corridor affect, resulting in forest landscape dysfunction and related threats to habitat integrity and species survival. The usage of this term here is not applied to canopy fragmentation.

HCV
High Conservation Value as determined by identifiable biodiversity components. HCVs are distinct from lower conservation values which may still be worthy of protection as well as other site aspects of no significant conservation value.

HCV 1
Forest areas containing globally, regionally or nationally significant concentrations of biodiversity values (e.g. endemism, endangered species, refugia).

HCV2
Forest areas containing globally, regionally, or nationally significant large landscape level forests, contained within, or containing the management unit, where viable population of most if not all naturally occurring species exist in natural patterns or distribution and abundance.

HCV3
Forest areas that are in or contain rare, threatened or endangered ecosystems.

HCV4
Forest areas that provide basic services of nature in critical situations (e.g. watershed protection, erosion control).

HCV5
Forest areas fundamental to meeting basic needs of local communities (e.g. subsistence, health).

HCV6
Forest areas critical to local communities' traditional cultural identity (areas of cultural, ecological, economic or religious significance in cooperation with such local communities).

HCVF
High Conservation Value Forest area determined according to the presence of one or more high conservation values within areas of conservation value.

***Kawasan Lindung / Protection* Area**
According to Presidential Decree No.32 of 1990, Protection Areas.

Keystone species
Species providing ecological functions (e.g., seed dispersal, pollination, key food resources) necessary for preventing the local extinction of other species in the community.

Landscape Forest
Large blocks of forest covering more than 50,000 ha that are (a) continuous enough to allow dispersal of plant and animal populations and (b) are mostly in primary or lightly disturbed condition.

Local Community
A village (*Desa*), sub-village (*Dusun*) or other social sub-group unit within the village or from another village (e.g, fishermen, rattan gatherers), whose area of livelihood development overlaps partly or entirely the FMU's natural forest area or is adjacent to it. Local communities may be recently or long-established. The social unit of community may apply to settlements downstream that are impacted by human forest disturbance, e.g., canal digging, or settlements close to smoke sources from fire mismanagement.

Lightly degraded forest
In the Pulau Muda FMU this term is applied to lightly selectively logged forest which has increased the frequency of gaps, but retains high biodiversity conservation value. If protected from fire, natural processes of ecological succession and regrowth will return this forest towards primary forest conservation value.

Lower Risk (LR) Species
A taxon is Lower Risk when it has been evaluated, does not satisfy the criteria for any of the categories Critically Endangered, Endangered or Vulnerable. Taxa included in the Lower Risk category can be separated into three subcategories:

- **Conservation Dependent (cd).** Taxa which are the focus of a continuing taxon-specific or habitat-specific conservation programme targeted towards the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years.
- **Near Threatened (nt).** Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable.
- **Least Concern (lc).** Taxa which do not qualify for Conservation Dependent or Near Threatened.

Non-forested land
Land that has been entirely cleared of its former vegetation, or has been colonized by secondary forest species, e.g. monotypic stands of *Macaranga* and other pioneer species. Faunal composition entirely open country scrub species.

Overlap
Refers to ecological as well as physical characteristics. For species, this would apply to those whose ranges extend across the Protected Area (PA) and the FMU. For habitats, this applies to vegetation communities which occur in both the PA and the FMU, and are of significant conservation concern or priority on national, regional or global scales.

Peat Swamp Forest (PSF)

Forests growing on surface peat, of variable structure and floristic composition depending on edaphic (soil) and drainage factors. Those at the Pulau Muda FMU are coastal peat swamp forests on peat deposits that have accumulated over marine sediments. The peat layer comprised of partially or nearly undecomposed plant litter, including fallen leaves, twigs, limbs and roots, may be a surface layer or many meters deep. Peat is highly acidic (pH 3.5-4.5), which inhibits its decomposition by microorganisms and inhibits essential mineral nutrient availability for plants. Peat swamp plant species are mostly endemic to this nutrient-poor, drought-prone habitat. Three major types of PSF occur in the Pulau Muda FMU, namely, Short PSF, Tall PSF and Mixed PSF.

Precautionary Principle
Ethical principle that if the consequences of an action, especially the use of technology, are unknown but are judged by some scientists to have a high risk of being negative from an ethical point of view, then it is better *not to carry out the action* rather than risk the uncertain, but possibly very negative, consequences (Wikipedia 2004, *http://en.wikipedia.org/wiki/Precautionary_principle,* 18 July 2004).

Primary forest
Forest in its natural state, unmodified by human activity (i.e., with negligible impact from human gathering activities, including the rare cutting of isolated timber trees). This refers to forest structure, and not to its fauna, or its size. Hunting may have removed certain species (e.g. large mammals), but the forest stand remain undisturbed.

> Also considered is the AMEC definition derived from World Bank, "This forest is relatively intact 'natural forest' and essentially unmodified by human activity. The forest shows no signs of fire, logging in the form of infrastructure such as railways or canals. Local people may be present in sufficient low numbers or under take activities that leave the forest in near-natural condition. The forest does not have adjacent activities that in the near future might essentially modify the natural forest cover, or leave the forest in other than near-natural condition. Some of these primary forest areas are critical habitats if they occur in existing 'protected areas' and or in areas that are being proposed for Protection Forest status under provincial land use planning legislation."

Severely degraded forest
Forest drastically altered in composition and structure, as a result of human activity or natural events, e.g. fire. The forest no longer retains natural structure and most of its fauna has been reduced to pioneer and secondary forest species. In the Pulau Muda FMU this is heavily logged forest that often has also burned, or forest that has established after agricultural clearing. It has negligible conservation of biodiversity value, but if protected from further disturbance, could help serve as a forested corridor lending continuity between forested block, or serve as a buffer zone forest helping to protect HCVF.

> Also considered is the AMEC definition derived from World Bank, "This is a forest that has been irreversibly modified by human activity and has reduced the habitat's ability to maintain viable populations of native species. These forests are also under current and increased threat from local people and their associated illegal activities that will continue to degrade the forest structure to a point where it loses habitat values for the conservation of fauna and flora and sustainable livelihood of local people. Severely degraded forests have been impacted by previous repeated logging activities which are indicated by the presence of railway lines or canals, repeated fires as evidenced by fire scars, vines, shrubs and grasslands."

Traditional
Of long-established social or economic practices reflected in social norms and institutions. In the context of HCV, taken to apply to practices that have been established for at least one generation or approximately 25 years.

Umbrella Species
Species occurring at low density whose habitat needs in terms of area and diversity encompass areas sufficient to maintain viable populations of other species.

Vulnerable Species

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

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of ≥50% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are: clearly reversible AND understood AND ceased, based on (and specifying) any of the following:
   (a) direct observation
   (b) an index of abundance appropriate to the taxon
   (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) actual or potential levels of exploitation
   (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2. An observed, estimated, inferred or suspected population size reduction of ≥30% over the last 10 years or three generations, whichever is the longer**,** where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible**,** based on (and specifying) any of (a) to (e) under A1.

3. A population size reduction of ≥30%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.

4. An observed, estimated, inferred, projected or suspected population size reduction of ≥30% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:

1. Extent of occurrence estimated to be less than 20,000 km^2, and estimates indicating at least two of a–c:
   a. Severely fragmented or known to exist at no more than 10 locations.
   b. Continuing decline, observed, inferred or projected, in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) area, extent and/or quality of habitat
      (iv) number of locations or subpopulations
      (v) number of mature individuals.
   c. Extreme fluctuations in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) number of locations or subpopulations
      (iv) number of mature individuals.

2. Area of occupancy estimated to be less than 2000 km^2, and estimates indicating at least two of a–c:
   a. Severely fragmented or known to exist at no more than 10 locations.
   b. Continuing decline, observed, inferred or projected, in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) area, extent and/or quality of habitat
      (iv) number of locations or subpopulations
      (v) number of mature individuals.
   c. Extreme fluctuations in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) number of locations or subpopulations
      (iv) number of mature individuals.

C. Population size estimated to number fewer than 10,000 mature individuals and either:

1. An estimated continuing decline of at least 10% within 10 years or three generations, whichever is longer, (up to a maximum of 100 years in the future) OR

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a–b):
   a. Population structure in the form of one of the following:
      (i) no subpopulation estimated to contain more than 1000 mature individuals, OR
      (ii) all mature individuals are in one subpopulation.
   b. Extreme fluctuations in number of mature individuals.

D. Population very small or restricted in the form of either of the following:
1. Population size estimated to number fewer than 1000 mature individuals.

2. Population with a very restricted area of occupancy (typically less than 20 km^2) or number of locations (typically five or fewer) such that it is prone to the effects of human activities or stochastic events within a very short time period in an uncertain future, and is thus capable of becoming Critically Endangered or even Extinct in a very short time period.

E. Quantitative analysis showing the probability of extinction in the wild is at least 10% within 100 years.

Appendix 5 Village Data Tables

Overview of Tanjung Pal Village, Kabupaten Siak, as of 07 February 2005

Local Community	**Population** Male & Female **Households** (KK)	**Proximity of Village to FMU Natural Forest**	**Village-FMU Area Connection**	**Proximity to Neighbor Villages**	**Village Livelihoods** (KK numbers or %)	**Social Institutions**	**Social Sub-groups**
Village (Desa) **Tanjung Pal**	KK 315	Adjacent. 6 km from village settlement to FMU natural forest	Common border	(i) south east along coastal strait of Selat Panjang to [. village (ii) north west along coastal strait of Selat Panjang to Sungai Rawa	Housegarden subsistence crops >95% Fishing in rivers *40%* Timber extraction from natural forests > *90%* Employment [16]companies *60% male adults*	Village Head BPD Adat Mesjid Other NGO	Akit (Suku Asli) >95% *Melayu 5 KK* *Java 3 KK*

[16] Companies near this village include AA, RAPP, PTPN V.

A Basic Needs from Natural Forests in Tanjung Pal Village, as of 7 February 2005

Basic Needs		Origins					
		NATURAL FORESTS			Farmland	Buy	Aid
		Within FMU	Adjacent to FMU	Elsewhere			
(1)		(2)	(3)	(4)	(5)	(6)	(7)
Carbohydrates	Rice (*beras*)	-				> 95%	
	Corn (*jagung*)	-					
	Sago (*sagu*)	-					
	Cassava (*singkong*)	-			<10%		
	Sweet potato (*ubi jalar*)	-					
Protein	Fish (*ikan*)	[2]					
	Meat (*daging*)	[0]	20%	>50%	<10%	<10%	
Vitamins & Minerals	Vegetables (*sayur mayur*)	-	20%		30%	50%	
	Fruits (*buah²an*)	[0]			40%	50%	
Water	Wells (*sumur*)	-			75%		
	Rain (*hujan*)	-					
	Rivers (*sungai*)	[0]		75%			

	Canals (*kanal*)	-					
Medicinal Plants	*Obat-obatan*	-		[4]			
Animal Feed	Leaves, grass (*dedaunan, rerumputan*)	-		20%	80%		
Materials	Timber (*kayu*)	[0]	80%				
	Rattan (*rotan*)	[0]	90%				
	Others (*lainnya*)	[0]					
Fuel	Fuelwood (*kayu bakar*) / a /	-		>90%			
	Kerosene (*minyak tanah*)	-				10%	
Cash Income	Timber (*kayu*)	-	>90%				
	Rattan (*rotan*)	-	<10%				
	Bamboo (*bambu*)	-					
	Honey (*madu*)	-					
	Resin (*getah*)	-	<10%				
	Coconuts (*kelapa*) and sago	-	<10%				

Notes:
/ a / fuelwood mostly come from mangrove forests

B HCV 5 Status of Basic Needs from Natural Forests in Tanjung Pal Village, as of 7 February 2005

Basic Needs (1)		**FMU score** (2)	**Production Parametres**			**HCV Status**
			Harvest sustainability (8)	**Readily available alternatives** (9)	**Trend for the last five years** (10)	**[+/-]** (11)
Carbohydrates	Rice	-	-	-	-	-
	Corn	-	-	-	-	-
	Sago	-	-	-	-	-
	Cassava	-	-	-	-	-
	Sweet potato	-	-	-	-	-
Protein	Fish	[2]	s1	r1	decr	**[+]**
	Meat	[0]	s0	r1	decr	**[-]**
Vitamins & Minerals	Vegetables	-	-	-	-	-
	Fruits	[0]	s0/1	r1	stable	**[-]**
Water	Wells	-	-	-	-	-
	Rain /a/	-	-	-	-	-
	Rivers	[0]	-	-	decr	**[-]**
	Canals	-	-	-	-	-

Medicinal Plants	Obat-obatan	-	-	-	-	-
Animal Feed	Leaves, grass	-	-	-	-	-
Materials	Timber	[0]	s0	r1	decr	**[-]**
	Rattan	[0]	s1	r1	decr	**[-]**
	Others	[0]	-	-	decr	**[-]**
Fuel	Fuel wood	-	-	-	-	-
	Kerosene	-	-	-	-	-
Cash Income	Timber	-	-	-	-	-
	Rattan	-	-	-	-	-
	Bamboo	-	-	-	-	-
	Honey	-	-	-	-	-
	Damar / Resin	-	-	-	-	-
	Coconuts and Sago	-	-	-	-	-

Overview of Sungai Rawa Village, Kabupaten Siak, as of 07 February 2005

Local Community	**Population** Male & Female **Households** (KK)	**Proximity of Village to FMU Natural Forest**	**Village-FMU Area Connection**	**Proximity to Neighbor villages**	**Village Livelihoods** (KK numbers or %)	**Social Institutions**	**Social Sub-groups**
Village (Desa) **Sungai Rawa**	Male = 800 Female = 716 KK 400	Adjacent area 5 km from village settlement to FMU natural forest	Common border	(i) south east along coastal strait of Selat Panjang to Tanjung Pal village (ii) north west along coastal strait of Selat Panjang to Mengkapan.	Fishing in rivers *20 KK* Fishing in seas *20 KK* Timber extraction from natural forests *30%* Traders *25 KK* Civil servants *10 people* Employment in AA *3 people*	Village Head BPD Adat Mesjid Other NGO	Melayu (80%) Java (10%) Bugis, Sumbar, Sambas (10%)

A Basic Needs from Natural Forests in Sungai Rawa Village, as of 7 February 2005

Basic Needs		Origins					
		NATURAL FORESTS			Farmland	Buy	Aid
		Within FMU	Adjacent to FMU	Elsewhere			
(1)		(2)	(3)	(4)	(5)	(6)	(7)
Carbohydrates	Rice (*beras*)	-	-	-	-	100%	-
	Corn (*jagung*)	-	-	-	-	-	-
	Sago (*sagu*)	-	-	-	-	-	-
	Cassava (*singkong*)	-	-	-	-	-	-
	Sweet potato (*ubi jalar*)	-	-	-	-	-	-
Protein	Fish (*ikan*)	[2]	-	15% / a /	-	70%	-
	Meat (*daging*)	[0]	-	-	-	95%	-
Vitamins & Minerals	Vegetables (*sayur mayur*)	[0]	-	-	-	95%	-
	Fruits (*buah²an*)	[0]	-	-	-	95%	-
Water /b/	Wells (*sumur*)	-	-	-	100%	-	-
	Rain (*hujan*)	-	-	-	-	-	-
	Rivers (*sungai*)	[3]	-	-	-	-	-

	Canals (*kanal*)	-	-	-	-	-	-
Medicinal Plants	*Obat-obatan*	[2]	-	-	-	50%	-
Animal Feed	Leaves, grass (*dedaunan, rerumputan*)	-	-	-	100%	-	-
Materials	Timber (*kayu*)	[2]	-	-	-	>60%	-
	Rattan (*rotan*)	[0]	-	-	-	-	-
	Others (*lainnya*)	-	-	-	-	-	-
Fuel	Fuelwood (*kayu bakar*)	[0]	-	-	>90%	-	-
	Kerosene (*minyak tanah*)	-	-	-	-	50%	-
Cash Income	Timber (*kayu*)	[2]	-	-	-	-	-
	Rattan (*rotan*)	-	-	-	-	-	-
	Bamboo (*bambu*)	-	-	-	-	-	-
	Honey (*madu*)	-	-	-	-	-	-
	Resin (*getah*)	-	-	-	-	-	-
	Sago (*sagu*)	-	-	-	>90%		-

Notes:
/a/ Percentage of fishermen going to ocean for fishing
/b/ During rainy season they use wells in their own houses, meanwhile in dry season they go to river Mengkapan for fulfulling their water needs.

B HCV 5 Status of Basic Needs from Natural Forests in Sungai Rawa Village, as of 7 February 2005

Basic Needs (1)		**FMU score** (2)	**Production Parametres**			**HCV Status**
			Harvest sustainability (8)	**Readily available alternatives** (9)	**Trend for the last five years** (10)	**[+/-]** (11)
Carbohydrates	Rice	-	-	r1	stable	**[-]**
	Corn	-	-	r1	stable	**[-]**
	Sago	-	-	r1	stable	**[-]**
	Cassava	-	-	r1	stable	**[-]**
	Sweet potato	-	-	r1	stable	**[-]**
Protein	Fish	[2]	s1	r1	decr	**[+?]**
	Meat	[0]	s0	r1	decr	**[-]**
Vitamins & Minerals	Vegetables	[0]	s1	r1	stable	**[-]**
	Fruits	[0]	s1	r1	stable	**[-]**
Water	Wells	-	-	-	-	-
	Rain /a/	-	-	-	-	-
	Rivers	[3]	s1	r0	decr	**[+]**
	Canals	-	-	-	-	-
Medicinal Plants	Obat-obatan	[2]	s1	r1	decr	**[+]**

Animal Feed	Leaves, grass	[0]	s1	r1	decr	**[-]**
Materials	Timber	[2]	s0	r1	decr	**[-]**
	Rattan	-	-	-	-	-
	Others	-	-	-	-	-
Fuel	Fuel wood	[2]	s1	r1	stable	**[-]**
	Kerosene	-	-	-	-	-
Cash Income	Timber	[2]	s0	r1	decr	**[-]**
	Rattan	-	-	-	-	-
	Bamboo	-	-	-	-	-
	Honey	-	-	-	-	-
	Damar / Resin	-	-	-	-	-
	Sago	-	-	-	-	-

Overview of Kumpai Village, Kecamatan Bunga Raya, Kabupaten Siak

Local Community	**Population** Male & Female **Households** (KK)	**Proximity of Community to FMU Natural Forest**	**Village-FMU Area Connection**	**Proximity to Neighbor villages**	**Community Livelihoods** (KK numbers or %)	**Social Institutions**	**Social Sub-groups**
Sub-village (Dusun), Mengkapan village **Kumpai** Coconut farming community of Bugis origin	KK 7	3 km from village settlement to FMU natural forest	Downstream of scrub and bush bordering the FMU	(i) south east along coastal strait of Selat Panjang to Sungai Rawa village (ii) north west along coastal strait of Selat Panjang to Mengkapan main village settlement	Housegarden subsistence crops >95% Coconut plantation *100%* Off-farm income-earning 60%	Informal leader	Bugis (100%)

A Basic Needs from Natural Forests in Kumpai (Bugis coconut farmer community), Mengkapan, as of 10 February 2005

Basic Needs		Origins					
		NATURAL FORESTS			Farmland	Buy	Aid
		Within FMU	Adjacent to FMU	Elsewhere			
(1)		(2)	(3)	(4)	(5)	(6)	(7)
Carbohydrates	Rice (*beras*)	-					
	Corn (*jagung*)	-					
	Sago (*sagu*)	[0]					
	Cassava (*singkong*)	-					
	Sweet potato (*ubi jalar*)	-					
Protein	Fish (*ikan*)	[0]					
	Meat (*daging*)	[0]					
Vitamins & Minerals	Vegetables (*sayur mayur*)	[0]					
	Fruits (*buah²an*)	[0]					
Water	Wells (*sumur*)	-					
	Rain (*hujan*) /2/	-					
	Rivers (*sungai*)	[0]					

	Canals (*kanal*)	-					
Medicinal Plants	*Obat-obatan*	-					
Animal Feed	Leaves, grass (*dedaunan, rerumputan*)	-					
Materials	Timber (*kayu*)	-	[4]				
	Rattan (*rotan*)	-	[1]				
	Others (*lainnya*)	-	-				
Fuel	Fuelwood (*kayu bakar*)	[0]					
	Kerosene (*minyak tanah*)	-					
Cash Income	Timber (*kayu*)	-	[0]				
	Rattan (*rotan*)	-	[0]				
	Bamboo (*bambu*)	-					
	Honey (*madu*)	-					
	Resin (*getah*)	-					
	Coconuts (*kelapa*)	-					

B HCV 5 Status of Basic Needs from Natural Forests in Kumpai (Bugis coconut farmer community), Mengkapan, as of 10 February 2005

Basic Needs (1)		FMU score (2)	Production Parametres			HCV Status
			Harvest sustainability (8)	Readily available alternatives (9)	Trend for the last five years (10)	[+/-] (11)
Carbohydrates	Rice					
	Corn					
	Sago	[0]	s1	r1	stable	**[-]**
	Cassava					
	Sweet potato					
Protein	Fish	[0]			decr	**[-]**
	Meat	[0]			decr	**[-]**
Vitamins & Minerals	Vegetables	[0]			decr	**[-]**
	Fruits	[0]			decr	**[-]**
Water	Wells					
	Rain /a/					
	Rivers	[0]			decr	**[-]**
	Canals					
Medicinal Plants	Obat-obatan					

Animal Feed	Leaves, grass					
Materials	Timber					
	Rattan					
	Others					
Fuel	Fuel wood	[0]	s1	r1	stable	**[-]**
	Kerosene					
Cash Income	Timber					
	Rattan					
	Bamboo					
	Honey					
	Damar / Resin					
	Coconuts					

Overview of Mengkapan Village, Kecamatan Bunga Raya, Kabupaten Siak

Local Community	**Population** Male & Female **Households** (KK)	**Proximity of Village to FMU Naural Forest**	**Village-FMU Area Connection**	**Proximity to Neighbor Villages**	**Village Livelihoods** (KK numbers or %)	**Social Institutions**	**Social Sub-groups**
Village (Desa) **Mengkapan**	Male = 901 Female = 915 KK = 428	Adjacent area 3 km from village settlement to FMU natural forest	Common border	(i) south east along coastal strait of Selat Panjang to Sungai Rawa village (ii) north west along coastal strait of Selat Panjang to Bunga Raya village	Housegarden subsistence crops >95% Fishing in rivers *20 KK* Fishing in sea *30 KK* Timber extraction from natural forests *50%* Traders *20 KK* Civil servants *3 KK* Employment in AA *0%*	Village Head BPD Adat Mesjid: Other NGO:	Melayu (85%) Java, Banjar, Bugis' North Sumatran (15%)

A Basic Needs from Natural Forests in Mengkapan Village, as of 8 February 2005

Basic Needs		Origins					
		NATURAL FORESTS			Farmland	Buy	Aid
		Within FMU & % of Households	Adjacent to FMU	Elsewhere			
(1)		(2)	(3)	(4)	(5)	(6)	(7)
Carbohydrates	Rice (*beras*)	-	-	-	-	100%	-
	Corn (*jagung*)	-	-	-	-	-	-
	Sago (*sagu*)	-	-	-	<10%	-	-
	Cassava (*singkong*)	-	-	-	-	-	-
	Sweet potato (*ubi jalar*)	-					
Protein	Fish (*ikan*)	[2]	-	<25%	-	>50%	-
	Meat (*daging*)	[0]	-	-	-	>90%	-
Vitamins & Minerals	Vegetables (*sayur mayur*)	[0]	-	-	-	>90%	-
	Fruits (*buah²an*)	[0]	-	-	-	>90%	-
Water	Wells (*sumur*)	-	-	-	-	-	-
	Rain (*hujan*) /2/	-	-	-	-	-	-
	Rivers (*sungai*)	[2]	<10%	-	-	-	-

	Canals (*kanal*)	-	-	-	-	-	-
Medicinal Plants	*Obat-obatan*	[2]	-	-	-	-	-
Animal Feed	Leaves, grass (*dedaunan, rerumputan*)	-	-	-	100%	-	-
Materials	Timber (*kayu*)	[2]	-	-	-	-	-
	Rattan (*rotan*)	-	-	-	-	-	-
	Others (*lainnya*)	-	-	-	-	-	-
Fuel	Fuelwood (*kayu bakar*)	-	50%	-	50%	-	-
	Kerosene (*minyak tanah*)	-	-	-	-	50%	-
Cash Income	Timber (*kayu*)	[3]			-	-	-
	Rattan (*rotan*)	-	-	-	-	-	-
	Bamboo (*bambu*)	-	-	50%	-	-	-
	Honey (*madu*)	-	-	-	-	-	-
	Resin (*getah*)	-	-	-	-	-	-
	Sago (*sagu*)	-	-	10%	-	-	-

B HCV 5 Status of Basic Needs from Natural Forests in Mengkapan Village, as of 8 February 2005

Basic Needs (1)		FMU score (2)	Production Parametres			HCV Status
			Harvest sustainability (8)	Readily available alternatives (9)	Trend for the last five years (10)	[+/-] (11)
Carbohydrates	Rice	-	-	r1	Stable	**[-]**
	Corn	-	-	r1	stable	**[-]**
	Sago	-	-	r1	stable	**[-]**
	Cassava	-	-	r1	stable	**[-]**
	Sweet potato	-	-	r1	stable	**[-]**
Protein	Fish	[2]	s1	r1	decr	**[+]**
	Meat	[0]		r1	decr	**[-]**
Vitamins & Minerals	Vegetables	[0]	-	r1	decr	**[-]**
	Fruits	[0]	-	r1	decr	**[-]**
Water	Wells	-	-	-	-	-
	Rain	-	-	-	-	-
	Rivers /b/	[2]	s1	r0	decr	**[+]**
	Canals	-	-	-	-	-
Medicinal Plants	Obat-obatan	[2]	s1	r1	decr	**[+]**

Animal Feed	Leaves, grass	[0]	s1	r1	stable	**[-]**
Materials	Timber	[2]	s0	r0	decr	**[-]**
	Rattan	[0]	s0	r1	decr	**[-]**
	Others	-	-	-	-	-
Fuel	Fuel wood	[0]	s1	r1	stable	**[-]**
	Kerosene	-	-	r1	stable	
Cash Income	Timber	[3]	s0	r0	decr	**[-]**
	Rattan	[0]	-	-	decr	**[-]**
	Bamboo	[0]	-	-	stable	**[-]**
	Honey	[0]	-	-	stable	**[-]**
	Damar/Resin	[0]	-	-	decr	**[-]**
	Coconuts	-	-	-	stable	**[-]**

Overview of Pebadaran Village, Kecamatan Sungai Apit, Kabupaten Siak

Local Community	**Population** Male & female **Households** (KK)	**Distance of village to FMU Forest**	**Village-FMU Area Connection**	**Proximity to Neighbor villages**	**Village Livelihoods** (KK numbers or %)	**Social Institutions**	**Social Sub-groups**
Village (Desa) **Pebadaran**	pop More than 300 people KK = 80	Adjacent area 4 km from village settlement to FMU natural forest	Common border	(i) upriver south to Dosan village (ii) downriver north to Sungai Apit village	Housegarden subsistence crops >95% Fishing in rivers *60%* Rubber garden *80%* Coffee plantation *10%* Timber extraction from natural forests <5% Traders 5% Employment in AA 0 (?)	Village Head BPD Adat Mesjid: Other NGO:	Melayu (90%) Java and others (10%)

A Basic Needs from Natural Forests in Pebadaran Village, as of 10 February 2005

Basic Needs		Origins					
		NATURAL FORESTS			Farmland	Buy	Aid
		Within FMU	Adjacent to FMU	Elsewhere			
(1)		(2)	(3)	(4)	(5)	(6)	(7)
Carbohydrates	Rice (*beras*)	-					
	Corn (*jagung*)	-					
	Sago (*sagu*)	-			[0]		
	Cassava (*singkong*)	-					
	Sweet potato (*ubi jalar*)	-					
Protein/a/	Fish (*ikan*)	[0]	15%	60% from Siak		25%	
	Meat (*daging*)	[0]	10%			90%	
Vitamins & Minerals	Vegetables (*sayur mayur*)	-		5%	10%	85%	
	Fruits (*buah²an*)	-	10%		40%	50%	
Water	Wells (*sumur*)	-					
	Rain (*hujan*)	-					
	Rivers (*sungai*)	-					

	Canals (*kanal*)	-					
Medicinal Plants	*Obat-obatan*	-		10%	15%	75%	
Animal Feed	Leaves, grass (*dedaunan, rerumputan*)	-					
Materials	Timber (*kayu*)	[0]		[2]		[1]	
	Rattan (*rotan*)						
	Others (*lainnya*)						
Fuel	Fuelwood (*kayu bakar*)	-		[3]			
	Kerosene (*minyak tanah*)						
Cash Income	Timber (*kayu*)	[1]		[2]			
	Rattan (*rotan*)	-					
	Bamboo (*bambu*)	[0]					
	Honey (*madu*)	-		[0]			
	Resin (*getah*)	-					
	Coconuts (*kelapa*)	-					

B HCV 5 Status of Basic Needs from Natural Forests in Pebadaran Village, as of 10 February 2005

Basic Needs (1)		FMU score (2)	Production Parametres			HCV Status
			Harvest sustainability (8)	Readily available alternatives (9)	Trend for the last five years (10)	[+/-] (11)
Carbohydrates	Rice					
	Corn					
	Sago					
	Cassava					
	Sweet potato					
Protein	Fish	[0]	s1	r1	decr	**[-]**
	Meat	[0]	s1	r1	decr	**[-]**
Vitamins & Minerals	Vegetables					
	Fruits					
Water	Wells					
	Rain /a/					
	Rivers					
	Canals					
Medicinal Plants	Obat-obatan					

Animal Feed	Leaves, grass					
Materials	Timber	[0]	s0	r1	decr	**[-]**
	Rattan					
	Others					
Fuel	Fuel wood					
	Kerosene					
Cash Income	Timber	[1]	s0	r1	decr	**[-]**
	Rattan					
	Bamboo	[0]	s1	r1	stable	**[-]**
	Honey					
	Damar / Resin					
	Coconuts					

Overview of Dosan Village, Kecamatan Bunga Raya, Kabupaten Siak

Local Community	**Population** Male & Female ---------- **Households** (KK)	**Distance of village to FMU Natural Forest**	**Village-FMU Area connection**	**Proximity to Neighbor Villages**	**Village Livelihoods** (KK numbers or %)	**Significant Social Institutions**	**Social Sub-groups**
Village (Desa) **Dosan**	population Male = 222 Female = 394 KK 225	Adjacent area 5 km from village settlement to FMU natural forest	Common boundary	(i) Pebadaran village downriver on Siak river to north. (ii) Sungai Limau village upriver on Siak river to south.	Housegarden subsistence crops >95% Fishing in rivers *40 KK* Timber extraction from natural forests *15 KK* Rubber gardens *80%* Employment at PTP V *25%* Employment in AA *1 KK*	Village Head BPD Adat Mesjid Other NGO	Melayu (75%) Java, Bengkinang (25%)

A Basic Needs from Natural Forests in Dosan Village, as of 10 February 2005

Basic Needs		Origins					
		NATURAL FORESTS			Farmland	Buy	Aid
		Within FMU	Adjacent to FMU	Elsewhere			
(1)		(2)	(3)	(4)	(5)	(6)	(7)
Carbohydrates	Rice (*beras*)	-				100%	
	Corn (*jagung*)	-					
	Sago (*sagu*)	-					
	Cassava (*singkong*)	-					
	Sweet potato (*ubi jalar*)	-					
Protein	Fish (*ikan*)	[0]	5%	10%		85%	
	Meat (*daging*)			10%		90%	
Vitamins & Minerals	Vegetables (*sayur mayur*)	-			5%	95%	
	Fruits (*buah²an*)						
Water	Wells (*sumur*)						
	Rain (*hujan*)						
	Rivers (*sungai*)	[0]					

	Canals (*kanal*)						
Medicinal Plants	*Obat-obatan*					100%	
Animal Feed	Leaves, grass (*dedaunan, rerumputan*)						
Materials	Timber (*kayu*)	[0]					
	Rattan (*rotan*)	[0]					
	Others (*lainnya*)						
Fuel	Fuelwood (*kayu bakar*)			5%	95%		
	Kerosene (*minyak tanah*)						
Cash Income	Timber (*kayu*)	[0]					
	Rattan (*rotan*)						
	Bamboo (*bambu*)						
	Honey (*madu*)						
	Resin (*getah*)						
	Coconuts (*kelapa*)						

B HCV 5 Status of Basic Needs from Natural Forests in Dosan Village, as of 10 February 2005

Basic Needs (1)		**FMU score** (2)	**Production Parametres**			**HCV Status**
			Harvest sustainability (8)	**Readily available alternatives** (9)	**Trend for the last five years** (10)	**[+/-]** (11)
Carbohydrates	Rice					
	Corn					
	Sago					
	Cassava					
	Sweet potato					
Protein	Fish	[0]			decr	**[-]**
	Meat					
Vitamins & Minerals	Vegetables					
	Fruits					
Water	Wells					
	Rain					
	Rivers	[0]			decr	**[-]**
	Canals					
Medicinal Plants	Obat-obatan					

Animal Feed	Leaves, grass					
Materials	Timber	[0]	s0	r1	decr	**[-]**
	Rattan	[0]	s1	r1	stable	**[-]**
	Others					
Fuel	Fuel wood					
	Kerosene					
Cash Income	Timber	[0]	s0	r1	decr	**[-]**
	Rattan					
	Bamboo					
	Honey					
	Damar / Resin					
	Coconuts					

Notes that apply to previous tables:

(1) ** or * = ranking of different sources of types of basic need.

(2) **Ranking of Sources of Basic Needs**

4 = CRITICAL. 90 or more to 100% of a given need is fulfilled by one source, indicating HCV status
3 = GREAT IMPORTANCE. 50% or more to almost 90%, indicating HCV status
2 = IMPORTANT. 25% or more to almost 50% (important), indicating HCV status
1 = SMALL SIGNIFICANCE. 10% or more to almost 25%, therefore not HCV
0 = INSIGNIFICANT. Less than 10%, therefore not HCV
- = not relevant, e.g., rice inside forested areas.
[ ] = Score inside square brackets refers to natural forest sources
Blank = Not assessed

(2) **%** =`score and percentage of households obtaining basic need from the natural forest within FMU

(2) & (3) = includes rivers and canals that flow through farmland.

(4) **Elsewhere** = Forests in village areas on the south side of river Kampar or on Serapung island

(5) **Farmland** = One or more of agroforestry (*kebun)*, housegardens (*pekarangan*), dryland (*ladang*), irrigated rice (*sawah*); includes rivers and canals that flow through farmland.

(6) **Buy** = from shops (*warung*), weekly markets, traveling traders, etc.

(7) **Aid** = food aid from government, from company, from other charities.

(8) **Harvest Sustainability**

s1 = sustainable, HCV allowed
s0 / 1 = uncertain sustainability, HCV not allowed
s0 = unsustainable, HCV not allowed

(9) **Production trends over last 5 years**

- increasing (incr), HCV allowed
- stable, HCV allowed
- fluctuating (fluct), HCV allowed
- decreasing (decr), HCV not allowed unless directly correlated with natural forest loss.

(10) **Readily Available Alternatives**:

r1 = there are readily available alternatives to the basic need obtained from within the FMU natural forest area, therefore no HCV
r0 / 1 = uncertainty over whether or not alternatives are readily available, therefore HCV allowed
r0 = no readily available alternatives, therefore HCV allowed.