



INTEGRATED MANAGEMENT PLAN

FOR NORTH SELANGOR PEAT SWAMP FOREST 2014-2023



VOLUME 2

A: COOPERATIVE FIRE MANAGEMENT PLAN

B: REHABILITATION PLAN

C: BUFFER ZONE PLAN



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Integrated Management Plan for North Selangor Peat Swamp Forest 2014-2023 (Vol. 2)

Prepared by:

Selangor State Forestry Department with technical support from Global Environment Centre (GEC).

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SUPPORTED BY:



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FOREWORD

First and foremost, it is a great honor to write the foreword to the Volume 2 of Integrated Management Plan for North Selangor Peat Swamp Forest 2014-2023 (IMP-NSPSF 2014-2023 Vol. 2)

North Selangor Peat Swamp Forest (NSPSF), covering an area of 81,304 hectares is the second largest contiguous peat swamp forest in Peninsular Malaysia. Over the years, NSPSF had faced with many challenges including recurring fires and forest degradation, both from inside and outside the forest reserves.

While Vol. 1 of the IMP-NSPSF 2014-2023 provides a framework for the management of the NSPSF, Vol. 2 includes three key supporting documents which form the backbone of Integrated Management Plan – The Cooperative Fire Management Plan for NSPSF, The Rehabilitation Plan for NSPSF and The Buffer Zone Plan for NSPSF.

These three plans tackle specific issues and represent the outcome of a broad stakeholder engagement process. The Cooperative Fire Management Plan provides guidance for multiple stakeholders to work together to prevent, prepare for, respond to and recover after fires. The Rehabilitation Plan focusses on facilitating natural regeneration of forests by restoring the hydrology and ecology. The Buffer Zone Plan covers an area of 15,000ha in a strip 1km wide around the forest reserves. It is my hope that the relevant agencies would find the respective plans informative and useful.

In preparing the Vol. 2 of IMP-NSPSF 2014-2023, many agencies and stakeholders were involved and provided their valuable inputs. I would like to give my sincere thanks and gratitude to all who had contributed to the process. I especially would like to thank the Selangor State government and many agencies in particular the three Land and District Offices (for Kuala Selangor, Sabak Bernam and Hulu Selangor Districts) as well as local community representatives. The Global Environment Centre and the Forestry Department Peninsular Malaysia helped to facilitate the preparation of the plan with support through the ASEAN Peatlands Forests Project (APFP) and SEApeat project (with funding from IFAD/GEF and the European Union respectively). We hope that the IMP-NSPSF 2014-2023 will act both as a guideline for the management of NSPSF over the next 10 years and also as a model for others in the country and region to follow.

DR. MOHD PUAT BIN DAHALAN

DIRECTOR, SELANGOR STATE FORESTRY DEPARTMENT



INTEGRATED MANAGEMENT PLAN

FOR NORTH SELANGOR PEAT SWAMP FOREST 2014-2023



VOLUME 2

A: COOPERATIVE FIRE MANAGEMENT PLAN

CREDITS AND ACKNOWLEDGEMENT

This Cooperative Fire Management Plan (CFMP) for the North Selangor Peat Swamp Forest (NSPSF) was prepared by Global Environment Centre (GEC) with the intention that this plan forms a component input to the Integrated Management Plan (2014-2023). This CFMP was done through participatory process with a series of consultation workshops with multi-agencies and multi-stakeholders.

The CFMP preparation was guided by the Selangor State Forestry Department and Forestry Department of Peninsular Malaysia with specific inputs from a number of agencies working under the APFP Smart Partnership Programme including Department of Agriculture, Department of Irrigation and Drainage, Malaysian Meteorology Department, Forest Research Institute of Malaysia, University Putra Malaysia, Malaysian Nature Society, Sahabat Hutan Gambut Selangor Utara and Global Environment Centre.

Five stakeholder consultations were organized at state and district level between November 2013 and June 2014 to enable inputs to be provided by a broad range of state and local stakeholders. Stakeholder participating in the meetings included Respective District Offices and District Township Councils (Kuala Selangor, Hulu Selangor and Sabak Bernam), Department of Wildlife and National Park, Malaysia, Economic Planning Unit, Federal Department of Town and Country Planning Peninsular Malaysia, Fire and Rescue Department, Minerals and Geoscience Department, Malaysian Palm Oil Board, Public Work Department, Department of Environment, Department of Veterinary and Services, Selangor Agriculture Development Corporation, FELDA, LUAS, IADA, Kumpulan Darul Ehsan Bhd, Kumpulan Semesta Sdn Bhd., Sime Darby Plantation and Peers Consult (M) Sdn Bhd.

We wish to extend our appreciation to the members of Smart Partnership programme, staffs of Selangor State Forestry Department and state government agencies and other stakeholders who had provided their valuable inputs and advice to the development of the CFMP. In addition we thank the National Coordinator of APFP facilitated the various related studies and activities.

A special acknowledgement to the financial assistance given by the Global Environment Facility through the International Fund for Agriculture Development (IFAD). Co-financing was provided by the Selangor State government and the SEApeat project funded by the European Union. Special thanks are made to the ASEAN Secretariat for facilitating the APFP.

EXECUTIVE SUMMARY

Forming the backbone of Integrated Management Plan for North Selangor Peat Swamp Forest (NSPSF), three supported documents were developed at the request of the Forestry Department of Peninsular Malaysia and Selangor State Forestry Department. The three documents are Cooperative Fire Management Plan for NSPSF, Rehabilitation Plan for NSPSF and Buffer Zone Management Plan for NSPSF.

This is the summary for Cooperative Fire Management Plan for NSPSF.

The Cooperative Fire Management Plan (CFMP) was prepared through extensive consultation with various stakeholders across the site as well as through field surveys and past experiences. It is divided into three components, the first being the development of fire management strategies. Secondly, a resource planning budget is developed at a high level to provide guidance toward the costs of implementing the plan across the site. Thirdly an implementation plan has been prepared for both the prevention and suppression components. The implementation plans are in the form of a single A3 page with attached map and it is expected that they will be updated on an annual basis to reflect changes and features that are to be implemented across the coming 12 month period.

CFMP is structured around the emergency management cycle which is used to plan for and respond to natural and human disasters both at small local scales and large national scales. The four key components for the emergency cycle are prevention, preparedness, response and recovery. The CFMP essentially provides a list of strategies and action that must be carried out and implement at different times of the year, and a list of equipment and tools required for preparedness and suppression.

In short, the CFMP provides details and recommendations for six fire prevention strategies, five fire preparedness strategies, six fire response strategies, four post-fire recovery strategies and a proposed five years budget.

Fire prevention strategies focused on preventing fire from igniting in the first place or reducing the fire risk. For example raising water level through canal blocks and construction of clay dyke; restricting access to forest, working closely with surrounding landholders, conducting effective public information, awareness campaigns and enhancing integrated enforcement.

For preparedness, strategies focused on preparation of the implementation plan, enhancing communication system for fire risk and danger rating tool and community based fire management, utilising aerial fire detection and ensuring availability of sufficient fire fighters with appropriate capabilities.

Once fires start, response strategies should kick in to minimize the area affected by fire; strengthen fire-fighting teams and coordination, regular mopping up and patrolling to prevent re-ignition and formalise a cooperative fire management committee in each district.

Finally the post-fire strategies deal with assessment and documentation of lessons learned, maintenance and repair of fire equipment and infrastructure as well as rehabilitation of the damages caused by fire.

In addition to that, a five year budget plan is included with description of resources, equipment and financial budget required to implement the activities stated in the various strategies.

A Fire Risk Map is also included for NSPSF to identify areas with low, medium and high fire risks. This map will served as indicator for prioritized activities and works needed to prevent fire in NSPSF.

Preparation of the cooperative fire management plan provides a consistent framework to define the principles and strategies to meet the primary objectives for the site while the implementation plans will define activities to better manage prevention, preparedness and response actions to be taken by agencies, communities and private sector participants.

With this contextual appreciation in mind the overriding objective within the actions and activities of this plan is to prevent any fire from igniting within the site, and if it should ignite, to respond rapidly to minimise the overall area burnt and costs of fire suppression.

RINGKASAN EKSEKUTIF

Tiga dokumen sokongan telah dibangunkan atas permintaan Jabatan Perhutanan Semenanjung Malaysia dan Jabatan Perhutanan Negeri Selangor untuk membentuk tulang belakang kepada Pelan Pengurusan Bersepadu (IMP) untuk Hutan Paya Gambut Utara Selangor (HPGSU). Tiga dokumen ini adalah Pelan Pengurusan Kebakaran Secara Bekerjasama bagi HPGSU, Pelan Pemulihan bagi HPGSU dan Pelan Pengurusan Zon Penampungan bagi HPGSU.

Dokumen ini meringkaskan Pelan Pengurusan Kebakaran Secara Berkerjasama (PPKSB).

PPKSB telah disediakan melalui rundingan meluas dengan pelbagai pihak berkepentingan, tinjauan lapangan serta pengalaman lalu. Ia dibahagikan kepada tiga komponen; termasuk penjelasan tentang strategi pengurusan kebakaran, bajet perancangan sumber di peringkat tinggi serta pelan pelaksanaan. Pelan pelaksanaan terdiri daripada satu halaman A3 dan lampiran peta. Ia dijangka akan dikemas kini setiap tahun untuk mencerminkan kemajuan dan perancangan.

PPKSB distrukturkan berdasarkan kitaran pengurusan kecemasan yang digunakan untuk merancang dan bertindak balas terhadap bencana alam dan manusia, baik pada skala yang kecil di tempatan dan skala besar di nasional. Empat komponen utama untuk kitaran kecemasan adalah pencegahan, persediaan, tindak balas dan pemulihan. PPKSB pada dasarnya menyediakan senarai strategi dan tindakan yang perlu dilakukan dan dilaksanakan pada masa yang berlainan di sepanjang tahun, serta senarai peralatan dan kelengkapan yang diperlukan untuk persediaan dan pemadaman.

Pendek kata, PPKSB menyediakan maklumat dan cadangan untuk enam strategi pencegahan kebakaran, lima strategi persediaan kebakaran, enam strategi tindak balas kebakaran, empat strategi pemulihan selepas kebakaran serta cadangan bajet lima tahun.

Strategi pencegahan kebakaran bertujuan mengelakkan kejadian kebakaran mengurangkan risiko kebakaran. Contohnya termasuk menaikkan paras air melalui sekatan parit dan pembinaan benteng tanah liat, menghadkan kemasukan ke hutan, bekerja rapat dengan pemilik tanah yang berdekatan, menjalankan kempen kesedaran dan maklumat awam yang berkesan, dan meningkatkan penguatkuasaan bersepadu.

Strategi penyediaan kebakaran memberi tumpuan kepada penyediaan pelan pelaksanaan, Penambahbaikan sistem komunikasi untuk risiko dan peralatan penilaian bahaya kebakaran, pengurusan kebakaran berasaskan komuniti, menggunakan pengesanan kebakaran udara, memastikan ketersediaan pasukan pemadam kebakaran yang mencukupi dan berkeupayaan.

Setelah kebakaran bermula, strategi tindak balas harus digunakan untuk mengurangkan kawasan yang terjejas oleh kebakaran; ini termasuk mengukuhkan penyelarasan serta pasukan memadam kebakaran, rondaan berterusan dan pemadaman untuk mengelak api dari hidup semula, mewujudkan jawatankuasa Pengurusan Kebakaran Secara Bersama di setiap daerah.

Akhir sekali, strategi pasca kebakaran berurusan dengan penilaian dan siasatan selepas kebakaran serta mendokumentasikan pengajaran yang diperolehi, penyelenggaraan peralatan dan baik pulih infrastruktur yang rosak; dan kawalan kerosakan dan pemulihan kawasan yang terjejas oleh kebakaran.

Selain daripada strategi pengurusan, bajet lima tahun turut disertakan dengan penerangan berkenaan sumber, peralatan, dan modal yang diperlukan untuk melaksanakan aktiviti-aktiviti yang dinyatakan di dalam pelbagai strategi.

Satu Peta Risiko Kebakaran bagi HPGSU juga disertakan untuk mengenalpasti kawasan yang mempunyai risiko kebakaran yang tinggi, rendah dan sederhana. Peta ini akan digunakan sebagai petunjuk bagi aktiviti yang akan diutamakan bagi mengelakkan kebakaran di HPGSU.

Penyediaan PPKSB memberikan rangka kerja yang konsisten untuk mentakrifkan prinsip dan strategi untuk mencapai objektif utama bagi kawasan itu manakala pelan pelaksanaan menentukan aktiviti untuk pengurusan pencegahan, persediaan dan tindakan balas yang akan diambil oleh agensi-agensi, masyarakat dan peserta sektor swasta.

Dengan penghayatan kontek ini, objektif utama dalam tindakan dan aktiviti pelan ini adalah untuk mengelakkan kebakaran daripada bermula, bertindak- balas dengan pantas jika terjadi kebakaran untuk mengurangkan kawasan yang terjejas serta merendahkan kos operasi pemadaman.

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LIST OF ABBREVIATIONS

AATHP	ASEAN Agreement on Trans-boundary Haze Pollution
ASEAN	Association of South East Asian Nations
ASEC	ASEAN Secretariat
ASMC	ASEAN Specialised Meteorological Centre
Bomba	Malaysian Fire and Rescue Department
CFMP	Cooperative Fire Management Plan
FDRS	Fire Danger Rating System
GEC	Global Environment Centre
GIS	Geographic Information System
GPS	Global Positioning System
ICS	Incident Command Systems
MMD	Malaysian Meteorological Department
MPOB	Malaysian Palm Oil Board
MTES	Selangor Economic Action Council
NAP	National Action Plan
NSPSF	North Selangor Peat Swamp Forest (the conservation reserve site)
SFD	Selangor State Forestry Department

Cooperative Fire Management Plan for North Selangor Peat Swamp Forest

A. COOPERATIVE FIRE MANAGEMENT PLAN FOR NSPSF

1.0 Introduction

1.1 Context

This Cooperative Fire Management Plan (CFMP) for the North Selangor Peat Swamp Forest (NSPSF) has been prepared by the Global Environment Centre (GEC) in consultation with key stakeholders across the site, with the intention that this plan forms a component input to the Integrated Management Plan (2014-2023) that is being prepared for the site, funded by ASEAN Peatland Forest Project, Malaysia.

The plan is divided into three components, the first being the development of fire management strategies. Secondly, a resource planning budget is developed at a high level to provide guidance toward the costs of implementing the plan across the site. Thirdly an implementation plan has been prepared for both the prevention and suppression components. The implementation plans are in the form of a single A3 page with attached map and it is expected that they will be updated on an annual basis to reflect changes and features that are to be implemented across the coming 12 month period.

Preparation of the cooperative fire management plan provides a consistent framework to define the principles and strategies to meet the primary objectives for the site while the implementation plans will define activities to better manage prevention, preparedness and response actions to be taken by agencies, communities and private sector participants.

1.2 Stakeholders

This plan has been drafted following consultation with stakeholders including:

- a) Selangor State Forestry Department (SFD)
- b) Selangor State Fire and Rescue Department (Bomba)
- c) Selangor State Environment Department
- d) Kuala Selangor and Sabak Bernam District and Land Office
- e) Community representatives from the Friends of NSPSF
- f) Raja Musa Division of Sime Darby Plantation district
- g) Malaysian Palm Oil Board (MPOB)

The plan will undergo review by a stakeholder group and will be discussed at community forums to gain community input and concurrence.

1.3 Cooperative Fire Management

The concept of Cooperative Fire Management is being introduced through this plan as a core component of its design and later implementation. Cooperative Fire Management is the technique where multiple agencies, private and community teams can join together during fire prevention and suppression efforts to support each other. Cooperative fire management engages with stakeholders and will increase the effectiveness of fire prevention and suppression efforts. Indeed, many of the actions outlined in this plan are reliant on cooperative relationships and efforts.

Cooperative Fire Management recognises that:

- Fire cannot be managed by one single agency or landholder, and
- Fire is a shared responsibility across all land managers in the public sector and private sector, both small holder and large land holders.

To engage in Cooperative Fire Management there are two key needs to be fulfilled to achieve success, which are:

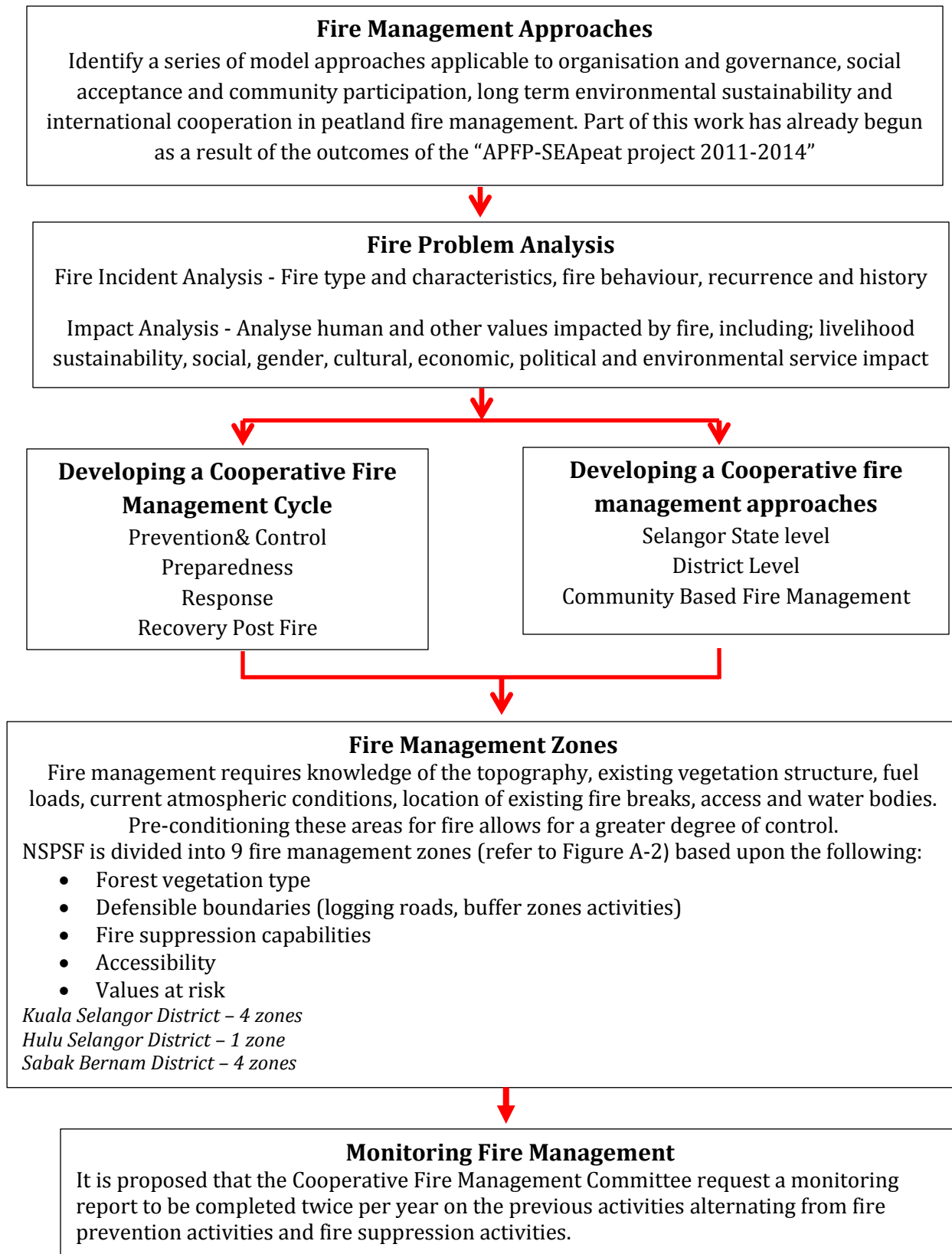
- A willingness from all participants to jointly work together on fire prevention and suppression activities in a cooperative and collaborative manner, and
- A task force or committee that can meet and oversight activities, creating a formal driving force behind the collaborative efforts.

It must be emphasised that the burden of fire management should not be placed upon the shoulders of any one agency, private owner or community group, but rather the efforts should be shared proportionally to the relative strength and capability of the individual or agency.

Cooperative Fire Management has been used informally in Malaysia in the past. This plan proposes to formalise Cooperative Fire Management at a District level with the intention to test it more fully and if proven successful to share these lessons across other Districts and Selangor State in Malaysia, creating a groundswell of success that leads the way to improved planning and management in this field of endeavour.

It is desired that this cooperative fire management plan be put before the Selangor Economic Action Council (MTES) meeting for formal recognition and endorsement of the actions and activities being undertaken at this site.

Flow chart representing a systematic approach to the preparation and development of Cooperative Fire Management Plan and Guidelines

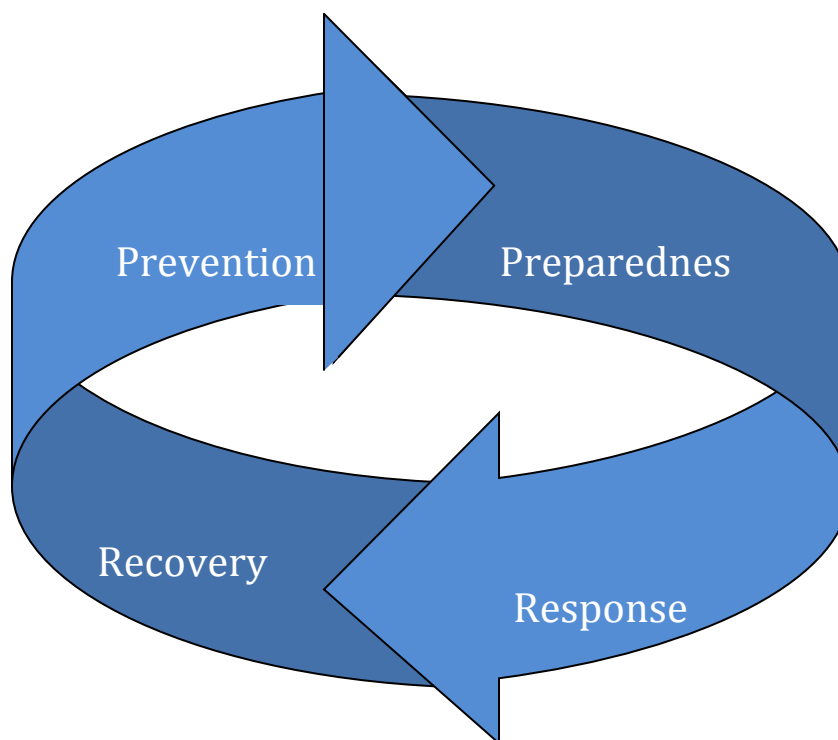


1.4 Emergency Cycle

The cooperative fire management plan will be structured around the emergency management cycle, see Figure A-1, which is used to plan for and respond to natural and human disasters, at small local scales and large national scales. Traditionally the use of the emergency management cycle has focussed agency efforts toward the response component of the cycle. However since 2005 under the auspice of the Hyogo Framework (UNISDR 07/2007, Geneva) a re-balancing of activities within the emergency management cycle has evolved and a focus of efforts is now toward prevention, preparedness and recovery aspects of disasters.

During consultations with stakeholders it became apparent that there is an existing focus of efforts toward prevention aspects in fire management which is well aligned with the current international perspectives. This plan will continue to evolve that focus of effort

Figure A-1: The Emergency Management Cycle



1.5 Peatland fire management

The NSPSF is a forest reserve and as such it requires particular consideration in respect of fire management activities. In recent years, peatland fires influenced by rapid demographic change, increased human activities and climatic variability became a major environmental problem in NSPSF. The primary objective of fire management in the context of NSPSF is the prevention of all fire within the reserve.

Fire is not part of the natural vegetation succession on peat soil. Peat soil is not tolerant to any level of fire. Peat soils when burnt produce large amounts of smoke haze and release proportionally large volumes of stored carbon.

With this contextual appreciation in mind the overriding objective within the actions and activities of this plan is to prevent any fire from igniting within the site, and if it should ignite to respond rapidly to minimise the overall area burnt and costs of fire suppression.

1.6 Plan Structure

This plan is divided into three parts as follows:

Strategies for Cooperative Fire Management Planning – Information outlining the wider site characteristics and values, principles and strategies to prevent fire occurrence

Resource Planning Budgets – Estimates of people, equipment and work effort needed to fulfil the activities outlined within this fire plan

Implementation of the Cooperative Fire Management Plan – activities and actions that will contribute toward implementing the strategies and make a difference to fire management

This approach allows consolidation of strategies for the site as a whole, budget estimates along with the actions and activities that are needed to occur on an annual basis to protect the site from unwanted fire.

1.7 The Fire Management Planning Environment in Malaysia

Planning for fire management across the wider landscape is not a common practice in Malaysia. It was the view of stakeholders that the use of cooperative fire management planning has not formally been undertaken in Malaysia and this plan would represent a first opportunity to demonstrate its use.

1.7.1 Federal Planning

Malaysia's Federal planning legislation focuses on planning for and implementing public works for Federal purposes, primarily infrastructure. It does influence water use rights and canals, unless the water and canal is wholly within one state or is under an agreement between states; however there is no connection to planning for fire management aspects.

Under the Ministry of Natural Resources and Environment (NRE) a recent report related to planning of Peat Fire Prevention and Control was released. The information offered in the report is higher level information that is less directed or relevant to NSPSF.

1.7.2 ASEAN Agreements

Malaysia is a signatory to the ASEAN Peatland Management Strategy (APMS), and the ASEAN Agreement on Transboundary Haze Pollution (AATHP).

The APMS has developed four primary objectives being:

- Enhance Awareness and Knowledge on Peatlands
- Address Transboundary Haze Pollution and Environmental Degradation
- Promote Sustainable Management of Peatlands
- Enhance and Promote Collective Regional Cooperation on Peatland Issues

The AATHP has developed three areas where countries agree to participate which include:

- cooperate in developing and implementing measures to prevent, monitor, and mitigate transboundary haze pollution by controlling sources of land and/or forest fires, development of monitoring, assessment and early warning systems, exchange of information and technology, and the provision of mutual assistance;
- respond promptly to a request for relevant information sought by a State or States that are or may be affected by such transboundary haze pollution, with a view to minimising the consequence of the transboundary haze pollution; and
- take legal, administrative and/ or other measures to implement their obligations under the Agreement.

1.7.3 State Planning

The NSPSF is under the jurisdiction of the Selangor State Forestry Department and thereby the State Government of Selangor. The majority of the land area within the NSPSF falls under the direct management of the Department of Forestry; however some small sections are unallocated state land and fall to the State Department. The surrounding water management and canal infrastructure falls to the Department of Drainage and Irrigation and much of the surrounding agricultural lands are supported by the Department of Agriculture.

Forestry and Agricultural activities fall wholly within the Government of Selangor jurisdiction.

Fire and Rescue services fall wholly within the Government of Selangor jurisdiction, unless an emergency progresses to a National scale.

The State Executive Committee (EXCO), as an arm of the Selangor State Government, has absolute powers to make decisions on all aspects of forestry, conservation and fire management within the State unless it contravenes Federal or State Laws.

The implication of the information laid out above is that NSPSF can fully plan for and manage for fire within the jurisdiction of the State Government and its attendant agencies.

1.7.4 District Planning

A corresponding District Office as the local arm of the State Government of Selangor is present at the three districts that encompass the NSPSF.

Corresponding Forestry staff and services are present at the District level, and take guidance and oversight from the State level. The same is represented for the Fire and Rescue Department, Agriculture Department and Drainage and Irrigation Department. Developing the NSPSF cooperative fire management plan is occurring under the auspice and support of the State level departments of Forestry and Fire and Rescue as the key agencies managing fire in this land area.

Creating a cooperative fire management committee requires the consent and guidance of the District Office. As part of the consultative processes the District Office for Kuala Selangor was met with and concurred with the establishment of a cooperative fire management committee. The other two district offices will similarly be approached to gain their concurrence.

The Kuala Selangor District Office has suggested that once the cooperative fire management plan is developed and a District Fire Management Committee established, the results of these efforts be presented to the Selangor State EXCO for concurrence and endorsement.

1.8 Administration and Review

This plan of management has been prepared as part of the Integrated Management Plan for the NSPSF. The future of this plan is proposed to reside under the auspice of the proposed Cooperative Fire Management Committee who would oversight its implementation and allocation of actions to various cooperative partners.

The cooperative fire management plan is proposed to be implemented from 2014 to 2023. It is suggested that a 5 year highlight review occur to examine the newly introduced concepts and confirm that their implementation is positive and working within NSPSF or if it requires some adjustment.

The operational implementation plans will be reviewed and updated annually dependent upon changes and achievements in the operational aspects completed in the year prior.

2.0 Fire Management Context

The preparation of a fire management plan for any one land area requires the development of a landscape scale and holistic understanding of the particular circumstances and the site, including:

- How and what the land is used for
- What the surrounding land uses are
- The hydrology of the area
- What is the climate and weather
- What is the fire history and past fire occurrence at the site and how and why did fires start in the past, and importantly
- What is the economic-socio-cultural uses of fire within and surrounding the site

Only when a wider appreciation of fire in the wider landscape, economic, social and cultural context is appreciated can a set of fire management strategies be developed.

The following section is aimed at providing the breadth of wider appreciation from which a series of fire management principles and strategies can be drafted within this plan.

2.1 Hydrology

Within the context of a peat swamp forest the relationship between water management and fire occurrence is the single most important linkage to understand and manage. This is widely recognised by land and fire managers across Malaysia and SE Asia more broadly. If peat soil is wet or moist a fire cannot be started or spread across the landscape or penetrate the peat soil itself. Desiccated peat soil combined with hotter weather and low rainfall increases the vulnerability of an area to fire incidence.

Within NSPSF the experience and knowledge of the water management linkage and past fire vulnerability is particularly acute. Areas where excessive past water drainage has occurred reflect a markedly higher than average fire occurrence within the site. This is best reflected in the fire risk map (Figure A-2). The high risk (red area) in the south east corner is a highly drained area that has had repeated fire occurrences over the past 20 years and will continue to be more vulnerable to future fire occurrence due to its dryer condition as compared to other parts of the forest.

Recent rehabilitation work within parts of NSPSF have resulted in water level rises across selected areas via both canal blocking and installation of a clay dyke (an impervious barrier of clay trenched through the peat to the clay layers below) to reduce draining into the sand and clay mining areas. The results have proven successful by creating direct benefits to both preventing fires as well as encouraging re-wetting and natural regeneration of forests in burnt or degraded areas.

A detailed description of the hydrological parameters within NSPSF is provided in other sections of this Integrated Management Plan, including the future plans for hydrological management in the forest reserve and buffer zone. This section of the fire management plan will not repeat that information but rather put hydrology into the context of fire management practices.

Hydrology, Drying Effects and Fire Danger

Within the dry season, several patterns of shorter term influences can combine to cause significant drying of peat, which in turn increase fire danger. Foremost is the management of water across the site. If the water management of a peatland site is not considered across the landscape scale patterns, any one location can find itself either very dry or flooded depending upon the time of year, and where it is positioned within the hydrological unit.

It is now recognised that planning for water use and flows at the hydrological unit scale or at a whole of peat dome scale is required to appreciate the water flow patterns and the impacts and influences that upstream and downstream land use and development may have on water availability and its relative height to ground surface. This has not traditionally been completed across the peatlands but more recently recognised as an important practice moving forward for all peatland areas and will have strong benefits and use toward fire management plans.

The water flow direction for NSPSF is from the middle of the forest toward the outside of the forest, suggesting a dome shape toward the centre. NSPSF is a significant water catchment area and plays an important role in flood mitigation in the wet season and freshwater supply to the surrounding landscapes in the dry season.

NSPSF was traditionally managed by the Department of Forestry for timber production. Traditional methods of timber extraction in peat swamp forests required construction of canals for access, transport and drainage. Therefore, NSPSF has an extensive network of canals due to timber extraction.

Canals drain water from the surrounding peat body and channel it away at a much greater rate. Areas on both sides of the canals tend to become drier, due to the drainage and thus become fire prone. Several areas within the NSPSF are heavily drained by either canals or the surrounding mining activities creating pockets of the forest to be dryer in the dry season and more susceptible

to fire starts. This has proven to be true as past fire incidents often occurred in these areas. A fire risk map has been prepared as part of this plan to detail areas of high, medium and low fire risk which will prioritise activities and works needed to further prevent fires.

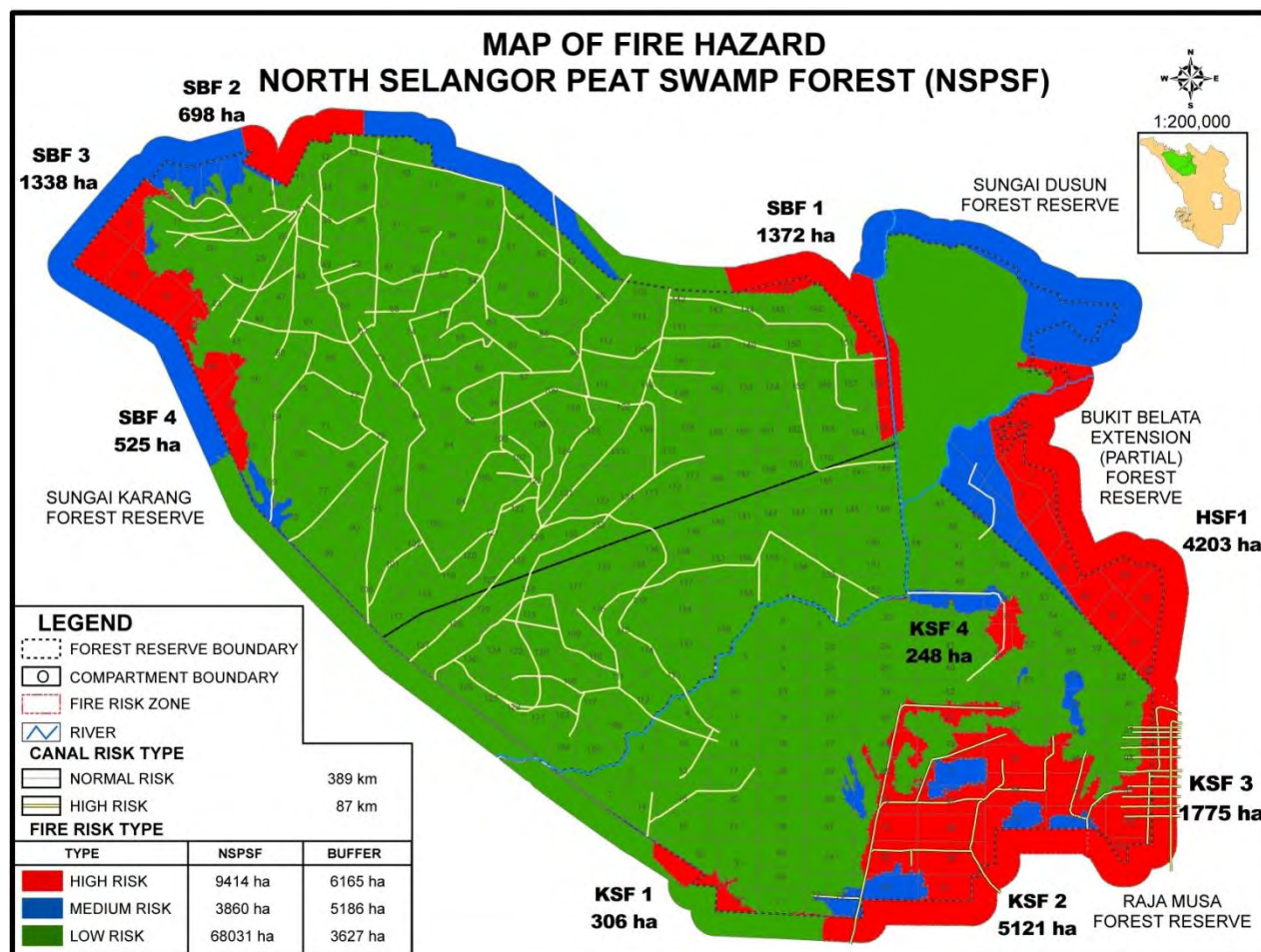


Figure A-2: Fire Risk Map of NSPSF

Figure A-2 is representative of the areas within NSPSF that are considered high and medium risk of fire occurrence. An interpretation of the map follows:

The high risk area to the south east corner relates to the area adjacent to the sand and clay mining and has a history of repeated fires across the entire red zone. This area requires concerted effort to block canals, install the clay dyke and install a series of forest guards at the entry points to the forest.

The high risk area to the north-west corner relates to oil palm plantation owners who are inside the gazetted forest boundary. The focus of efforts here is to demarcate the boundary and ensure no new oil palm trees are planted and no new clearing occurs and no use of fire occurs.

The high risk area to the most northerly point is where the forest boundary has been re-gazetted for construction of a school. The construction works have opened roads into this area of forest and local people are now entering this area, burning for clearing and planting oil palm and other crops.

This area requires immediate attention and placing of forest guards to prevent illegal clearing, burning and crop growing.

The high and medium risk areas in the middle of the forest follow canal distribution canals. The canals allow ready access by boat and people entering have caused fire ignitions. It is recommended that several of the canals and offshoot branches of the main canal that leads to the high fire risk areas are banned from entry. Past history of use of this area has caused repeated burning in the middle of the forest.

Table A-1: Detailed description of each high fire risk area based on Fire Risk Map

Fire Risk Areas / zones / Districts	Size of the area		Description	Generalised prevention strategies
	Forest Reserve (Ha)	Buffer zone (Ha)		
Kuala Selangor District				
KSF 1*	146	160	<p>KSF 1 is located in the district of Kuala Selangor (Mukim Tanjung Karang 1 & 2) and West of NSPSF.</p> <p>The land-uses adjoining the forest reserve is smallholder oil palm plantation and one larger plantation (Sime Darby) to the south-west of the NSPSF.</p> <p>This zone has relatively few problems for NSPSF, such as encroachment, fires and others but one portion of about 20 ha has adjacent to the Sime Darby plantation has burnt each year for the past 3 years.</p> <p>Along the eastern side of the main canal there is a gas pipeline and also a TNB transmission line. The periodic clearing of vegetation along the pipeline and transmission line can enhance the risk of fire.</p> <p>The FR type is poor forest and degraded by fires, covered with lalang grass, which is very prone to fire.</p>	<p>Prevention</p> <ul style="list-style-type: none">• Strategy 1 Block abandoned logging canals• Strategy 3 Restricting access to the forest• Strategy 4 Cooperation with surrounding landholders (Sime Darby/smallholders)• Strategy 5 Conducting Effective Public Information and Awareness Campaigns• Strategy 6 Enhancing Integrated Enforcement
KSF 2*	3771	1350	<p>KSF 2 is located in the district of Kuala Selangor (Mukim Ulu Tinggi) and South NSPSF.</p>	<p>Prevention</p> <ul style="list-style-type: none">• Strategy 1 Block abandoned

			<p>The area has been leased to the Selangor State Government Linked Corporations (GLC) to carry out mining activities of clay, sand and palm oil plantations such as PKPS, KDEB, MBI and others.</p> <p>These activities impact negatively to Raja Musa Forest Reserve, especially drying out peat swamp forest through poor hydrology management.</p> <p>Extensively burnt in 2010 – 2014. Fires are very frequent in this area and have affected about 4000ha.</p> <p>Some areas has a buffer of 20m- 50m between the development and the forest reserve and other areas do not have any buffer and are developed until the forest reserve boundary.</p> <p>The FR type is poor forest and degraded by fires, covered with lalang grass, which is very prone to fire.</p>	<p>logging canals</p> <ul style="list-style-type: none"> • Strategy 2 Construct a Clay dyke between the ex-mining area and the forest • Strategy 3 Restricting access to the forest • Strategy 4 Cooperation with surrounding landholders • Strategy 5 Conducting Effective Public Information and Awareness Campaigns • Strategy 6 Enhancing Integrated Enforcement
KSF 3*	728	1047	<p>KSF 3 is located in the district of Kuala Selangor (Mukim Ulu Tinggi) and is to the south east of NSPSF.</p> <p>The land-uses adjoining the forest reserve are oil palm plantation primarily controlled by small holder/ local community.</p> <p>Activities are undertaken not following good management practices for peat.</p> <p>The areas are over-drained with little or no water management and subject to subsidence and periodic fires.</p> <p>Extensively burnt in March 2014. Fires are very frequent in this area. Fires start outside FR boundary and spread in.</p> <p>The FR type is poor forest and degraded by fires, with patches of</p>	<p>Prevention</p> <ul style="list-style-type: none"> • Strategy 1 Block abandoned logging canals • Strategy 2 Construct a firebreak between FR and oil palm plantations • Strategy 3 Restricting access to the forest • Strategy 4 Cooperation with surrounding landholders • Strategy 5 Conducting Effective Public Information and Awareness Campaigns • Strategy 6

			lalang grass, which is very prone to fire. Rehabilitation was undertaken in 2008-2014 but degraded by fire in 2014.	Enhancing Integrated Enforcement
KSF 4*	240	8	<p>KSF 4 is located in the district of Kuala Selangor, to the southeast of Sungai Tengi.</p> <p>The area is a former logging area with unblocked drainage system.</p> <p>Drains built are still active and drained the water from Raja Musa Forest Reserve to the Tengi River.</p> <p>There is an access trail (by motorbike) from Kg Tawakal through Bukit Belata Extension FR. Fires are likely started by hunting or fishing groups.</p> <p>The area is covered by lalang grassland and takes a long time to recover and is vulnerable to fire.</p>	<p>Prevention</p> <ul style="list-style-type: none"> • Strategy 1 Block abandoned logging canals • Strategy 3 Restricting access to the forest • Strategy 6 Enhancing Integrated Enforcement
Hulu Selangor District				
HSF 1*	2093	2110	<p>HSF 1 is located in the district of Hulu Selangor (Mukim Hulu Selangor) and North-East portion of NSPSF.</p> <p>The land-uses adjoining the forest reserve are oil palm plantations developed and managed by Felda Sungai Tengi Selatan, Sungai Tengi Plantation, PKPS and local communities from Kampung Tawakal A & B.</p> <p>The area developed by the local community includes a mixture of legal and illegal land development.</p> <p>There has been significant encroachment and fires affecting the forest reserve with oil palm planted inside three Bukit Belata FR extensions.</p>	<p>Prevention</p> <ul style="list-style-type: none"> • Strategy 1 Block abandoned logging canals • Strategy 2 Construct a firebreak between FR and oil palm plantations • Strategy 3 Restricting access to the forest • Strategy 4 Cooperation with surrounding landholders and remove encroachment in FR. • Strategy 5 Conducting Effective Public Information and Awareness Campaigns

			Activities undertaken at community-owned lands are not following the good farming practices for peat.	<ul style="list-style-type: none"> • Strategy 6 Enhancing Integrated Enforcement
Sabak Bernam District				
SBF 1*	573	799	<p>SBF 1 is located in the district of Sabak Bernam (Mukim Sungai Panjang) and North-West NSPSF.</p> <p>An oil palm plantation has recently been developed is located near Sungai Dusun Forest (Wildlife Conservation Centre Sungai Dusun) and managed by PKPS.</p> <p>Local community members also graze cattle on the banks of the JPS bund and in some locations keep the cattle overnight – this leads to some impacts on the forest reserve and risk of fires.</p> <p>The FR is good forested area.</p>	<p>Prevention</p> <ul style="list-style-type: none"> • Strategy 1 Block abandoned logging canals • Strategy 2 Construct a firebreak between FR and oil palm plantations • Strategy 3 Restricting access to the forest • Strategy 4 Cooperation with surrounding landholders • Strategy 5 Conducting Effective Public Information and Awareness Campaigns • Strategy 6 Enhancing Integrated Enforcement <p>This oil palm plantation should prepare the environmental management plan that can be managed perfectly well without any impact on conservation areas and forest reserve.</p> <p>The illegal cattle farm should be moved out of the forest reserve.</p>
SBF 2*	0	698	<p>SBF 2 is located in the district of Sabak Bernam (Mukim Sungai Panjang) and North-West NSPSF.</p> <p>Mara Junior Science College</p>	<p>Prevention</p> <ul style="list-style-type: none"> • Strategy 1 Block abandoned logging canals

			<p>(Maktab Rendah Sains Mara-MRSM) is under the construction in the buffer zone. The project is expected to be completed in early 2015.</p> <p>Surrounding area (except Forest Reserve areas) MRSM encroached by the local community, for the purpose of planting oil palm.</p> <p>Local people involved in the clearing work at the area by using fires. This activity has been stopped and the encroached land has recently been given to PKPS for oil palm cultivation</p> <p>The FR type is relatively good forest which is recovering. Some portions have been affected by fire</p>	<ul style="list-style-type: none"> • Strategy 3 Restricting access to the forest • Strategy 4 Cooperation with surrounding landholders (MRSM/PKPS) • Strategy 5 Conducting Effective Public Information and Awareness Campaigns • Strategy 6 Enhancing Integrated Enforcement
SBF 3*	1338	0	<p>SBF 3 is located in the district of Sabak Bernam (Mukim Sungai Panjang) and North-West portion of the NSPSF.</p> <p>The land-uses adjoining the forest reserve are oil palm plantations and agriculture.</p> <p>The planting of oil palm and yam was carried out by farmers who settled in the area mainly prior to the establishment for the Forest reserve.</p> <p>Local people involved in the clearing work at the area by using fires. This activity has been recently stopped and the encroached land been given to PKPS through MBI for oil palm cultivation with proper management to prevent the further threats to the forest reserve.</p> <p>Construction of a 90ha reservoir by IADA within the Sg Karang Forest</p>	<p>Prevention</p> <ul style="list-style-type: none"> • Strategy 1 Block abandoned logging canals • Strategy 2 Construct a firebreak between FR and oil palm plantations • Strategy 3 Restricting access to the forest • Strategy 4 Cooperation with surrounding landholders • Strategy 5 Conducting Effective Public Information and Awareness Campaigns • Strategy 6 Enhancing Integrated Enforcement

			<p>Reserve at Kampung Sungai Hj Doraini adjacent to the feeder canal to store the water during the rainy season and supply to the rice fields during the dry season.</p> <p>This has resulted in 90ha of forest being cleared and excavation/disposal of up to 4 metres of peat, construction of an earth bund and drainage/disruption of the hydrology of adjacent forest areas.</p> <p>The FR type is poor forest and mostly converted to oil palm and degraded by fires.</p>	
SBF 4*	525	0	<p>SBF 4 is located in the district of Sabak Bernam (Mukim Sungai Panjang) and North-West portion of the NSPSF.</p> <p>The area is poor forest for the trees because the trees died as a result of high water levels from the ground up to 50cm. this has led to death of trees which may provide fuel for future fires Local community members also graze cattle on the banks of the IADA bund and in some locations keep the cattle overnight – this leads to some impacts on the forest reserve and risk of fires.</p>	<p>Prevention</p> <ul style="list-style-type: none"> • Strategy 1 Block abandoned logging canals • Strategy 3 Restricting access to the forest • Strategy 4 Cooperation with surrounding landholders • Strategy 5 Conducting Effective Public Information and Awareness Campaigns • Strategy 6 Enhancing Integrated Enforcement <p>The clay bund has been constructed along the main canal and Tenggi river needed a comprehensive management plan including maintenance and others action to prevent from forest mortality due</p>

				to high water level in the forest reserve including installation of water gate. The illegal cattle farm should be moved out of the forest reserve.
Total Area	9,414	6,172		

Note *:

- I. CFMP cycle for strategic preparedness, response and recovery post fire can be implemented as fire management actions in all fire risk areas.
- II. All the fire risk areas should be re-demarcated using warning signs with the help from Selangor State Forestry Department and District and Land Offices from Kuala Selangor, Hulu Selangor & Sabak Bernam.
- III. The degraded area has to be rehabilitated and imposed all these prevention strategies to stop the peatland fires and haze and reduction in GHG emissions

2.2 Fire History and Ignition Sources

The fire history for the NSPSF has only recently begun to be developed into a captured report format and kept as a matter of record by GEC, beginning in July 2012. Over the coming period of this fire plan it is expected that the Selangor Forestry Department, the Fire & Rescue Department, District and Land Office, and Department of Environment may add to these records improving the knowledge of past fire history at the site.

It is through past fire occurrence, its timing and location that we can better understand the patterns of fire and why or how some fire occurrences come about.

Fire records are a summary of the fire reports that have been developed as part of this planning exercise. It is recognised that the reports are not complete and some additional effort will continue in this area of work to improve the accuracy and detail of each fire report.

A recent report by Deltares, (March 2014, on behalf of the USAID funded Lowering Emissions in Asia's Forests, LEAF) uses an April 2013 Landsat image overlaid with past MODIS hot spot data to derive a fire scar of burnt land area. Between June 2001 and April 2013, 5,568 ha of fire scar history are present across NSPSF. While the written history of fires in the area do not match this number the satellite imagery and hot spot history clearly show this level of fire activity. There is an ongoing need for future fire records to be recorded and used appropriately to strengthen suppression systems and prevention activities.

Table A-2: Recent Fire History for NSPSF

Year	Area Burnt *(ha)
Apr 2011	4
Jul 2012	±6
Jul 2012	±14
Aug 2012	±14
Aug 2012	±308
Oct 2012	±40
Total 2012	±386 ha
Aug 2013	±200
Sept 2013	±15
Oct 2013	±20
Oct 2013	±500
Total 2013	±735 ha
Feb – Apr 2014	±1766
Total 2014	±1766 ha

* Copies of the detailed fire reports are in Appendix A.

a) Ignition Causes

The ignition causes at NSPSF are varied from accidental to intentional and tend to correspond with one or the other depending upon the location of a fires start point. For example a fire that starts in the middle of the forest tends to be an accidental ignition, whereas the fires adjacent to the edge of the forest tend to be intentionally lit for land preparation, land development or farming activities.

The degree to which areas of NSPSF are prone to fire depends on three major factors:

- an ignition source,
- fuel or vegetation that can carry a fire, and
- weather that will spread a fire rapidly.

The first factor, ignitions, are caused by humans as the major source and virtually all fires in Selangor are caused by human activities like land clearing for agriculture and people entering the forest for activities such as fishing.

Accidental fire escapes from land clearing activity and fire started by fisherman are expected from villages and agricultural settlements adjacent to NSPSF. These are notable in the southwest and southeast along the edges of the forest where road access occurs.

b) Hot Spots

Fire hot spots are able to be tracked using the ASEAN Hot Spot maps and outputs provided by the ASEAN Specialised Meteorological Centre (ASMC). The hot spot outputs have both benefits and detractions for the land and fire manager.

Benefits

The advantage is that the technology can penetrate haze and pick up new potential fire starts when ground based and aircraft viewing platforms are negated because of visual impedance.

Detractions

A disadvantage of hot spot outputs is that there are a percentage of false readings. The risk of a false reading may increase in locations on or adjacent to open and degraded peatland and is reduced in locations where forest cover and vegetation cover is present.

Within the context of NSPSF the area is primarily forested and the chances of false reading would therefore be at the lower end of the spectrum, approximately 10%, and the hot spot data is likely to be relatively reliable data.

It is know that the hot spot location on the ground may vary with the corresponding hot spot map by a distance of up to 1km. Land and Fire managers within NSPSF are aware of this variance and will use a 1km buffer surrounding the site as an indicator of a fire ignition that could be within the site or nearby.

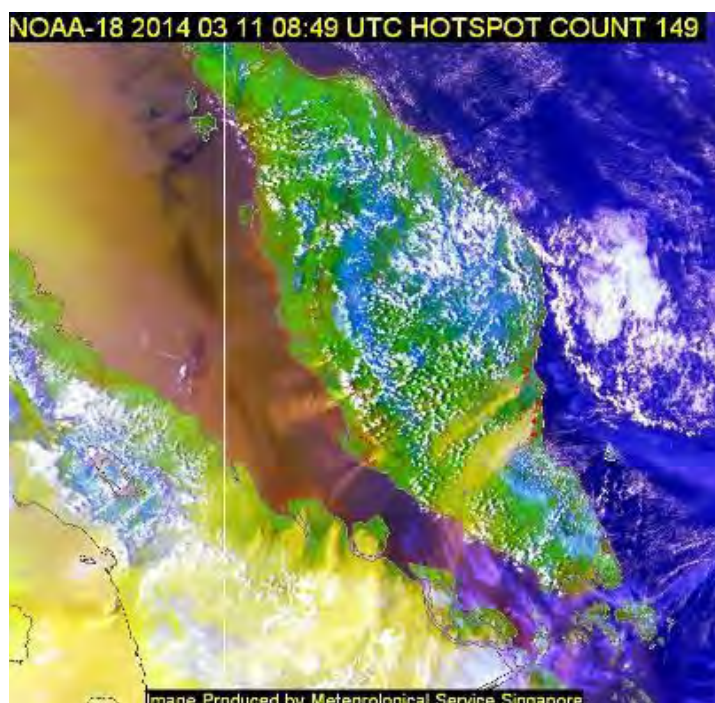


Figure A-3: Sample Hot Spot map for Peninsular Malaysia

This hotspot map example indicates the date, time and number of hotspots present across Peninsula Malaysia at that time. Each hot spot can be correlated with GPS point location to determine its relative position to any one area of land. The map also indicates the smoke haze pathway directed by the prevailing wind. This data can be found at <http://www.weather.gov.sg>

c) Lighting Fires

People light fires in the areas surrounding NSPSF. They are not well planned, most are illegal and some escape the control of the landowner and escape into the forest causing considerable environmental damage to the forest regeneration and peat losses.

The fires that occur in surrounding lands include:

- Fire used to burn the paddy field waste. Open burning is illegal unless via the permit system.
- Fire used for cattle grazing to burn the unpalatable grass and create fresh green growth. This type of fire occurs but is in fact not permitted under the no open burning policy in Malaysia.

- Fire used as a land development tool following the felling of forest in order to prepare it for planting cash crops or predominantly oil palm by small holders. Some of this land development is legal and some illegal, however any use of fire for land clearing is illegal.

2.3 Climate and Weather

Climate and weather factors have a significant effect on fire occurrence and behaviour. The timing and length of the dry season is driven by seasonal climate. Weekly and daily changes within the dry season are driven by localised weather patterns, and quickly impact the fire vulnerability of any one area and particularly peat soils.

Seasonal Patterns

NSPSF is closely influenced by its proximity to the coastal region. It typically receives 1950mm annual average rainfall that falls in two distinct peaks around February to May and October to December, coinciding with the south-west and north-east monsoon. The alternate months coincide with two distinct drying seasons

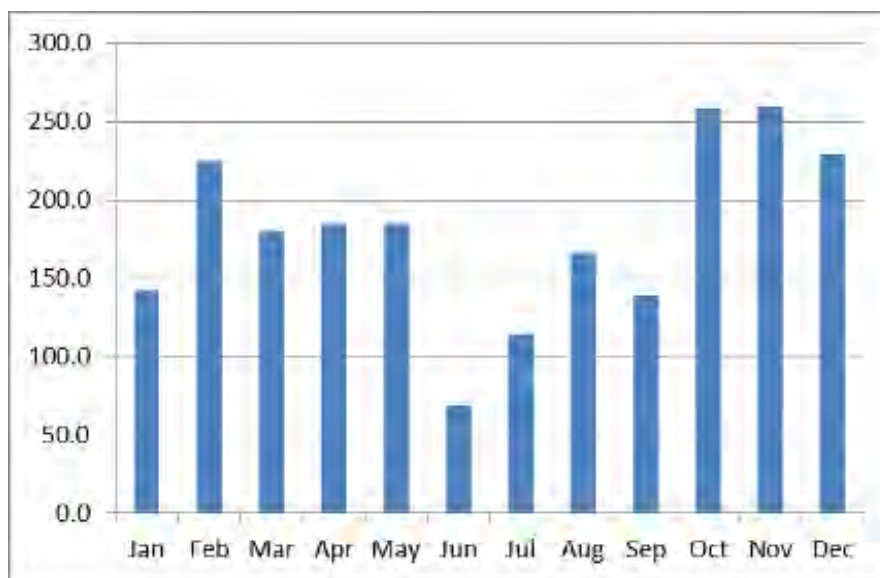


Figure A-4: Monthly Rainfall Average (mm), Tennamaram Estate, 2005-2013

in January and June to September. Figure 4 and 5 below are monthly and annual rainfall averages for the period 2005 to 2013. The rainfall data is taken from the Tennamaram Estate weather station which is located in close proximity to NSPSF.

Short term weather changes can have significant influences on the drying patterns and fire danger to peatlands. A recent haze example in June 2013 saw a month of low rainfall, windy weather and some of the most intensive smoke haze for more than 10 years. The seasonal climatic influences indicated the region was within a la Nina period, i.e. wetter than normal and yet the fires and smoke haze were some of the most intense recorded and were onset by a brief period of dryer weather. The short term influence on drying that the strong winds and low rainfall induced were the significant factors in the weather at the time.

The important point that the 2013 experience highlights is that even in La Nina seasons monitoring of the Fire Danger Rating (FDR) which monitors the weekly rainfall patterns is essential.

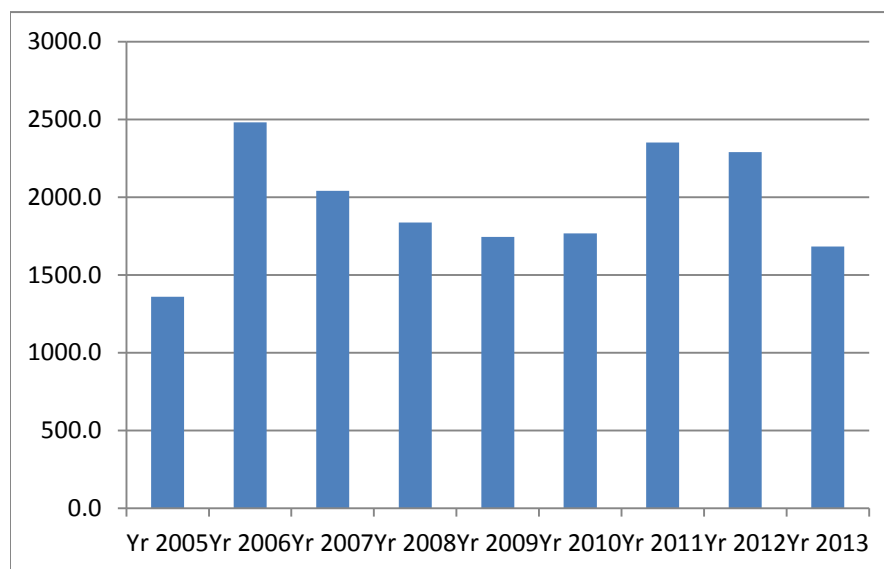


Figure A-5: Annual Rainfall (mm), Tennenamaram Estate, 2005-2013

a) Malaysian Fire Danger Rating System

Malaysia has developed a Fire Danger Rating System (FDRS), leveraging the ASEAN FDRS which is based upon the Canadian FDRS. Since 2003 the system, first developed by the Canadian Forest Service, has been managed by the Malaysian Meteorological Department (MMD), and offers a daily set of regional map outputs registering the changes in FDRS based upon prevailing weather. The FDRS is:


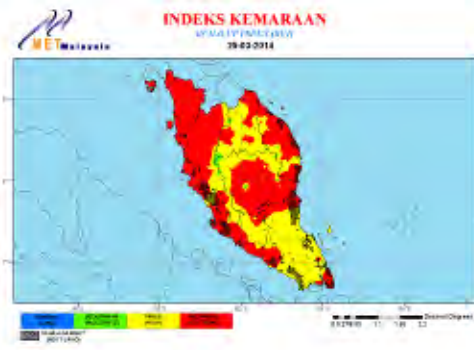

- The process of systematically evaluating and integrating individual and combined factors that influencing fire danger.
- A system that provides a fire manager with a sense of order, relating today's conditions to past experience with fire behaviour in order to plan activities and allocate resources effectively.
- A system that monitors fire related risk factors and supplies information that assists in fire management. The products of FDRS can be used to predict fire behaviour and can be used as a guide to policy-makers/ stakeholders / land owners in developing actions to protect life, property and the environment.
- A system that measures meteorological variables (Temperature, Relative Humidity, Rainfall, Wind Speed) at Malaysia's Principal meteorological stations and automated weather stations (AWS)
- At the local level, a system that assists in the monitoring, management and prevention of fire. It enables more effective fire management by concentrating patrol efforts in critical areas.

Meteorological and vegetation parameters are used to produce the Fire Weather Index and the combined set of FDRS maps. The inputs and outputs of the FDRS are shown below in Table A-3.

The examples shown below are images taken from the Malaysian FDRS.

Table A-3: The Malaysian Fire Danger Rating System

Type of Index	Brief Description	Example Map Output (Peninsular Malaysia)
Fine Fuel Moisture Code (FFMC) Kebakaran Lalang	Showing moisture in litter / fine fuels (pasture, grass, bushes, slash fuels) It measures the ability of a fire to start Useful to monitor fire area grasslands, scrub	
Duff Moisture Code (DMC) Kebakaran Gambut Terosot	Showing the moisture content of waste / materials (organic layer and medium size woody material) on the soil surface Useful for monitoring degraded peat, drought and open peat for agriculture.	
Drought Code (DC) Kebakaran Hutan Gambut	Showing moisture in peat (organic material deep compact) Useful for monitoring forest peat	

<p>Initial Spread Index - ISI</p> <p>Risiko Kebakaran Merebak</p>	<p>Shows the rate of fire spread and difficulty of control in grass.</p> <p>ISI is a combination of wind speed and humidity fine fuels, ignition and fire spread.</p> <p>Useful for monitoring peat near the high ISI</p>	
<p>Build Up Index (BUI)</p> <p>Index Bahan Bakar</p>	<p>Indicator of the amount of fuel available for combustion.</p> <p>The combination of DMC and DC</p>	
<p>Fire Weather Index (FWI)</p> <p>Risiko Kebakaran</p>	<p>Combination index ISI and BUI in identifying the intensity of the fire and fire hazards</p>	

The products of the Malaysian FDRS can be used as a guide to the likely timing when fires can ignite as well as predict fire behaviour and can be used as a guide for fire management actions to protect life, property and the environment. The meteorological variables used (temperature, relative humidity, rainfall, wind speed) are those measured at meteorological stations throughout the Southeast Asia region and spatial analysis is carried out using ArcView software. The outputs from the Malaysia FDRS can be found at http://www.met.gov.my/index.php?option=com_content&task=view&id=4717&Itemid=1157

b) Implementing the FDRS across NSPSF

Step 1: Download the FDRS parameters weather interpretation from MMD website and send that information to the Forestry Site Offices in Selangor.



Step 2: Use of FDRS as an early warning system to the forestry officer to monitor the area and time when the fire index indicate moderate or high or extreme. At the same time adjust the fire danger sign board located in the forest reserve and buffer zone accordingly.



Step 3: Activate prevention and preparedness plan.

It is planned as part of the ongoing peatland management activities to create an online tool called Peat Watch. The fire management planning and system of operational tools plan to link in with Peat Watch and enhance its use and value to the land and fire managers across the ASEAN region.

3.0 Prevention

3.1 Prevention Management Principles

The following principles offer guidance for cooperative fire management at NSPSF. These are not absolutes but rather characteristics that fire and land managers, land owners and community participants alike can appreciate and work toward.

i) Prevention is better than cure

It is widely held that prevention is better than cure, and this is vitally important when considering fire management and increasingly so when considering fire within a peatland context.

The basis for the heightened focus on prevention aspects, as compared to suppression aspects, in a peatland context, is as a result of the extraordinary effort required to suppress a peatland fire once it starts. A peatland fire on an area basis holds a higher degree of difficulty for suppression as compared to other land and soil types under comparable area and weather conditions.

ii) 80:20 Rule

Cooperative Fire Management can be expressed in terms of the 80:20 rule, which characterises that 80% of the resource efforts need to be put into fire prevention as compared to 20% toward fire suppression efforts.

iii) No ignition = no fire

Without a source of ignition there is no fire and therefore no fire suppression efforts. In the tropical environment nearly 100% of fire ignitions are human caused; therefore a focus on human activities

that ignite a fire will create the opportunity to significantly reduce the number of fires on an annual basis.

iv) No fuel = no fire spread

Should a fire ignition occur it can only spread if there is fuel on the ground that is dry enough to support fire spread. In a peatland context there is always fuel on the ground by the very nature that the peat soil is the fuel source, however in a peatland environment the proximity of the water table to the surface of the peat can have a significant impact on the relative wetness or dryness of the peat. A wet peat soil area will not be able to support the continued spread of a fire and therefore a focus on water management within peatland areas should be a priority consideration.

3.2 Prevention Management Approaches

3.2.1 Hydrology Context

It is acknowledged by all the key stakeholders surrounding the NSPSF that the management of the water levels within NSPSF is the single most important aspect to managing the risk of a fire igniting and spreading through the forest reserve.

Past canal construction, used for forest harvesting and access that leads to the interior of the forest reserve creates an outflow of water from the peat dome into the surrounding lands. The broad area drainage of the forest reserve causes partial drying of the surface of the peat on an annual basis in the dry season.

Water is used in the surrounding land by the oil palm plantation, rice paddy, small holder farming, mining industry, home residences and a water retention pond (under construction). The surrounding land owners have varying perspectives and values toward the water that is shared from inside the peatland reserve, as compared to the highland river water that is transported to the area by canal. The topography of the reserve is such that it is a peat dome within the borders of the forest reserve and the surrounding lands are generally lower creating a movement of water from within the forest reserve toward the lands outside the reserve.

It is suggested by the paddy farming areas that peatland water has properties that are not as ideal to rice paddy as compared to highland river water. In this respect the highland river water is laden with suspended sediment which will bring an increased nutrient level to the rice paddy fields as compared to peatland water which does not carry suspended sediment.

The oil palm plantation managers are in part reliant upon the shared water resource that moves from within the forest reserve; however they do supplement their water needs via storages on their own land and via highland river water.

The surrounding small holder farmers are in part reliant upon the NSPSF water as well as highland river water.

A water storage dam covering an area of 80ha, constructed of a clay bund raised approximately 4m above surrounding land height, is under development. This water storage facility will hold highland

river water pumped into it during the peak wet season and released during the dry season for the surrounding paddy fields. The aspect of consideration at this point is the potential for water damming to occur on the forest reserve side of the bund, and if the water level is held too high for too long it can cause forest death. Management of the water levels at this point will require consideration and monitoring.

A large industry of clay and sand mining occurs along one 20km portion of the NSPSF boundary in the south east corner of the reserve. The clay and sand minerals are lower in the soil profile as compared to the surface peat, resulting in the extractive land areas to be lower in land height as compared to the peat. The lower mining land area results in an outflow of water from the peatlands into the basins of the clay and sand mines which must then be pumped out to enable mining activities. The outflow of water is significant causing the drying of the surrounding peatlands raising the risk of fire within this dry zone.

Land restoration activities within the conservation reserve can be significantly enhanced through raising the water levels and temporarily flooding an area of land for several years while regeneration takes hold. Examples of this are present within NSPSF.

Raising water levels in recently burnt areas is a positive rehabilitation activity, as the natural forest area can sustain a period of prolonged inundation on an annual basis, mirroring the normal wet season cycle. Regular inundation is no longer a normal occurrence within the conservation reserve due to the presence of drainage canals that rapidly remove the water and drain it.

3.2.2 Water Management Strategies

The context of hydrological needs of NSPSF and surrounding land owners is a complex set of relationships and compromises. However there are some guiding strategies that have been developed to create beneficial outcomes for the forest reserve and surrounding land owners.

Strategy 1.1: Establish a set of strategic canal blocks in areas of the forest reserve that are more fire prone, and balance the water sharing options at these locations.

The design and implementation of canal blocks, sluice gates or similar, needs to be more broadly tested. There are several canal block constructions used, see Figure 6 and Figure 7. Temporary and permanent construction types have been used across the forest reserve in the past. More permanent structures can be used in easily accessible locations where construction equipment has ready access. This is not practical in some of the more inaccessible and remote parts of the conservation reserve, particularly in the upper reaches of the canals in the high fire risk area.

It is suggested that some localised pilot studies be developed to 'infill' a section of canal with peat and surround this at either end with clay 'plugs' and timber poles for immediate stability. It is suggested that this infill and plug area needs to be higher than the surrounding land to cause the canal water to flow overbank into the surrounding forest before it returns to the canal further downslope. A series of these canal infill points starting at the top of the canal system and moving down the canals toward their outflow points will disrupt the speed of drainage causing the water to flow back into the forest and again transit underground to the canal via a longer route.

Figure A-6: Peat Canal Block



Figure A-7: Concrete and tyre Canal Block



There are approximately 50km of canal within the high fire risk area shown on Figure 2. This area covers more than 5000ha of NSPSF and has been repeatedly burnt over the past 15 years. In order to rehabilitate this area and reduce the incidence of fire occurrence closing of canals, and stopping the drainage of this area will be the key element for future success. It is estimated that a block will be required every 250m along these canals requiring approximately 200 separate canal blocks.

The type of canal block recommended for this area predominantly uses local materials available within the forest (peat, clay and timber poles). However it requires the use of a small excavator and small tracked dump truck. See **Error! Reference source not found.8** for the style of equipment suggested. The type of blocking device is suggested to infill a section of the canal with peat and holds the infill together with a clay plug at either end and stabilise the clay plug with wooden poles embedded into the canal floor. See **Error! Reference source not found.9** for a depiction of this type of canal block. It must be noted the actual block must be higher than the surrounding peat land and must fan out on either side of the canal in order to cause excess water to run across the peat landscape, not down the canal.

Figure A-8: Indicative equipment requirements for use in canal blocks at NSPSF



A requirement of the canal block is to also rapidly establish vegetation on top of the block and the fan walls to reduce the risk of erosion and washing away during peak rainfall events.

It is recommended to install canal blocks beginning at the upstream parts of the canals and then move down along the canal flow path. In order to access the canal the excavator and dump truck will require the establishment of an entry track which will need to be rehabilitated as they move down the canal to prevent the track from being continually used for forest access.

Figure A-9: long section and cross section of a canal block

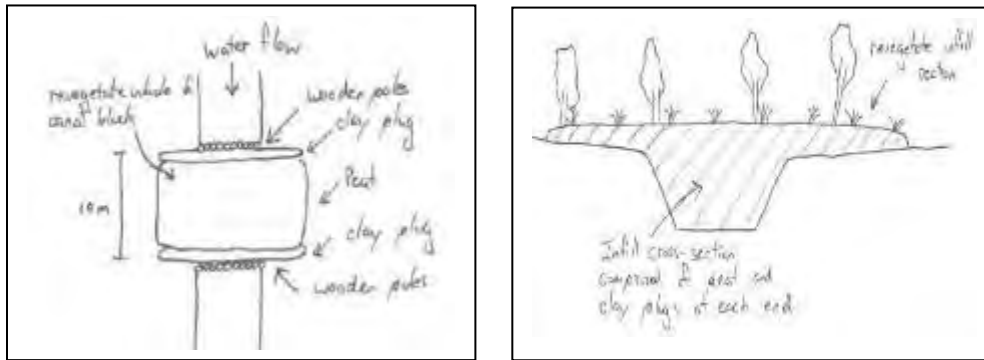


Figure A-10 and Table A-4 show the proposed location of canal blocks.

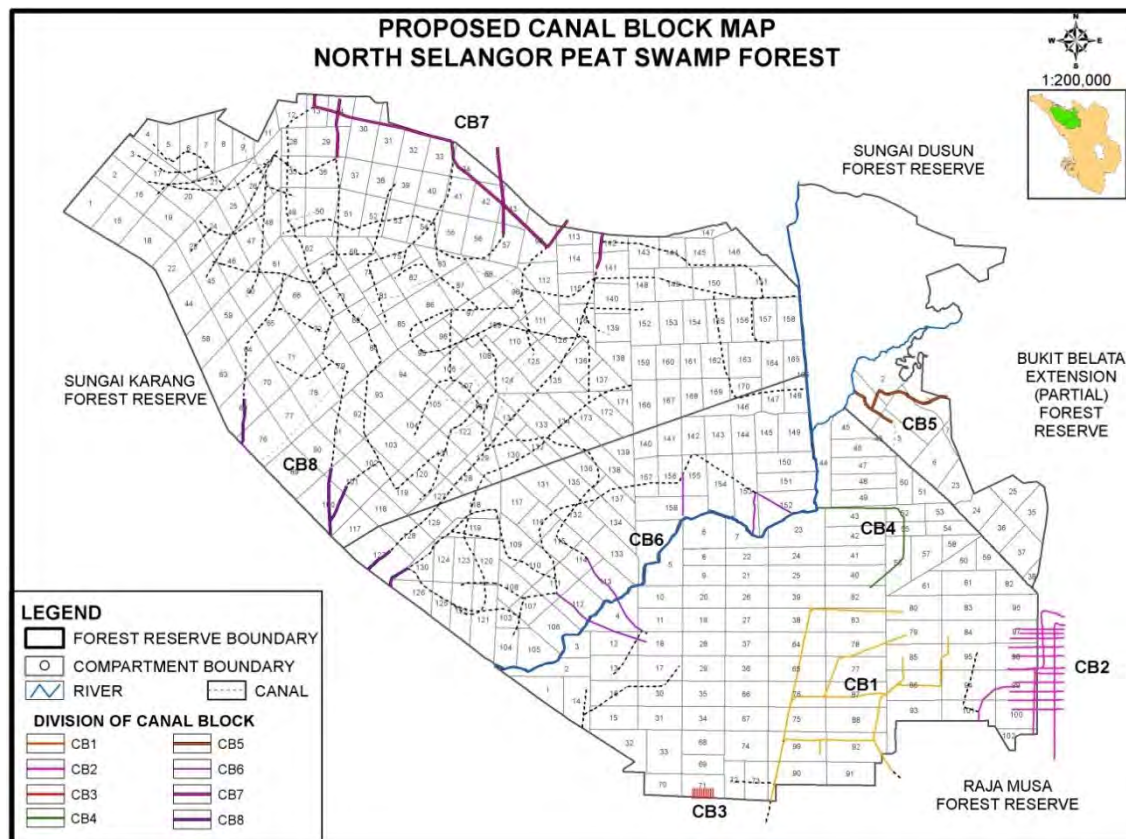


Figure A-10: Proposed locations for canal blocks

Table A-4: Proposed location for canal block and its justifications

No	Location	Approx. length	Description	Justification
CB1	Western portion of RMFR Management Zone R1 and E5	60km	Abandoned logging canals (8-10m wide)	Root cause of regular fires and poor forest regeneration in SW portion of RMFR in an area covering about 4000ha.
CB2	Eastern portion of RMFR Management Zone R1	20km	Abandoned agricultural drainage canals (parit 1-16) in formerly encroached area adjacent to Bestari Jaya-Sg Tenggi road	Root cause of fires and forest degradation in southwest corner of RMFR in an area of about 1000ha. 70% of canals blocked in 2008-9 but repairs and upgrading of the blocks are needed
CB3	SW corner of RMFR in Management Zone R2	10km	Abandoned agricultural drainage canals along forest boundary	80% of canals blocked in 2008-9 but repairs and upgrading of the blocks are needed
CB4	North east portion of RMFR in Management Zone R6	6km	Abandoned logging canals (8-10m wide)	Root cause of regular fires and poor forest regeneration in zone R6.
CB5	Northern end of BBEFR in management Zone R5	6km	Drainage canal 5-8m wide for logging access and agricultural drainage of adjacent land area in Kg Tawakal	Root cause of regular fires and poor forest regeneration in northern section of zone R5.
CB6	Sg Tenggi/JPS diversion Canal	18km	Nine Logging canals draining RMFR and SKFR into Sg Tenggi	Poor forest regeneration along both sides of the Sg Tenggi. Drainage reduces water storage function of forest and increases fire risk.
CB7	Northern boundary of SKFR	18km	Six Logging canals draining SKFR into drains along Sg Panjang road.	Root cause of regular fire along both side of the road. Drainage reduces water storage function of forest and increases fire risk

CB8	Western SKFR and RMFR along main irrigation canal	15km	Five large logging canals draining the western portion RMFR	Poor forest regeneration Drainage reduces water storage function of forest and increases fire risk
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Strategy 1.2: Establish a clay dyke adjacent to the clay and sand mining areas and Firebreak (between plantations and the forest reserve)

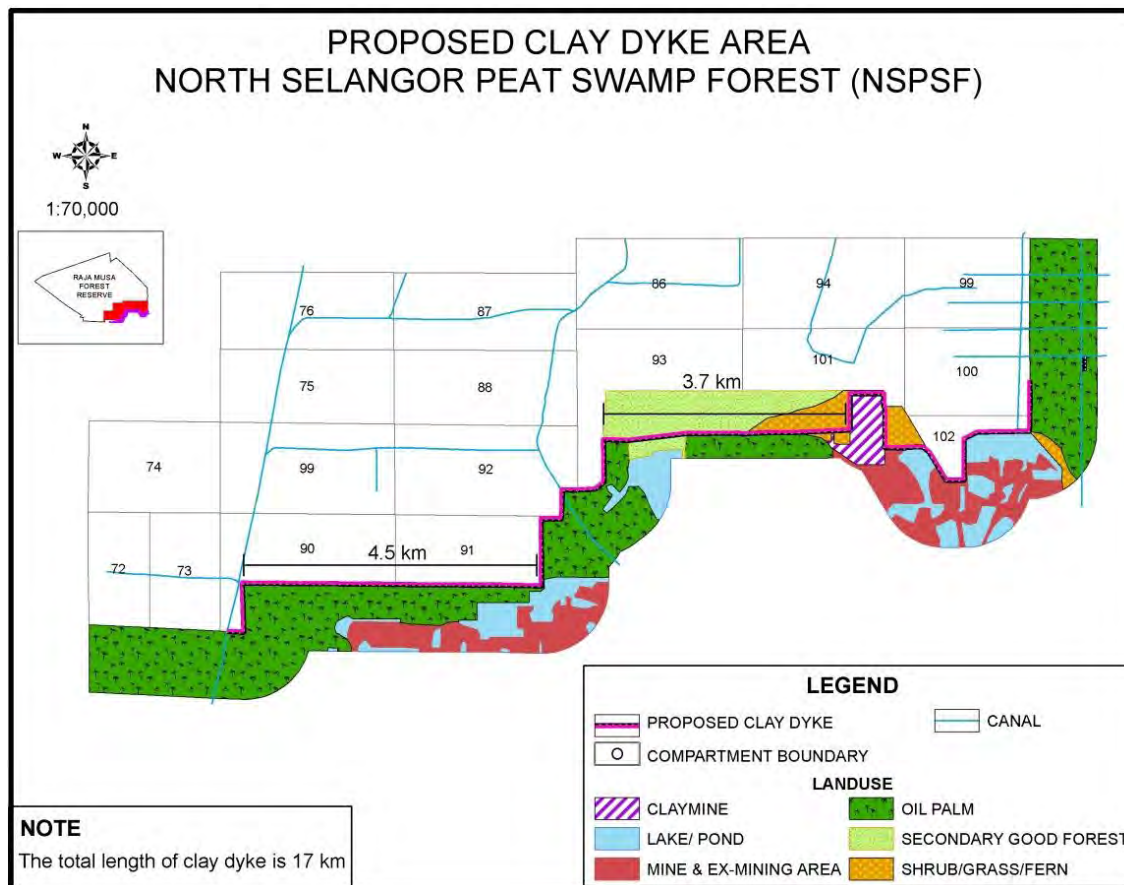


Figure A-11: Proposed clay dyke area for NSPSF

The lowering of the clay and sand mining areas is causing significant drainage in the adjacent forest resulting in this location being repeatedly burnt and one of the highest fire prone locations across NSPSF.

A pilot test using a clay dyke with compacted clay to stop water outflow was completed in 2012 at PKPS clay mining site (Figure A-12). This was a 600m long trench dug through the peat to the clay layer. The trench was filled with clay and compacted. The aim of this pilot was to establish a workable technique to stop the rapid outflow or seepage of water into the adjacent clay mine, and lift the water level on the adjacent peatland side of the conservation reserve. The pilot has proved successful for both the mining operator and the peatland reserve. The mining operator no longer has to run a set of water pumps continuously removing water from the mining area and the surrounding forest water levels have been raised and subsequently a significant improvement to

natural forest regeneration has occurred. A series of water outflow points have been established to manage the water levels to the desired height.

The cost of this trench and clay dyke is quite variable depending upon ease of access and proximity to clay and varies from MYR 400,000 / 1km to MYR 550,000 / 1km and it is estimated that approximately 19km of boundary between the mining areas and forest reserve would benefit from the construction of a similar clay dyke.



Figure A-12: Pilot testing using clay dyke in NSPSF

It is recommended that the capital construction cost of this effort requires ongoing efforts as it will be too large to complete in any one year and by any one party. It is recommended to phase the development of the bund over 2-3 years.

Firebreak is an obstacle/ barrier preventing fire from spreading. Fire spread depends on the amount of fuel material on the ground. The intention of firebreak is to divide the large potential fuels available in an area into smaller and more manageable sections. This is crucial to stop fire from spreading to other part. Firebreaks in strategic location would greatly reduce the chance of a fire advancing.

In NSPSF, firebreaks formed by closed canal systems should be constructed along selected sections of the boundary of the forest reserves in Fire prone sites where the fires spread from open burning beyond the FR boundary. A firebreak consists of ditches between the plantations and forest reserve, about 1-2m wide, 1.5 m deep and 200m long separated by a break of about 3-5 m from the next

section of closed canal, Such a canal should be able to stop the progress of a fire front, or at least reducing the fire spreading and maintain the high water level. They constitute an important technique to control or prevent fire, especially when used together with other fire prevention and control measures. Firebreaks should be used in Fire prone zones KSF1, KSF3, HSF1, SBF1 and SBF3 further site assessments may be needed to determine exact placement and design.

3.2.3 People Context

In the context of fire ignition within a tropical climate and at NSPSF, nearly 100% of fire ignitions are caused by people, either by accident or intentional purposes. With this in mind, restriction in public access into the forest reserve in the dry season is vitally important to manage and reduce the chance of an accidental fire ignition. Malaysia has a broad no open burning policy and on any peatland fire is not permitted and it is part of the zero burning policy. Through this plan it is desired to not use open fire for any land clearing or management activities.

Strategy 1.3 Manage people entering the forest via the establishment of a forest entry permit system and forestry staff posted at strategic points vulnerable to fire.

There is long standing community history using the forest for fishing and collection of non-timber forest products (NTFPs) purposes. It is not desirable for community relations to put a blanket ban on access to the forest, it is more desirable to manage access through a permit system and forest staff stationed at vulnerable locations so that people are known to be entering, for which purpose, at which location and for how long.

Through a permit system the forest users will be briefed by the forest staff about conservation and protection measures and simultaneously be briefed on the risk of fire and impacts and implications of fire on sustainability of the reserve. It is desired that through these one on one briefing that the forest users will increasingly become fire responsible and reduce the likelihood of lighting a fire.

It is proposed that during the dry season the forest permits are reduced dramatically or stopped completely. The determination whether to ban forest access will have to be judged by the Selangor Forest Department (SFD) and the forest staff dependent upon some survey work with forest users and the potential for individual unrest that could follow if permits are banned. An adverse reaction to a permit ban in the dry season could result in a person intentionally entering the forest without a permit and maliciously starting a fire in retaliation to the ban. Monitoring of individual persons response to the prospect of a ban should be accounted for when determining whether to reduce the number of permits or put a ban across the dry season.

Table A-5: Proposed responsibility for patrolling for range offices

Range Office	Proposed responsibilities for patrolling
Bestari Jaya	Raja Musa FR south of Sg Tenggi Bukit Belata Tambahan FR Sg Dusun FR

Kuala Selangor	<p>Sungai Tengi from irrigation canal (compartment 104) to compartment 158</p> <p>Raja Musa FR western boundary north of Sg Tengi</p> <p>Sungai Karang FR from compartment 117- compartment 44</p>
Sabak Bernam	<p>Sungai Karang FR western boundary compartment 22 to compartment 1 and northern boundary compartment 1- compartment 151</p> <p>JPS diversion canal (SKFR compartment 151- RMFR compartment 155)</p>

Strategy 1.4: Manage surrounding landholders through cooperative methods

There is illegal land clearing that has occurred on the edges and encroached into the boundaries of NSPSF in the past. Approximately 1000ha of land was encroached upon within the forest reserve over a period of years. In 2008 the Government made a determination to stop the encroachment and evicted the squatters, removed the constructed houses and pulled out or poisoned all crops across the encroached area. The local communities recognise the resolve of the Government to hold fast to the conservation reserve boundaries and discourage encroachment. This site is now the focal area for which rehabilitation planting is occurring in partnership between the Selangor Forestry Department, Global Environment Centre, Friends of NSPSF, others private sectors and public.

In the NW corner of NSPSF, when originally gazetted, the alignment of the forest placed some existing landholders inside the forest boundaries, even though they were present prior to the boundary gazettal. This boundary line has caused some landholders to be inside the forest boundary and requires some consultative processes to occur to establish a new line of demarcation beyond which no cropping or plantations are permitted or encroached any further into the forest reserve.

It is recognised that the Selangor Forestry Department has forest officers whose duties are allocated to protect and monitor the forest reserve, some of which is monitoring encroachment. It is suggested that over a period of time a series of new demarcation markers be installed by these rangers at strategic points where past encroachment has occurred or likely to occur and that the Department communicate with surrounding land owners to take note of the demarcations and that the use of GPS alignment into the future will be used to maintain the boundaries whether or not the demarcation markers are present or have been removed. If the Department of Forestry is able to patrol these locations only once every two years, using a GPS alignment (not just the demarcation marker), and poison all plants on the wrong side of the GPS aligned demarcation it will soon become apparent to plantation encroachment parties that their efforts are for nought as it takes more than 2 years of palm oil growth to achieve a harvest from their labours. It is suggested that a patrol of all boundaries is necessary once every two years to look for encroachment and deal with it quickly to avoid the situation of the past where 1000ha was encroached.

A section of the reserve has been gazetted for use as a school and training college that is under construction. As part of the construction some roads and land clearing has occurred and local people are now using the roads and partial clearing to move in and expand the clearing and use fire to clear more land and begin planning this for crops. A concerted effort is required at this point to stop additional clearing and use of fire.

Some of the surrounding land holders are large scale plantation owners who have access to heavy equipment for land clearing and development. These large scale plantation owners do not want to see fire adjacent to their lands as it poses a risk of the fire passing into their lands and risk losing their plantation crop. The plantation industry has indicated a willingness to participate in a cooperative manner with surrounding land holders to assist in land clearing activities on adjacent lands to their plantations. The plantation owners cannot do this as a free service and some payment toward costs would be required. It is suggested that a series of cooperative land development processes be negotiated with the large plantation companies and develop a “cost of service” to local communities who are developing land adjacent to both their plantations and the NSPSF.

Cattle grazing occur in some lands adjacent to NSPSF, and as part of the grazing farmers use fire to burn the old unpalatable grasses which create a green fresh pick of grass for stock grazing. The burning of grasses for cattle grazing has in the past initiated fires in the forest reserve. It is not desirable to use any fire for grazing purposes, as it contravenes the no open burning policy and risks ignitions in the forest. It is suggested that a series of consultative workshops and discussions occur with surrounding graziers to develop a workable solution that stops their use of fire.

Strategy 1.5: Conducting Effective Public Information and Awareness Campaigns

The Cooperative Fire Management Plan points out that most forest fires are started by human beings. Hence, it is recommended that fire awareness campaigns should be conducted schools and communities located in the vicinity of the forest. The aim is to increase the understanding and awareness of the impact / implications of fires and reduce the risk of peat fires. Among the activities proposed are as follows:

- Provides monitoring and patrolling with the calendar;
- Distribute reference materials such as Fire Prevention Guidelines, posters, banners and pamphlets related;
- Fire risk warning signs (FDRS) should be erected at suitable and easily visible; and
- Talks and / or exhibit in public places and / or school.

The importance of maintaining a good relationship to people from neighbouring areas is stressed, and it is proposed that community based fire management should be established in villages in areas, that are known to be of high risk

Strategy 1.6 Enhancing Integrated Enforcement

Enhancing integrated and holistic enforcement can prevent peatland fires between the relevant enforcement agencies, such as SSFD, DOE, DO and other relevant departments. Take enforcement action against any person / agency that is found guilty of an offense in accordance with relevant

legislation. For example, under Section 29A of the Environmental Quality Act 1974 Any person who commits an open fire can be fined up to RM500,000 or five years imprisonment or both, if convicted.

Figure A-13 below shows the proposed sub-range office, forest guard post and watching tower, all these structures are meant to monitor access to forest reserve as well as fire incidents.

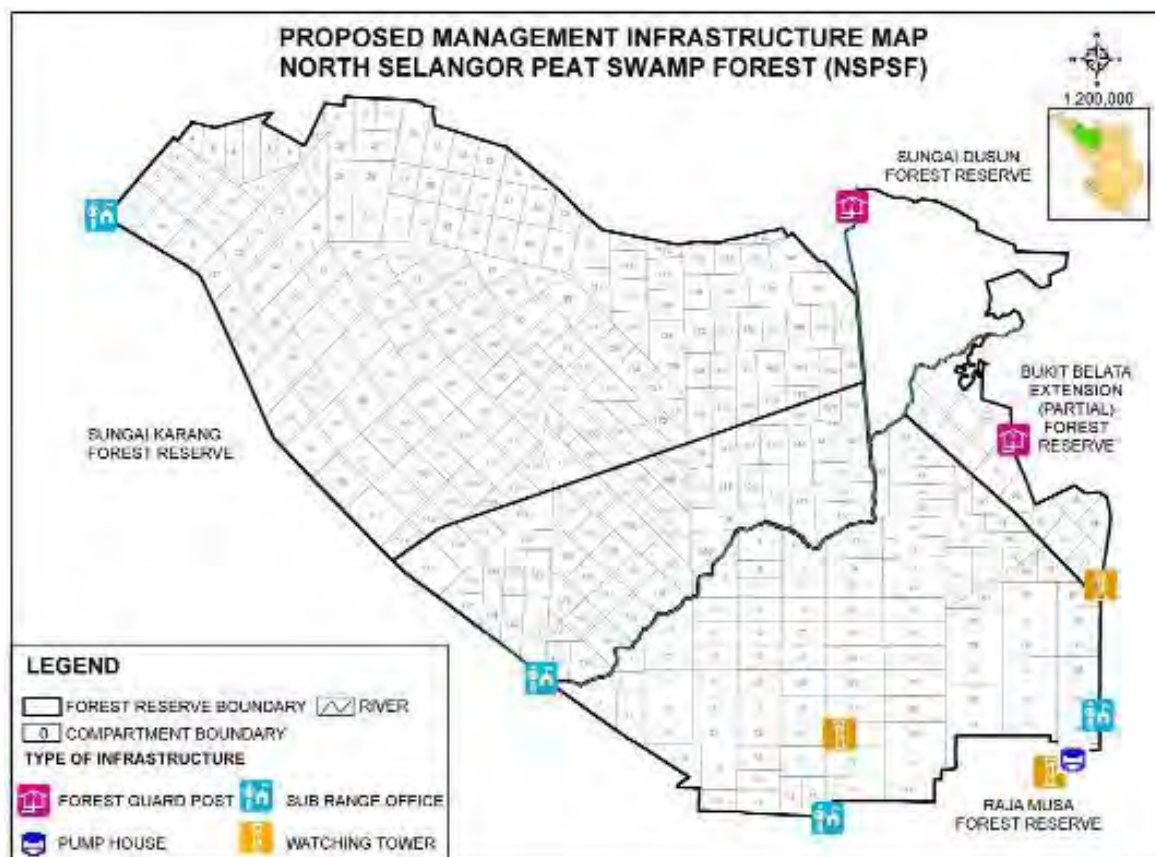


Figure A-13: proposed sub-range office, forest guard post and watching tower

4.0 Preparedness

4.1 Preparedness Management Principles

The following principles can be used to characterise and encapsulate the strategies toward cooperative fire management planning.

a) Be prepared

Fires, unlike some natural disasters are a regular and routine occurrence, and can be predicted as the seasons change. Weather and dryness (hydrology) elements are both measured and available at NSPSF. Fire is a phenomenon that we can plan for and manage for.

This principle is focussed on recognising fire as an annual cycle and occurrence that has a set of routines, processes and plans that we can follow on an annual basis. This principle encourages

planning for and implementing fire prevention, and secondly planning for and implementing a fire suppression system.

b) Re-communicate early warning / early detection measures

Tools such as the Fire Danger Rating System (FDRS) and Hot Spot systems have been in operation for near ten years. The tools create useful and valid information for a fire manager, but don't communicate their messages to fire managers using methods now in vogue and needed to meet their requirements. Fire and land managers can benefit from tools that "push" messages and urgent points of information to them via a smart phone app, rather than the manager having to "pull" the information from a web site.

The principle sought to focus on here is to re-communicate the messages that the tools like the FDRS and hot spots create via a series of push messages to the right manager at the right time.

c) Train the right people in the right course at the right time

Cooperative Fire Management requires people to come together and work in a team environment and be able to understand the needs, roles and responsibilities of each other to be able to work effectively and efficiently as a team. This requires that the people involved, be trained in specific activities, so that they can cooperate when coming together as an incident management team or firefighting team.

The principle to focus on here is that cooperative fire management requires all parties to be trained using similar materials and to know what their role and responsibility is in the cooperative team environment, leading to the right people being trained in the right course at the right time.

4.2 Implementing Preparedness Strategies

Fire Preparedness ensures that when peatland fires occur, the government agencies, the community and individual land managers are ready to respond in ways that are effective and soundly based. These will include early detection, having appropriately trained and experienced firefighters, a prepared community and the necessary plans, physical and information resources in place to respond to peatland fires and provide information, advice and warnings to the community. It includes:

Strategy 2.1: Prepare an annual implementation plans

The annual implementation plans are both single page plans that denote locations of planned activities that require specific work to be undertaken each year. The detail of each activity and costs of the activities (such as developing a new part of the clay dyke) can be prepared separately however the implementation plan simply notes the activity and its location and requirements to be completed.

Strategy 2.2: Enhancement of communication system for fire risk and danger rating tool

Enhanced communication of fire risk to the right people (communities, private landholders and forest rangers and community patrolling team) is important during and before periods of high fire risk. The Fire Danger Rating System (FDRS) and water levels across the forest can increasingly become an effective communication point with communities, individual landholders and the forest

permit officers when the FDRS is in increasing and the water levels are falling – increasing dryness and potential for fire occurrence.

As the Fire Danger Rating (FDR) rises, it is desired that an alert message is sent to a selected number of forestry, local government, GEC, plantation, community and members of the Cooperative Fire Management Committee via a smart phone app. As part of the fire implementation plan, a series of triggers including FDR and hot spot will be used as sufficient fire warning tool to initiate different preparation actions and mechanism to be applied for fire detection and compacting on the ground in NSPSF.

Table A-6: Fire Danger Rating (FDR)

Fire Danger Rating	Proposed Restrictions and Fire Warning Monitoring
Low	<p>Begin to install strategic canal blocks and clay dyke in the high risk zone (no restriction on work activities)</p> <p>Develop and undertake in-house fire training for Forestry Staff and Community groups</p> <p>Entry permits issued by the Forest Officers permit specific people to enter the forest.</p> <p>No major restrictions to use of the forest; however no fire use permitted at all.</p> <p>No Ground Patrols</p> <p>Monitor the water level through piezometer at across the site</p>
Medium	<p>Continue to install strategic canal blocks and clay dyke (no restrictions on work activities).</p> <p>Continue in-house training</p> <p>Closely monitor the use of fire for agriculture and land clearing and liaise with farmers and communities undertaking fire use activities.</p> <p>Entry permits issued by Forestry Staff will only be for Forestry personnel and essential forest users from the community. No use of fire is permitted.</p> <p>Visit the buffer zone (3 days per week) and inform land owners about the impending dry period</p> <p>Monitor the water level through piezometer at across the site</p> <p>Identify the names of people to establish the fire crews for three district areas.</p> <p>Conduct a field day for all fire fighters to test equipment and practice the use of pumps and firefighting techniques.</p>
High	<p>Stop all canal block works in the forest and remove all equipment and people from inside the forest.</p> <p>Restrict the clay dyke construction to ensure no people are camping on site.</p> <p>Ensure all construction staffs do not smoke on site. Ensure equipment is not faulty and at risk of starting a fire</p> <p>Entry permits to NSPSF are reduced to essential Forestry staff only, no access for community groups.</p> <p>Conduct a full briefing on measures to be undertaken throughout the week to reduce the risk of fire (include patrols, control of construction contractors and community / agriculture engagements).</p> <p>Start fire detection by ground patrols for high risk fire zones.</p> <p>Check equipment every Monday (water pumps, hoses for leaks, etc.) and do not remove equipment from vehicles.</p> <p>Warn and inform adjacent land owners /Forestry staff/Forest Workers of respective contractors of impending drought and ease of ignition.</p>

	<p>Step up awareness as to usage of fires to all villagers and private sectors in join collaboration related government agencies and NGO (GEC/ SHGSU).</p> <p>Phone / SMS every Monday agricultural / mining stakeholders adjacent to Forest Reserve about high fire danger rating.</p> <p>Monitor the water level through piezometer across the site</p> <p>Patrol and stop all open burning activities on adjacent land to Forest reserve by villagers and private sectors unless under the direct supervision of Forestry Staff or Fire and Emergency Staff with a full set of equipment for suppression activates</p> <p>Inform all forestry staff and forest workers of respective contractors in forest reserve that no smoking in the forest is permitted</p> <p>Activate ground patrols once a day.</p>
Extreme	<p>Step up patrols, awareness messages and stop all usage of fires by villagers and private sectors. Use collaboration with government agencies and NGO (GEC/ SHGSU) to inform and stop all fire use.</p> <p>Entry permits to the forest will be stopped for all people including Forestry Staff unless it relates to fire suppression.</p> <p>Monitor the water level through piezometer at both site (Forest Reserve and buffer zone)</p> <p>Patrol and monitor all forest boundaries and STOP all open burning activities on adjacent land to Forest reserve by villagers and private sectors</p> <p>Inform all forestry staff and forest workers of respective contractors in NSPSF that smoking is banned in the forest areas.</p> <p>Activate ground patrols daily.</p> <p>Activate fire crew stand by with emergency response teams for fire suppression.</p> <p>Check equipment (water pumps, hoses for leaks, etc.) daily.</p> <p>No vacation/leave allowed for firefighting crews and fire management staff.</p> <p>Maintain daily communication with adjacent land owners and Fire Operations Office, SFD Headquarter.</p>

Strategy 2.3: Enhancing Community Based Fire Management

Community Based Fire Management is recommended for inclusion to enable community participation in the preparation and development of peatland fire management guidelines. Patrols by local community members in coordination with the Forestry Department are an important part of preventing fires for land clearing and also notifying agencies of fires. It is proposed to expand the local patrol efforts to encompass the entire area surrounding NSPSF with the ambition of creating a community support for stopping fire ignitions in the dry season. It can be actively promote through the Sahabat Hutan Gambut Selangor Utara (SHGSU) which is currently active in all villages around Raja Musa Forest Reserve. In the future this will be expanded to cover the villages around the rest of NSPSF.

Strategy 2.4: Utilising Aerial fire detection

Fire management relies upon the use of rapid response, once a fire begins. The basis for this is that for every hour waiting, the fire is growing in size and growing in cost and complexity to suppress, therefore a rapid response to a fire will catch it at its smallest possible size and the overall suppression cost will be lower.

The hot spot technology is the most practical fire detection tool currently available to detect a fire in the centre of NSPSF. However it does have two points of error that require local efforts to overcome. The hot spot data can have positive and false readings and a hot spot on the maps may not correspond to a real

fire on the ground. Secondly the resolution and precision of the actual fire on the ground as compared with the hot spot point may differ in location for up to 1-2 km apart. Confirmation that a hot spot is a fire and its precise location inside NSPSF is important information because if it is a fire a series of costs for equipment and people will be mobilizing, and this cost is not desired to be incurred if a false hot spot reading occurs. And secondly due to the difficulty of actually mobilizing into the core of the forest area the exact location of the fire is imperative to find the shortest possible access route.

The use of aircraft is desired to confirm a fire and its location, as fire towers and lookout points on surrounding lands are not able to locate a small fire in the centre of the NSPSF as the smoke is obscured from ground based observation points by background smog, high humidity related issues and other smoke haze.

The use of aircraft and Unmanned Aerial Vehicles (UAV) is desired to confirm a fire and its location. A turbo prop helicopter will cost approximately MYR 4,000 to 5,000 per hour and approximately 2 hours flight time is required to complete a visual confirmation and location at NSPSF. UAV will be cheaper; however their use for fire detection has not been tested and is experimental at present. The use of UAV's may be limited by line of sight flight controls and distances.

It is planned as part of the fire plan to establish an aerial detection contract with a service provider and work with the Cooperative Fire Management Committee to establish a budget line that can cater for up to four uses of this service per dry season.

Strategy 2.5: Ensuring availability of sufficient firefighters with sufficient capabilities

This strategy enables us to identify the required number of firefighters and provide robust motivation to prevent, control and suppress peatland fires more efficiently. Prepared the firefighters mentally and physically were strong to undertake fire suppression activities.

A training needs assessment is required to determine the number of people from different agencies who will participate in an incident management team or a firefighting team for NSPSF. The numbers of people need to be determined, training courses established and monitoring of training effectiveness, for relevant agencies and individuals. Fire training should encompass Fire Prevention and Fire Preparedness. Listed below are the recommended trainings and is performed once a year or before an impending drought period:

- Safety and first aid
- Fire suppression tactics
- Fire patrols, monitoring and response services (fire patrol groups / forestry guard)
- Usage of hand tools and maintenance
- Manning portable water pumps
- Water delivery systems and layout of water hoses
- Mapping of the fire area
- Communication with radios
- Fire weather and fire behaviour
- Fireline organization
- Fire assessment
- Fire cause investigation

5.0 Response

5.1 Response Management Principles

The principles describing the response approach characterise the focus and efforts needed to create an appropriate response system at NSPSF.

a) The smaller a fire the least cost for suppression.

Society expects that when a fire starts it will be actively suppressed. This expectation is often bound in legislation; however it is more often a community and political demand for agencies to respond and react appropriately to suppress a fire, due to public smoke haze impacts and loss of values at the site.

The faster a response, the smaller the fire and therefore the cheaper the suppression costs.

History shows us that fire suppression efforts predominantly build up slowly over time, allowing the fire to grow and grow and causing exponentially higher costs to suppress. Reversing this trend requires significant policy, regulation, budgetary and cultural changes to the emergency management system for peatland fire response.

This principle is aimed at reversing the slow build up trend for fire suppression and move toward a comprehensive early response, rapid suppression and quick demobilisation of equipment and people once suppressed.

b) Peatland fire requires specialised equipment

Peat fires spread both above the ground and under the ground. This is very different from mineral soil fires and result in the requirement that a trench must be dug around the outside of the fire down to a depth that reaches the water level to ensure the fire does not continue underground past the surface containment lines.

Peatland soils are readily compressed with a low bulk density and can cause the soil to sink and bog equipment.

Using excavators and transport that has a distributed and low ground pressure is essential for movement across a peatland. It is not standard practice to source low ground pressure excavators for peatland fire suppression and past experience at NSPSF is the excavators used on site became bogged or could not reach the fire site. However it is now recognised as an essential protocol to establish a contract with equipment providers that have the right equipment for access across the peatlands.

Transporting people and heavy pumps several kilometres into a fire across peatlands has proven to be difficult in the past. The palm oil industry utilise dual wheel tractors with wide low ground pressure tyres, and draw behind them trailers with dual wheels on rocker suspensions. It is planned to investigate the use of these to transport people and pumps following an excavator trail that has been established to access a fire. A further research item will look into the use of tracks that can replace the tyres on a regular 4WD vehicle. These are in common use in low ground pressure situations in other countries but have not been trailed in peatlands in Malaysia.

c) Rapid Response requires pre-planning.

To achieve a rapid response capability the need to pre-plan is imperative. 90% of a fire suppression response can be pre-planned; the last 10% is following through on the actions established in the pre-planning when a fire starts.

This principle is aimed at several key areas of pre-planning:

- Pre-planned firefighting teams (comprised of fire fighters, a crew leader, a field commander and their equipment).
- Pre-planned incident command team (comprised of the Incident Command System (ICS) personnel structures and processes).
- Pre-planned access to the right kind of excavators (small, lightweight with wide tracks for movement across the peat).
- Pre-planned lists / schedules of resources (people and equipment) available to use for cooperative fire suppression.
- Pre-planned suppression strategies for standard suppression methods including “knock down” and “trenching” and patrol efforts to monitor the area once suppressed.

The focus of this principle is to plan, plan and then plan some more. An example of an Indonesia firefighting team mix, their equipment and training background has been developed by Olle Wennstrom (Wennstrom O. (2013) Standard Forest Fire Crews in Indonesia, www.ollewennstrom.net). The following light and heavy crew list of equipment is adapted from this document.

Light fire crew

The light fire crew is an initial attack crew aimed at rapid deployment to the fire front and to be used for surface fire knockdown and stopping spot fires. The light crew is also more mobile to mop up burning logs and persistent points of fire.

- 10 people with full firefighting personal protection equipment, including:
 - ✓ Cover-alls
 - ✓ Boots
 - ✓ Gloves
 - ✓ Smoke masks (plus face bandanna)
 - ✓ Smoke goggles
 - ✓ Helmets
 - ✓ Food and water for a 24 hour period
- 2x float pump (200L/min capacity), similar to Mark 3 or Floto pump brands
 - ✓ 600m 1.5” hose
 - ✓ 4x nozzles
 - ✓ 2x 1.5” branches
 - ✓ (capable of water supply of up to 100L /min to 4 separate nozzles)
 - ✓ 40L fuel for pumps
 - ✓ Oil for pumps
 - ✓ mechanical repair tool kit for the pumps
- 5x 15L water spray backpacks

- ✓ 5x swatters
- ✓ 5x long handle shovel
- ✓ 5x rake hoe

Heavy fire crew

The heavy fire crew is aimed at main suppression of the ground fire and works in conjunction with the excavators digging trenches to surround the fire. The heavy crew fills the trenches with water to prevent the ground fire escaping the contained boundary.

- 10 people with full firefighting personal protection equipment, including:
 - ✓ Cover-alls
 - ✓ Boots
 - ✓ Gloves
 - ✓ Smoke masks (plus face bandanna)
 - ✓ Smoke goggles
 - ✓ Helmets
 - ✓ Food and water for a 24 hour period
- 1x heavy pump (1500L/min capacity), similar to Tohatsu brand
 - ✓ 600m 2.5" hose
 - ✓ 600m 1.5" hose
 - ✓ 6x branch fittings from 2.5" to 1.5"
 - ✓ 6x nozzles
 - ✓ (capable of water supply of up to 200L /min to 6 separate nozzles)
 - ✓ 100L fuel for pumps
 - ✓ Oil for pumps
 - ✓ mechanical repair tool kit for the pumps

The development of teams similar to this for NSPSF that consist of a variety of staff from the Department of Forestry, Department of Fire and Rescue, GEC and the local Community need to be developed and equipped to better manage fires once they start.

Figure A-14 is an example of a pre-planned incident management team. By establish the names of people who are trained and capable in each role and calling upon them to undertake that role when a fire occurs allows for the best person to be in charge of each role to actively and rapidly suppress a fire.

Figure A-14: Example of an Incident Management Team



d) Cooperation is the key

No one land or fire management agency can manage all the fire on its land. A shared commitment to support each other will be the most effective fire management solution which is at the heart of Cooperative Fire Management.

Cooperative Fire Management has occurred informally at NSPSF and through agency and community consultations it has been concluded that it is desired to move the informal system to a formalised Cooperative Fire Management Committee, Chaired by the District Office and members drawn from government agencies, private plantations owners, NGO's and community representatives of small landholders and other interest groups.

The focus of this principle is to create the underlying formal system, structures and processes needed to develop the first Cooperative Fire Management Committee and pilot test its application at NSPSF.

5.2 Implementing Response Strategies

Effective Fire Response to peatland fire when they start can mitigate peatland fire risk, through limiting the spread and the consequences of peatland fire. Response includes the firefighting component of the overall peatland fire management process. Firefighting is generally the role of the Fire Services but, just as importantly response includes those critical actions that community members will take when peatland fire threatens. Responses may include:

Strategy 3.1: Improving access to funds for fire prevention and suppression

Fire begins at a small size. The concept of "fast initial attack" is to quickly suppress any fire which starts and keep the burnt area to a minimum. This method of fire suppression minimises cost and damage.

The increased level of effort and exponential costs of fire suppression in a peatland fire as compared to a mineral soil fire justify a re-negotiation of the trigger criteria that enables access to State emergency funding for support during a peatland fire.

It is important to secure rapid access to needed funds for fire suppression operations as soon as possible. Mechanisms and procedures need to be established at district level to secure and channel resources. It is planned to support the District Offices to steadily discuss and lobby the emergency funds administration to move the criteria for access to emergency funds in peatland fires from 1000 ha toward 10 ha. The shift in these criteria will support the transition toward rapid response and also overall cost profile of fire suppression to a lower total cost base.

Strategy 3.2: Pre-established specialised equipment contracts, fire control resources and personnel

In order to gain rapid access to specialised equipment (e.g. excavators) some pre-planned contracts need to be developed with equipment contractors for the supply of the right equipment. It is planned to source and negotiate one or more suppliers of smaller scale excavators that meet the needs of peatland fire suppression so as to be able to mobilise them quickly at the start of any fire season.

Documenting and updating lists of potential fire control resources and personnel, their location and the contact arrangement to the equipment owner are essential for cooperative fire management efforts. It is planned to establish a resource schedule of capabilities of all agencies under a Cooperative Fire Management arrangement including personnel and equipment.

Strategy 3.3: Develop new transportation options for peatland access

As one of the options to consider for transporting people and equipment across the peatland to reach a fire it is planned to conduct some research into the suitability, cost and use of tracked wheels that can be fitted to a 4wd vehicle or on availability of lightweight tracked vehicles.

A field study and contact with several field users of this equipment in the Agriculture area is planned and if suitable value criteria are perceived a pilot of one set of tracks may be considered and costed under the Selangor State Forestry R&D budget.

Strategy 3.4: Incident Command and Fire Fighting team structures for Cooperative Fire Management Committee

The pre-planned teams will use some standard organisational charts common to the Incident Command System (ICS), used by the Malaysian Fire and Rescue Department. The ICS structure, roles, responsibilities and management techniques are already available through the Fire and Rescue Department.

Under the auspice of Cooperative Fire Management Committee it is proposed to establish standards for teams of people for the incident command and field firefighting teams should a fire occur in NSPSF. It is proposed to establish two levels of pre-planned team, a small scale or initial fire team, and a large scale or emergency fire team. This will allow for the staged growth of a fire team should a routine fire suppression effort grow to become a large scale emergency response.

Strategy 3.5: Ongoing mopping up and patrolling of fire on affected areas

This strategy ensures to prevent re-ignition and limit further damage on the fire for affected areas. A team should establish to handle this strategy activity. Those involved in the task has to be provided the latest information on the situation to the Incident Command for further actions and updates.

Strategy 3.6: Formalise a Cooperative Fire Management Committee in each District

A formal Cooperative Fire Management Committee should be established in each District to oversee peatland fire prevention and control. It is suggested that the Committee have a full committee and a smaller Executive Committee. It is proposed that the full committee work to influence and develop the fire prevention aspects of the plan and when it comes to fire suppression operations these will be largely pre-planned and the smaller Executive Committee can meet and support the immediate suppression efforts more quickly and in an agile manner.

It is recommended that the three Districts that surround NSPSF each establish a fire management committee related to its area of influence and that the executive of each committee meet twice per year (before the dry season to confirm the pre-planned fire suppression arrangements and after the dry season to confirm the pre-planned fire prevention efforts).

It is proposed that the Cooperative Fire Management Committee request a monitoring report to be completed twice per year on the previous activities alternating from fire prevention activities and fire suppression activities.

It was recommended that the District Office undertake the role of Chair and potential participants in the committee include:

- District Office
- District Council
- Selangor Forestry Department (District level)
- Department of Drainage and Irrigation (District level)
- Department of Fire and Rescue (District level)
- Department of Public Works (District level)
- Police Headquarter (District level)
- Department of Health (District level)
- Department of Environment (District level)
- Department of Agriculture (District level)
- Department of Minerals and Geoscience (District level)
- Department of Malaysia Meteorological (District level)
- Department of Wildlife and National Park (District level)
- Department of Town and Country Planning (District level)
- Department of Civil Defence (District level)
- Department of RELA (District level)
- Department of Veterinary services (District level)
- Department of Integrated Agriculture Development Area (IADA) (District level)
- NGOs (Global Environmental Centre & Friends of NSPSF) (District level)
- Land owners adjacent to forest reserve, such as:
 - Sime Darby Plantation Sdn. Bhd
 - Selangor Agricultural Development Corporation (PKPS)
 - Kumpulan Darul Ehsan (KDEB)
 - Menteri Besar Incorporation (MBI)
 - SEMESTA Sdn. Bhd
 - UNISEL, Felda Plantation Sdn. Bhd and others.

It is suggested that the Committee have a full committee and a smaller Executive Committee. It is proposed that the full committee work to influence and develop the fire prevention aspects of the plan and when it comes to fire suppression operations these will be largely pre-planned and the smaller Executive Committee can meet and support the immediate suppression efforts more quickly and in an agile manner.

It is recommended that the three Districts that surround NSPSF each establish a fire management committee related to its area of influence and that the executive of each committee meet twice per year (before the dry season to confirm the pre-planned fire suppression arrangements and after the dry season to confirm the pre-planned fire prevention efforts).

The report would be prepared by member of the Cooperative Committee such as the Department of Forestry and GEC and would form a routine part of the planning, implementation and monitoring of results.

6.0 Recovery

The Integrated Management Plan (IMP) for which this report is a component will detail a chapter on the restoration and recovery techniques best applied to peatlands at the NSPSF following fire. This report will not detail the recovery aspects of the peatlands following fire but rather provide some guiding principles that will be detailed in strategies and techniques in the other chapter.

The driving principles to be considered following fire when restoring the vegetation cover is wherever possible utilise natural regeneration techniques for both speed of recovery and facilitating recovery across large areas.

Natural regeneration of peatland forests at NSPSF is facilitated by managing the water regime at the site and raising the water table to inundate the area that has been burnt. Rapid inundation of the burnt area via raising canal blocks will achieve this.

Ongoing management of the water levels following initial regeneration will continue to develop a healthy regenerated site.

6.1 Monitoring Fire Management

It is proposed that the Cooperative Fire Management Committee request a monitoring report to be completed twice per year on the previous activities alternating from fire prevention activities and fire suppression activities.

The report would be prepared by member of the Cooperative Committee such as the Department of Forestry and GEC and would form a routine part of the planning, implementation and monitoring of results.

The report may include items on:

- Fire occurrence (number of fires, where and when and what impacts);
- Improvements / changes achieved in prevention actions;
- New research findings that can be used to benefit NSPSF fire management;
- The dry season weather forecast;
- Capital works or resource budgets proposed for major upgrades;
- New policies for consideration by the committee, such as buffer zone management; and
- Rehabilitation and recovery plans for areas prior burnt.

6.2 Implementing Recovery Strategies

Recovery describes actions taken to limit the consequences following the fire. Recovery may be complex, as it deals with economic, physical and environmental rehabilitation. It is an integral part of the framework and should be considered consciously during the other elements of the framework. It encompasses the development and implementation of economic, physical and environmental recovery plans and strategies, and includes:

Strategy 4.1: Post fire assessment post mortem and documentation of lessons learned

In this strategy, a detailed fire report must be prepared with the size and map, identify the roots causes of the fire and a comprehensive investigation, and including the fire suppression costs for prepare future fire prevention plans for the area. Success or failure of the fire suppression should be recorded and suggestions made to enhance the existing strategies accordingly.

Strategy 4.2: Post fire equipment and infrastructure repair and maintenance.

After the completion of firefighting operations, the equipment and infrastructure have to be maintained and repaired. Equipment maintenance and infrastructure repair costs should be included in the annual budget of fire management.

Strategy 4.3: Post fire site rehabilitation

Firebreak which was built should be blocked as appropriate so that the water from the NSPSF will not flow out. This will raise or maintain the water level in the degraded area by fire. Any access roads built during firefighting should be blocked by a fence or gate so that no encroachers / hunters can get in to the burnt area. The degraded areas should be rehabilitated with the participation of local communities, land owners and local authorities in partnership with the Selangor State Forestry Department. Rehabilitation of the site will reduce the fire risk in the future.

6.3 Implementing Strategies

The following section is a high level description of what is required to implement the strategies developed in the NSPSF Cooperative Fire Management Plan. It includes equipment and resource estimates and financial elements for budget planning purposes.

Table A-7: Resources requirements and Budget Estimates

Prevention Strategies	Resource Requirements	Budget Estimates
Strategic Canal Blocks in the High risk priority areas. There are 50km of canals in the SE high risk zone, which will require approximately 4 blocks per 1000m of canal. Note new design requirements for upstream canal block	50km of canal 4 blocks per 1000m = 200 blocks Average cost of canal blocks = MYR 40,000	5 year budget MYR 8,000,000
Concrete canal blocks at the forest exit (high risk zone only). Able to raise and lower water level	There are 4 exit points of canals in the high risk zone. 4 blocks at MYR 100,000 each	5 year budget MYR 400,000
Clay dyke along 11km of length to separate the clay/sand mining areas from the peatlands to prevent rapid drainage.	11km clay dyke Cost / km length is variable depending upon location conditions, proximity to clay and difficulty of access. Range = 400,000 to 550,000 / km	5 year budget MYR 5,200,000
Forest Guards at strategic locations are proposed to be appointed. The locations are established in line with the higher risk areas across the forest.	2014 = 3 forest guards (plus 1 additional of a forest guard to work the days when the full time guard is on a weekend break or ill)	2014 = MYR 140,000 2015 – 2018 = MYR 210,000 / annum

	<p>2015 = additional 3 forest guards</p> <p>Annual Salary for a forest guard = MYR 25,000 / annum</p> <p>Annual expenses for a forest guard = 10,000</p>	<p>5 years budget = MYR 980,000</p>
<p>The NSPFS boundary is illegally encroached persistently by neighbouring land owners and agencies and squatters.</p> <p>There is a need to use aerial boundary affirmation twice per annum.</p> <p>Each boundary affirmation requires 3 hours of helicopter flight time.</p>	<p>Helicopter cost MYR 5000 / hour</p> <p>Annual usage 2x 3hr flight</p>	<p>Annual boundary affirmation = MYR 30,000</p> <p>5 years = MYR 150,000</p>
<p>Installation of High Density Polyethylene Pipe (225mmØ HDPE) MS1058 (5 km)</p> <p>Proposed location of installation :</p> <p>Parit 4 – Parit 16</p>	<p>Purchasing HDPE (RM 110 /meter) = MYR 110 x 5000 meter = MYR 550,000.00</p> <p>Installation cost :-</p> <p>Rental Installation tools and equipment</p> <p>Installation of “butt fusion”, valve & D/F tee</p> <p>Rental of backhoe & excavator</p> <p>Develop new access road</p> <p>Man power</p> <p>MYR 170 x 5000 meter = MYR 850,000.00</p>	<p>1,400,000</p>

Purchasing high pressure water pump (10k/ sec)	3 units x RM 200,000.00	600,000
Build a water pump house (15ftx10ftx12ft) at parit 1	Simple structure to accommodate the high pressure water pump	10,000
Build 3 suction ponds for relay water system for rewetting and fire suppression purposes	Suction ponds : size 10 m x 10m x (depth until clay layer) RM 30,000 x 3 units	90,000.00
Development of access road (10km)	RM 50,000 (1km) x 10 km	500,000
	Total Prevention (5 years)	MYR 17,330,000

Preparedness Strategies	Resource Requirements	Budget Estimates
<p>There is a requirement for detailed consultations and planning updates to occur on the fire plan, twice each year to support its ongoing implementation and work effort. This planning must not be looked over or skipped and requires a budget line item to ensure it is achieved.</p> <p>Annual Planning and consultations with major stakeholders. Two weeks of full time work effort, twice per annum.</p>	<p>2x Planning staff (SFD and/or GEC personnel) to actively communicate and update all fire management planning and preparation activities with ALL stakeholders and the district fire management sub-committee twice per annum.</p> <p>Professional staff time at 4 weeks per annum = 15,000 / person x2 people</p> <p>Expenses for meetings, workshops etc. = 15,000 / annum</p>	<p>Annual planning of prevention and preparedness actions and activities to support the District fire management committee = MYR 45,000</p> <p>5 years = MYR 225,000</p>

<p>Aerial fire detection to confirm hotspot data inside NSPSF. Up to 5 hotspots are recorded every year inside the boundaries (not on the edge) and requires aerial detection to confirm or not before initiating a full suppression effort.</p> <p>It is proposed to use local helicopters for this.</p>	<p>Confirm 5 hot spots per annum.</p> <p>Each flight is 2 hours at MYR 5000 / hr</p>	<p>Annual aerial detection of hotspots = MYR 50,000</p> <p>5 years = MYR 250,000</p>
<p>Construction and operation of fire towers (3)</p> <p>Fire towers are proposed in 3 strategic locations in order to cover most area where fire risk is high. One fire tower should be placed at compartment 75 (RMFR) so that area on both sides along the main canal and beyond can be monitored closely. Another fire tower is proposed at compartment 38 (BBEFR) to monitor for areas both in RMFR and BBEFR. The third fire tower is proposed at PKPS area near clay mine (either as a separate tower – or by upgrading the current lookout on the PKPS water tower). A watch tower here is strategic for monitoring the forest reserve as well as buffer zone area.</p>	<p>Construction of fire towers</p> <p>250,000 x 3 towers = 750,000</p> <p>Operation (including placement of information signage and maintenance)</p> <p>60,000 x 5 years = 300,000</p>	<p>MYR 1,050,000</p>
<p>A training needs assessment has to be conducted to then prepare a set of training courses and deliver those training courses.</p> <p>Estimate 3 x courses to be developed</p> <p>Estimate 4x course delivery per annum per</p>	<p>Needs assessment, 10 days effort at MYR 2000 / day for needs assessment expertise</p> <p>3x course development (training course curriculum, materials, presentations) = MYR 20,000 / course, total MYR 60,000</p>	<p>Needs Assessment = MYR 20,000</p> <p>Course Materials development = MYR 60,000</p>

course to be completed each year for 5 years	<p>Annual delivery of each course = 3 day planning and 1 day delivery per course = 16 days per annum of Malay national trainer deliver = 12,800</p> <p>Expenses / course = MYR 2000 = MYR 8000 / annum / course</p>	<p>Course delivery 5 years = 104,000</p> <p>5 year training total = MYR 184,000</p>
<p>Fire Monitoring & patrolling using contract workers / local community (SHGSU)</p> <p>Hulu Selangor – 10 pax</p> <p>Kuala Selangor – 10 pax</p> <p>Sabak Bernam – 10 pax</p>	MYR 50 x 30 pax x 30 days x 5 months x 5 years	MYR 1,125,000
	Total Preparedness (5 years)	MYR 2,834,000

Response Strategy	Resource Requirements	Budget Estimates
<p>Development of a District Fire Management Sub-Committee that is linked through the existing Disaster Management Committee is crucial to the implementation of this fire plan.</p> <p>It is recommended the Fire Sub-Committee hold 2x dedicated fire meetings per annum.</p> <p>The fire sub-committee is likely to be</p>	<p>Planned meetings 2 per annum – professional staff preparation time, agendas and planning effort = 1 person 2 weeks of professional staff effort per meeting = MYR 8,000 pre-planning (twice per year), total 16,000</p> <p>Planned meeting expenses – MYR 2000 / meeting</p>	<p>Pre-planning support = 20,000 / annum</p> <p>Ad hoc emergency support = 10,000 / annum</p> <p>5 year budget for support to the District fire management sub-committee = MYR 150,000</p>

needed for an additional 2x ad hoc 'fire emergency' session per annum	Unscheduled 'emergency meeting sessions', up to 2 weeks of professional staff support per annum on emergency support = 8,000 for 2 weeks plus expenses of MYR 2000	
<p>Pre-planning and contractor negotiations for equipment hire including contracts for excavators, large pumps, aircraft etc.</p> <p>Support equipment and suppliers for emergency and planned needs MUST be pre-established and planned so that when a fire occurs rapid deployment can happen.</p> <p>An experienced professional will need to pre-establish these contracts with suppliers and maintain a list of them and share that list with the Fire Sub-Committee for quick and ready access.</p>	<p>Sourcing, negotiating and establishing 12 separate contract suppliers for:</p> <p>Excavators (3 suppliers of 3-5 tonne excavators for use on peatlands)</p> <p>Pump suppliers (3x large volume water pump suppliers)</p> <p>Aircraft, helicopters (3x helicopter suppliers)</p> <p>Ad hoc emergency equipment (3 per annum)</p> <p>This volume of contract negotiations and maintenance will require approx. 2 professional person months per annum</p>	<p>Professional time for negotiation and management of contract MYR 32,000</p> <p>Expenses MYR 8,000 annum</p> <p>Total MYR 40,000 / annum</p> <p>5 years = MYR 200,000</p>
<p>Establish and equip 2x Light fire crew for suppression and deployment within NSPFS.</p> <p>It is proposed the Government staff such as Selangor Forest Dept. and the Fire and Emergency Rescue Department will cover the costs of their staff time.</p> <p>Support from NGO's will not be paid salary but reimbursed expenses.</p> <p>Volunteer support from Communities will not</p>	<p>1 team comprises ten (10) people (required 3 teams)</p> <p>30 personnel salary - paid by agencies</p> <p>30 personnel protective equipment / PPE (coveralls, boots, gloves, smoke masks etc.), MYR 1000 / person = 30,000 / annum</p> <p>Floating water pump x 6 = MYR= 120,000</p> <p>Hoses, couplings, adaptors, nozzles for</p>	<p>PPE = MYR 30,000</p> <p>Float pumps = 1200,000</p> <p>Pump hoses / adaptors = MYR 30,000</p> <p>Hand tool = 6,000</p> <p>Maintenance / consumables = 150,000 (5 years)</p> <p>MYR 336,000 for equipment and</p>

<p>be paid a salary but reimbursed expenses.</p> <p>Equipment is proposed to be held by the Selangor Forest Department and the Fire and Rescue Department. Secure storage is available at the Raja Musa offices of the SFD.</p> <p>A fire team is proposed to consist of 10 personnel with water pumps and tools capable of initial attack and suppression of a fire.</p> <p>Vehicles to access the fire are to be agency vehicles.</p> <p>Heavy equipment will be hired.</p> <p>To budget estimate these needs per annum of two week duration are used to guide costing.</p>	<p>water pumps = MYR 30,000</p> <p>Hand tools (swatters, rake hoes) = MYR 6,000</p> <p>Maintenance and restocking equipment breakages and consumables per annum MYR 30,000</p> <p>Working on an estimate of 2 week fires per annum the running expenses for 30 personnel in consumables, accommodation, food etc. is estimated at MYR 3000 / team / day for 14 days x 3 team = 126,000 per fire and 2 fires per annum = MYR 252,000</p>	<p>maintenance</p> <p>Over five years total cost = 336,000 to keep three (3) team consists of 30 person equipped. (per team 10 person)</p> <p>3x crews field expenditure on fire suppression = MYR 252,000 / annum. Over 5 years = MYR 1,260,000</p> <p>Budget recommendation for five years of fire suppression effort = MYR 1,260,000</p> <p>Total : MYR 1,596,000 (5 years)</p>
<p>Establish and equip 1x Heavy fire crew for suppression and deployment within NSPFS.</p> <p>It is proposed the Government staff such as Selangor Forest Dept. and the Fire and Emergency Rescue Department will cover the costs of their staff time.</p> <p>Support from NGO's will not be paid salary but reimbursed expenses.</p> <p>Volunteer support from Communities will not</p>	<p>1 team comprises ten(10) people (required 3 teams)</p> <p>30 personnel salary - paid by agencies</p> <p>30 personal protective equipment/ PPE (coveralls, boots, gloves, smoke masks etc.), MYR 1000 / person = 30,000 / annum</p> <p>Heavy duty water pump x 3 = MYR 120,000</p> <p>Hoses, couplings, adaptors, nozzles for water pumps = MYR 20,000 x 3 sets</p>	<p>PPE = MYR 30,000</p> <p>Heavy pump = MYR 120,000</p> <p>Pump hoses / adaptors = MYR 60,000</p> <p>Hand tool = 6,000</p> <p>Maintenance / consumables = 150,000</p> <p>84,000 for one crew x 3 teams /crews = 2520,000</p> <p>Over five years total cost = 618,000 to keep three</p>

<p>be paid a salary but reimbursed expenses.</p> <p>Equipment is proposed to be held by the Selangor Forest Department and the Fire and Rescue Department. Secure storage is available at the Raja Musa offices of the SFD.</p> <p>A fire team is proposed to consist of 10 personnel with water pumps and tools capable of initial attack and suppression of a fire.</p> <p>Vehicles to access the fire are to be agency vehicles.</p> <p>Heavy equipment will be hired.</p> <p>To budget estimate these needs per annum of two week duration are used to guide costing.</p>	<p>Hand tools (swatters, rake hoes) = MYR 6,000</p> <p>Maintenance and restocking equipment breakages and consumables per annum MYR 30,000</p> <p>Working on an estimate of 2 week fires per annum the running expenses for 10 personnel in consumables, accommodation, food etc. is estimated at MYR 3000 / team / day for 14 days x 3 teams = 126,000 per fire and 2 fires per annum = MYR 252,000</p>	<p>(3) teams consists of 30 person equipped.</p> <p>1x crews field expenditure on fire suppression x 3 teams = MYR 252,000 / annum Over 5 years = MYR 1,260,000</p> <p>Budget recommendation for five years of fire suppression effort = MYR 1,260,000</p> <p>Total : MYR 1,878,000 (5 years)</p>
<p>It is expected that heavy equipment hire will regularly be required for all fire suppression efforts.</p> <p>It is planned that 4 excavators per fire will be used.</p> <p>Using the estimate of 2 fires per annum for 2 weeks each we will need 112 days of excavator hire per annum</p>	<p>112 days of excavator hire at MYR 1500 / day</p>	<p>Excavator hire = 168,000</p> <p>5 year hire budget = 840,000</p>
	Total Response (5 years)	MYR 4,664,000

Post Fire Recovery Strategies	Resource Requirements	Budget Estimates
Post fire assessment post mortem and documentation of lessons learned	<p>Post fire assessment post mortem can be proposed to be included into the SSFD R&D</p> <p>The proposed budget allocation MYR 100,000 per year x 5 years = MYR 500,000</p>	MYR 500,000
Post fire equipment and infrastructure repair and maintenance	<p>Post fire equipment and infrastructure repair and maintenance can be proposed to be included into the SSFD operation cost</p> <p>The proposed budget allocation MYR 200,000 per year x 5 years = MYR 1,000,000</p>	MYR 1,000,000
Post fire site rehabilitation	<p>The burnt area in FR has to be rehabilitated.</p> <p>Based on the previous fire incident, the burnt area has been increased and more rehabilitation site available in NSPSF. The implementing processes of rehabilitation are water management / raise water table at burnt area and blocking the existing outlet / drains / canal.</p> <p>This measures will encourage the natural regeneration</p> <p>The proposed budget allocation MYR 200,000 per year x 5 years = MYR 1,000,000</p>	MYR 2,000,000

	<p>Planting the suitable plants and maintenance</p> <p>MYR 5,000/ 1ha x 200 ha (in 5 years) = MYR 1000,000</p> <p>This budget in consist of purchasing trees, planting site preparation, planting trees and maintenance.</p>	
	Total Response (5 years)	MYR 3,500,000

Appendix A

Fire History Records

Year 2012

- 1) Parit 16 (Hulu Selangor District -State land) and FC 82 & 96 at Raja Musa FR – 2012

Fire number	2012 / 1
Fire name	Peatland Fire adjacent to RMFR Raja Musa Forest Reserve Fire
Location of start point	FC 82 & 96 (N 3° 30' 42.86", E 101° 26' 29.49")
Start date	05 / 07 / 2012
Finish date	29 / 08 / 2012
Ignition source	Land Clearing for Palm Oil Cultivation
Ignition intent	Accidental
Area burnt (hectares)	± 100 ha in State land ± 6 ha in FR
Map	
Comments	



2) PKPS Clay Mining Area & Raja Musa FR FC 101 – 2012

Fire number	2012 / 2
Fire name	Peatland Fire adjacent to RMFR Raja Musa Forest Reserve Fire
Location of start point	PKPS Clay Mining Area FC 101 (N 3° 27'32.01", E 101° 25'09.88")
Start date	31 / 07 / 2012
Finish date	29 / 08 / 2012
Ignition source	Land clearing for clay mining operation
Ignition intent	Accidental
Area burnt (hectares)	± 200 ha in PKPS land ± 14 ha in FR
Map	
Comments	



3) Bridgestone Planting site (FC 99 & 100) at Raja Musa FR– 2012

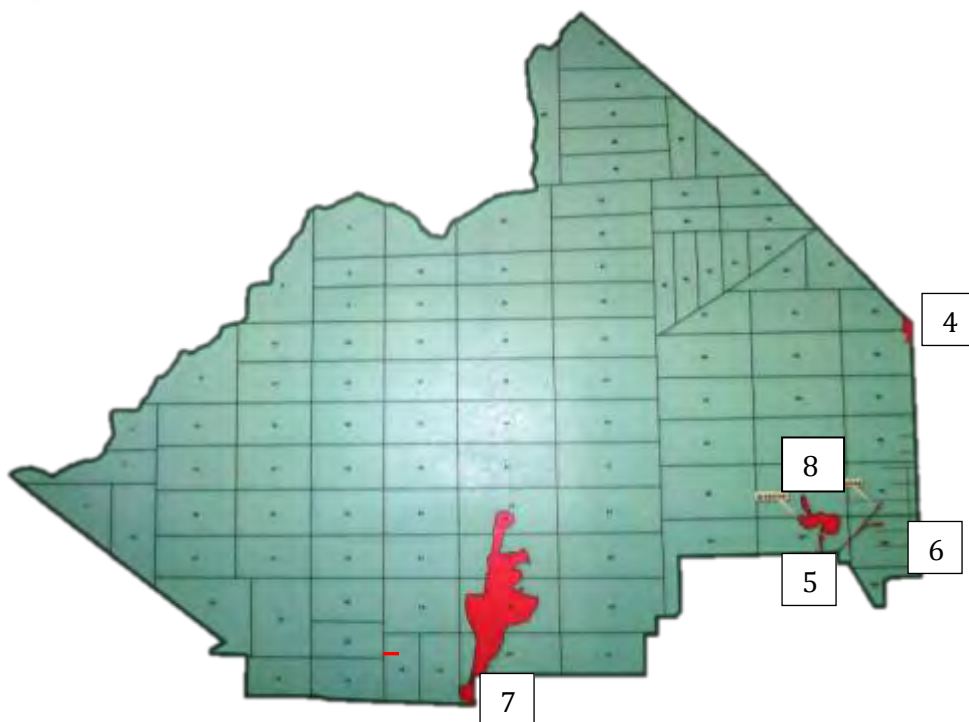
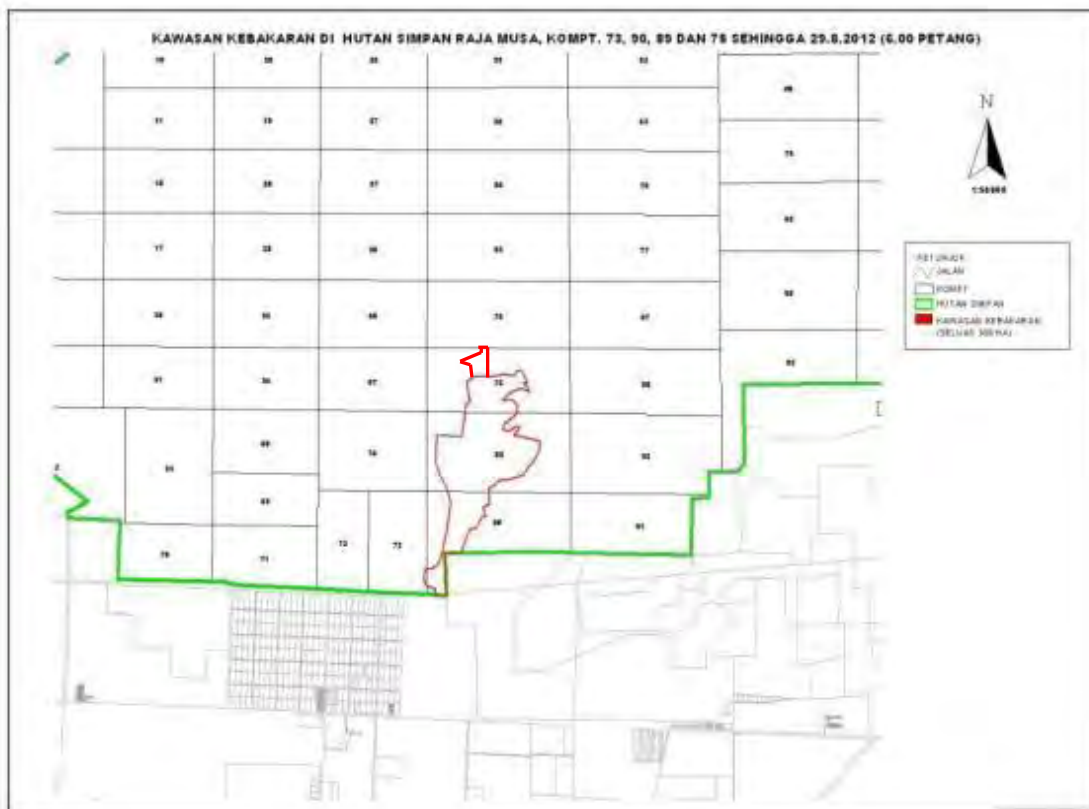
Fire number	2012 / 3
Fire name	Raja Musa Forest Reserve Fire (Bridgestone Planting site)
Location of start point	FC 99 & 100(N 3° 27'32.01", E 101° 25'09.88")
Start date	3 / 08 / 2012
Finish date	17 / 08 / 2012
Ignition source	Spread from Clay mining area
Ignition intent	Accidental
Area burnt (hectares)	± 200 ha in PKPS land ± 14 ha in FR
Map	
Comments	



4) Tokong cina / FC 73 Raja Musa Forest Reserve Fire

Fire number	2012 / 4
Fire name	Tokong cina / FC 73 Raja Musa Forest Reserve Fire
Location of start point	Forest encroachment (N 3° 25'39.65", E 101° 20'11.63")
Start date	28 / 08 / 2012
Finish date	16 / 09 / 2012
Ignition source	Land Clearing for Palm Oil Cultivation
Ignition intent	Accidental
Area burnt (hectares)	± 308 ha
Map	
Comments	





Raja Musa Forest Reserve Fire Map for 2012

5) FC 94 & 101 Raja Musa Forest Reserve Fire

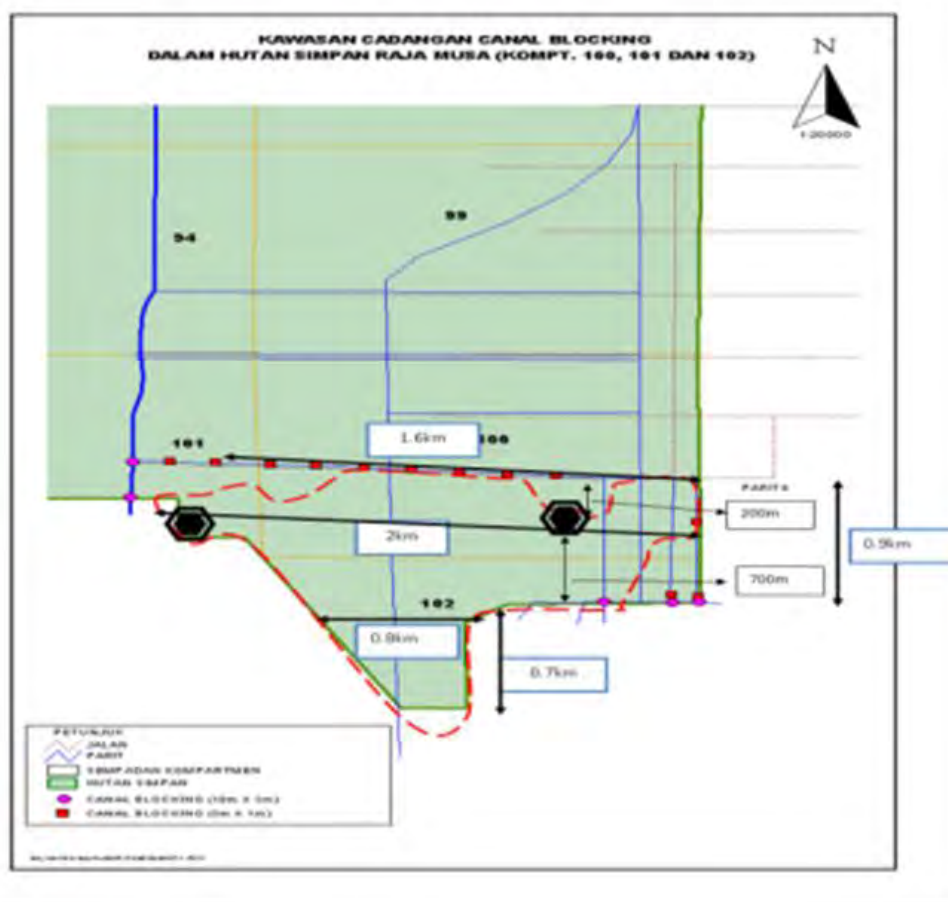
Fire number	2012 / 5
Fire name	FC 94 & 101 Raja Musa Forest Reserve Fire
Location of start point	(N 3° 28'00.34", E 101° 24'52.86")
Start date	5 /10 / 2012
Finish date	26 / 10 / 2012
Ignition source	Extended from FC 102
Ignition intent	Fire was not suppressed completely
Area burnt (hectares)	± 40 ha
Map	
Comments	



Year 2013

1) State land (MBI) & Parit 4 (FC102, 101 & 100)

Fire number	2013 / 1
Fire name	Parit 4
Location of start point	MBI & Parit 4 (N 3° 36'46.67", E 101° 25'57.01")
Start date	3 / 8 / 2013
Finish date	25 / 8 / 2013
Ignition source	Land Clearing for Palm Oil Cultivation
Ignition intent	Accidental
Area burnt (hectares)	± 200 ha
Map	
Comments	



2) Kampung Tawakal A (Hulu Selangor State land)

Fire number	2013 / 2
Fire name	Peatland fire adjacent to Bukit Belata Tambahan FR (N 3° 33'07.24", E 101° 25'11.72")
Location of start point	Kampung Tawakal A
Start date	21 / 9 / 2013
Finish date	28 / 9 / 2013
Ignition source	Land Clearing for Palm Oil Cultivation
Ignition intent	Accidental
Area burnt (hectares)	± 50 ha in Kampung Tawakal A ± 15 ha in Bukit Belata Tambahan FR
Map	
Comments	



3) MRSM construction (Jalan Sungai Panjang)

Fire number	2013 / 3
Fire name	Sungai Karang FR Fire
Location of start point	At the back of MRSM construction (N 3° 42' 22.79", E 101° 07' 56.37")
Start date	25 / 9 / 2013
Finish date	5 / 10 / 2013
Ignition source	Burning of construction waste
Ignition intent	Accidental
Area burnt (hectares)	± 20 ha in Sungai Karang FR
Map	
Comments	



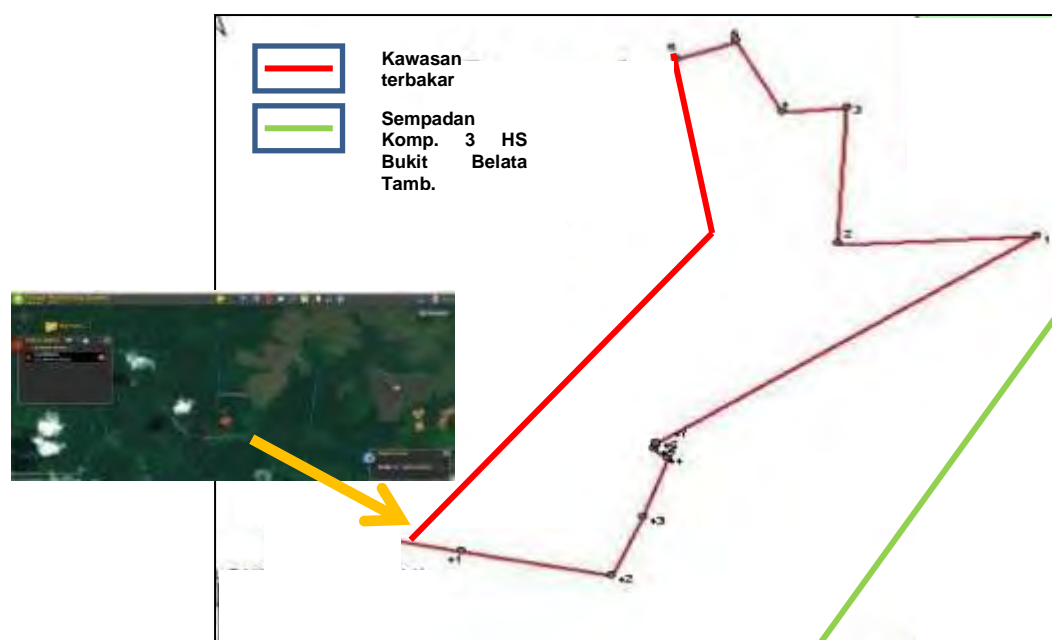
4) FC 85, 86, 94 & 95 at Raja Musa FR

Fire number	2013 / 4
Fire name	Raja Musa FR fire
Location of start point	FC 85,86,94 & 95 (N 3° 28'25.75", E 101° 26'29.65")
Start date	7 / 10 / 2013
Finish date	24 / 10 / 2013
Ignition source	Illegal fishing activities (suspect)
Ignition intent	unintentionally
Area burnt (hectares)	± 500
Map	
Comments	



5) FC 2 & 3 at Bukit Belata Tambahan FR Fire

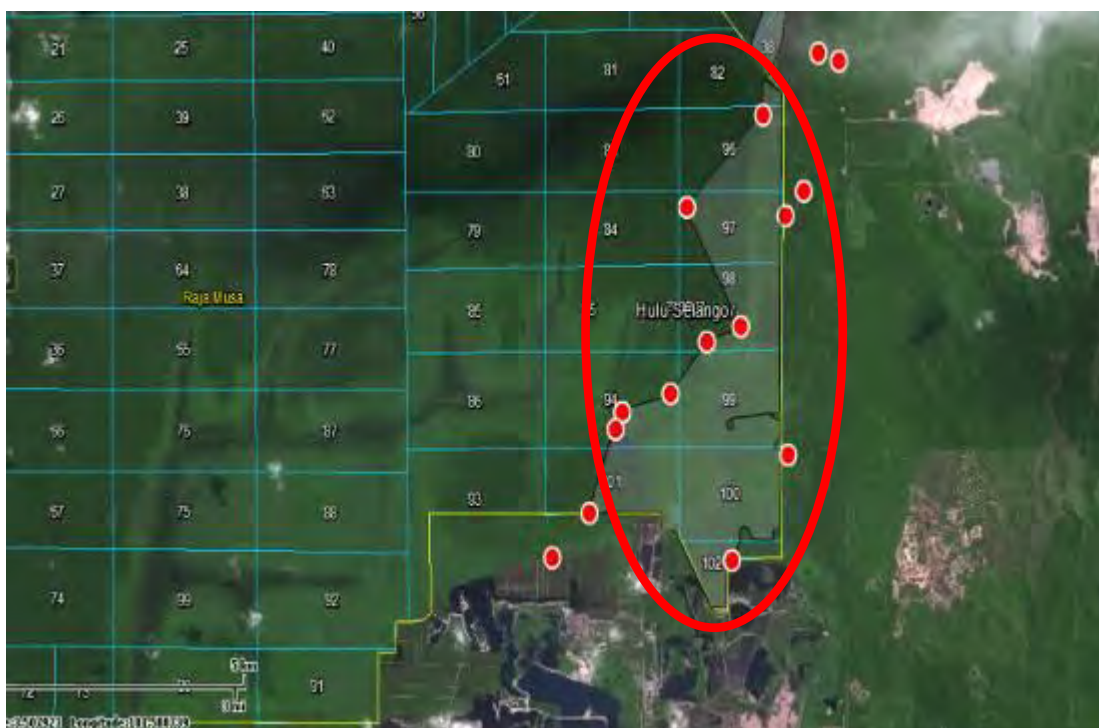
Fire number	2013 / 6
Fire name	Bukit Belata Tambahan FR Fire (N 3° 35'45.43", E 101° 23'06.10")
Location of start point	FC 2 & 3
Start date	7 / 10 / 2013
Finish date	15 / 10 / 2013
Ignition source	Land Clearing for Palm Oil Cultivation
Ignition intent	Accidental
Area burnt (hectares)	± 16
Map	
Comments	



Year 2014

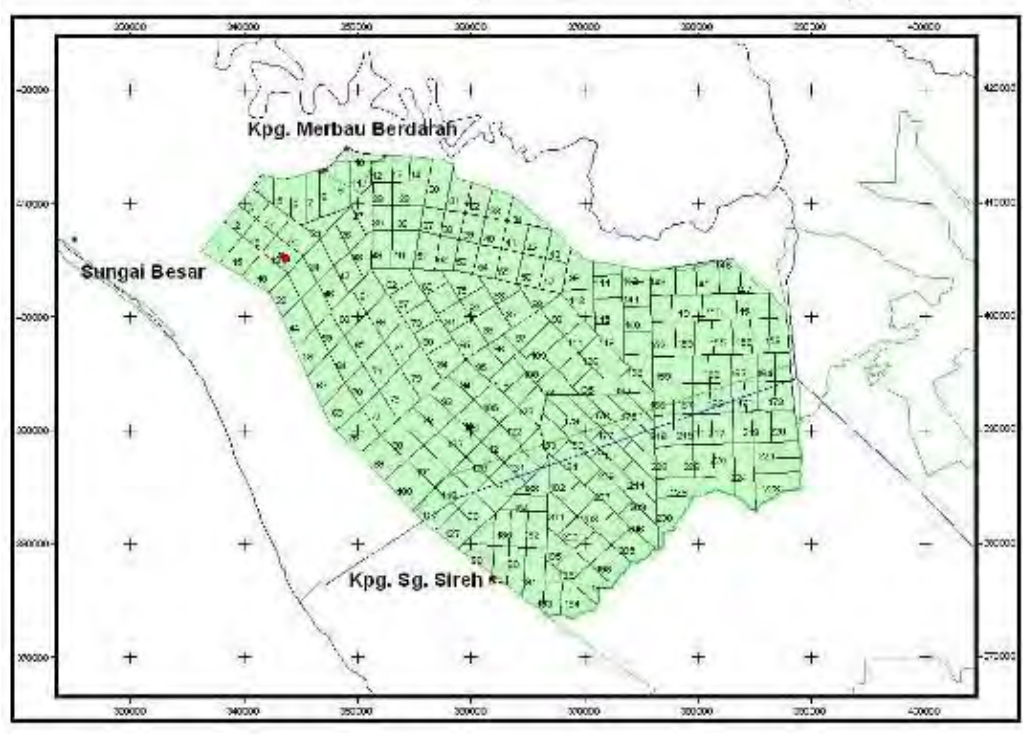
1) Fire at RMFR

Fire number	2014/ 1
Fire name	Raja Musa FR - Fire
Location of start point	FC 82,96,97,98,99, 100, 101,102 (N 3° 30'42.86", E 101° 26'29.49")
Start date	23 / 2 / 2014
Finish date	4 / 4 / 2014
Ignition source	Illegal hunting activities (suspect)
Ignition intent	Unintentionally
Area burnt (hectares)	± 1510 ha
Map	Attached
Comments	



2) Fire at SKFR

Fire number	2014/ 2
Fire name	Sungai Karang FR – Fire
Location of start point	At the back of MRSM construction Sungai Panjang Road Adjacent to JPS canal
Start date	22 / 2 / 2014
Finish date	30 / 3 / 2014
Ignition source	Illegal land clearing activities (suspect) at MRSM Accidental fire at Sungai Panjang Road & adjacent to JPS Canal
Ignition intent	unintentionally
Area burnt (hectares)	± 7 ha
Map	Attached
Comments	



3) Fire at Bukit Belata (Extension) FR

Fire number	2014/ 3
Fire name	Bukit Belata (Extension) FR – Fire
Location of start point	FC 1,2, 5, 35, 37 &38
Start date	23 / 2 / 2014
Finish date	4 / 4 / 2014
Ignition source	Illegal land clearing activities (suspect)
Ignition intent	unintentionally
Area burnt (hectares)	± 249 ha
Map	Attached
Comments	



Appendix B***FIRE SITUATION REPORT FORM***Initial report or situation
update (number)

--

Fire Information

Fire Name:

Fire Number

Date

Time

AdministrationFire report from:
(person, lookout,
aircraft)

--

Contact Phone of
person reporting fire

--

Person receiving fire
report (Name and
office)

--

Contact phone of
person receiving report
of a fire

--

Fire Agency and Person in Command and Control

Agency:

--

Person in Command

--

Contact Phone

--

Fire Location

State

--

District

--

Forest Reserve

--

GPS Coordinates

--

Estimate of Area Burnt

--

Map Attached?

<input type="checkbox"/> Yes <input type="checkbox"/> No
--

Directions to the fire

--

Fire Type

Type of Fire

Smouldering ☐Open Flame ☐Fast moving ☐

Slope:

Flat ☐Moderate ☐Steep ☐

What is burning

Grassland ☐ Shrubs ☐ Slash ☐ Degraded Forest ☐ Closed Forest ☐ Crops ☐ Palm Plantation ☐

Is water available

Yes ☐ No ☐

How far is water (M or KM)

Fire Suppression Resources (present)

People		Equipment	
Community / NGO		4wd Hilux (with water)	
Forestry		4wd water tanker (large)	
Bomba		Excavator	
Plantation / Industry		4wd tractor / trailer	
		Aircraft (fixed wing / helo)	

Fire Suppression Resources (needed)

People		Equipment	
Community / NGO		4wd Hilux (with water)	
Forestry		4wd water tanker (large)	
Bomba		Excavator	
Plantation / Industry		4wd tractor / trailer	
		Aircraft (fixed wing / helo)	

Fire Damage Information

Area Burnt (ha)		Losses	
Forest Reserve:		Infrastructure	
Palm Plantation		Houses	
Agriculture crops		Equipment	

Fire Origin / Investigation

Origin (Date/Time):	
Finish (Date/Time):	
Point of Origin:	(grid ref /lat long/GPS)
Tenure	
Fire Cause:	
Initiate Investigation	<input type="checkbox"/> Yes <input type="checkbox"/> No



INTEGRATED MANAGEMENT PLAN

FOR NORTH SELANGOR PEAT SWAMP FOREST 2014-2023



VOLUME 2

B: REHABILITATION PLAN

EXECUTIVE SUMMARY

Forming the backbone of Integrated Management Plan for North Selangor Peat Swamp Forest (NSPSF), three supported documents were developed at the request of the Forestry Department of Peninsular Malaysia and Selangor State Forestry Department. The three documents are Cooperative Fire Management Plan for NSPSF, Rehabilitation Plan for NSPSF and Buffer Zone Management Plan for NSPSF.

This is the summary of Rehabilitation Plan for NSPSF.

Over the years, large area of NSPSF had been degraded due illegal land clearing, drainages and fire incidents. Therefore it is deemed necessary for the relevant authorities to take the appropriate action to rehabilitate this site from further degradation.

The plan first discusses the root causes of the degradation and illustrates the inter-connection between fire, drainages and degradation. In light of this, three important steps had been identified in rehabilitation- hydrology restoration, fire prevention and re-vegetation. These 3 aspects are inter-linked closely and omitting any would not achieve the desired outcome.

Altogether a total of five management strategies had been introduced in this plan. The first and most important strategy is hydrology restoration. As drainage leads to degradation and fire, it is imperative that these all existing drainages be mapped and blocked. Canal blocking and clay dyke construction is also discussed in detail in the plan. As part of the hydrology restoration, water table in various location of NSPSF is being monitored in long term and the first year results are shown in the plan.

The second strategy is fire prevention; fire can do great damage to any rehabilitation site and it is no surprise that prevention of fire should be prioritized so that fire incidents do not occur. Matters related to fire prevention is discussed in detail in the separate Cooperative Fire Management Plan of NSPSF hence it is only being mentioned briefly here in this plan.

The following three strategies are closely connected to re-vegetation- encouraging natural regeneration whenever possible, assist reforestation if the site is severely degraded and enrichment planting in area with mono-stand.

Past experiences in Raja Musa Forest Reserve is also highlighted to demonstrate the various efforts in rehabilitation. A Map on rehabilitation zones is also produced to facilitate the relevant agencies by showing the location in need of rehabilitation. Six rehabilitation zones have been identified. To complement the map, descriptions on the current situation of the various zones is also provided. From the table, information such as degree of degradation, size and also a short history on the causes can be obtained. Another table focuses on the vegetation description of the rehabilitation zone and highlights the main strategy proposed for the site. These two tables shall provide all the

information needed by the relevant authorities on where and how the rehabilitation should be carry out.

Finally photos of the six rehabilitation zones are also being shown to provide a clearer picture on the current situation of all the degraded sites.

RINGKASAN EKSEKUTIF

Tiga dokumen sokongan telah dibangunkan atas permintaan Jabatan Perhutanan Semenanjung Malaysia dan Jabatan Perhutanan Negeri Selangor untuk membentuk tulang belakang kepada Pelan Pengurusan Bersepadu (IMP) untuk Hutan Paya Gambut Utara Selangor (HPGSU). Tiga dokumen ini adalah Pelan Pengurusan Kebakaran Secara Bekerjasama bagi HPGSU, Pelan Pemulihan bagi HPGSU dan Pelan Pengurusan Zon Penampakan bagi HPGSU.

Dokumen ini meringkaskan Pelan Pemulihan HPGSU.

Selama ini, sebahagian besar kawasan di HPGSU telah musnah akibat penerokaan haram, pembukaan saliran dan kebakaran. Oleh itu, pihak berkuasa yang berkaitan perlu mengambil tindakan yang sesuai untuk memulihkan tempat ini dari kemusnahan lanjut.

Pelan ini membincangkan punca-punca yang menyebabkan kemerosotan dan menggambarkan hubungan-kait antara kebakaran, saliran dan kemerosotan. Sehubungan ini, tiga langkah penting telah dikenal pasti dalam pemulihan: pemulihan hidrologi, pencegahan kebakaran, dan penanaman semula tumbuh-tumbuhan. Ketiga-tiga aspek ini saling berkait rapat dan kekurangan salah satu aspek ini akan menyebabkan hasil yang dikehendaki tidak dicapai.

Sebanyak lima strategi pengurusan telah diperkenalkan dalam pelan ini. Strategi yang pertama dan yang paling penting ialah pemulihan hidrologi. Berikutan pembukaan saliran yang menyebabkan kemusnahan dan kebakaran; adalah penting untuk memetakan kesemua saliran dan menyekat saliran-saliran ini. Kaedah menyekat serta membina benteng tanah liat juga dibincangkan secara terperinci di dalam pelan ini. Sebagai sebahagian daripada pemulihan hidrologi, paras air di HPGSU juga dipantau di beberapa lokasi dan keputusan bagi tahun pertama telah ditunjukkan di dalam pelan ini.

Strategi kedua adalah pencegahan kebakaran; api boleh melakukan kerosakan yang besar kepada tapak pemulihan dan pencegahan kebakaran perlu diberi keutamaan supaya kejadian kebakaran tidak berlaku. Perkara-perkara yang berkaitan dengan pencegahan kebakaran telah dibincangkan berasingan secara terperinci dalam Pelan Pengurusan Kebakaran Secara Berkerjasama ; oleh itu, ia hanya dibincangkan secara ringkas di dalam pelan ini.

Tiga strategi yang berikutnya adalah berkaitan dengan penhutanan semula: menggalakkan pemulihan semula jadi sebaik mungkin, membantu penanaman semula hutan jika kawasan tersebut sangat terosot, dan mempelbagaikan spesies tumbuhan di kawasan yang didominasi oleh satu species sahaja.

Pengalaman lepas di Hutan Simpan Raja Musa juga ditekankan untuk menunjukkan pelbagai usaha dalam usaha pemulihan. Satu peta yang menunjukkan zon pemulihan telah disediakan bagi memudahkan agensi-agensi yang berkaitan dalam mengenalpasti lokasi yang memerlukan usaha pemulihan. Enam zon pemulihan telah dikenal pasti di HPGSU. Penerangan mengenai keadaan semasa di pelbagai zon pemulihan juga disediakan dalam bentuk jadual bagi melengkapkan peta pemuliharaan.

Maklumat-maklumat termasuk tahap kemusnahan, saiz, dan sejarah ringkas mengenai punca-punca boleh diperolehi daripada jadual tersebut. Satu lagi jadual memberi tumpuan kepada penerangan tumbuh-tumbuhan zon pemulihan dan mengetengahkan strategi utama yang dicadangkan untuk kawasan ini. Kedua-dua jadual akan memberikan semua maklumat yang diperlukan oleh pihak berkuasa berkaitan di mana dan bagaimana usaha pemulihan harus dijalankan.

Akhir sekali, gambar-gambar bagi enam zon pemulihan ditunjukkan untuk memberikan gambaran yang lebih jelas mengenai keadaan semasa dan tahap kemerosotan.

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Rehabilitation Plan for North Selangor Peat Swamp Forest (NSPSF)

B. REHABILITATION PLAN

1.0 Introduction

This rehabilitation Plan was prepared at the request of the Forestry Department of Peninsular Malaysia and Selangor State Forestry Department as part of the revision of the Integrated Management Plan (IMP) for North Selangor Peat Swamp Forest 2014- 2023.

1.1 Peat Swamp Forest

Peat Swamp Forest (PSF) is a unique and fragile wetland ecosystem. In its natural state, PSF provide various environment functions such as fresh water sources, flood mitigation, biodiversity conservation and carbon storage. PSF consist of three main components: a) peat, b) water and c) vegetation and these components are inter-connected in its functions, hence, disturbing/ altering any one of these would have huge impacts on the whole ecosystem. When the disturbance is human induced, it is often lead to irreversible process which then resulted in negative impacts to the ecosystem.

The process in which peat accumulate took more than thousands of years, but it can be destroyed in just a few years. Lowering of water table provides the perfect conditions for the peat layer above water level to be oxidized and released into the atmosphere. Prolong exposure to the sun also lead to desiccated peat, causing irreversible drying and rendered this peat layered losing the ability to retain water.

Water in PSF is highly acidic and its colour is tea-like reflecting the high level of tannins and organic acids. This unique feature can only be found in PSF ecosystem. This uniqueness has led to the development of specialized fauna and flora that are highly adapted to this water-logged and acidic condition. Man-made drainage canals continuously draining out this precious water from the ecosystem, could lead to negative impacts to the fauna and flora there.

Vegetation in the PSF is highly specialized and adapted well to the unique ecosystem of PSF. Many of the trees have high buttresses or stilt roots in order to thrive in this condition, and many of the species are endemic to PSF. Unsustainable logging and illegal land clearing has caused significant reduction in the number of species.

1.2 Background Setting

Over the last 30 years, large portions of NSPSF had been degraded due to a few factors including: widespread commercial logging, illegal land clearing, drainage and fires. The combination of these factors has resulted in large areas of NSPSF- close to 20,000 hectares being degraded, although

degree of degradation varies greatly from site to site. At the southern portion of NSPSF, most areas had been burned repeatedly that the area had been severely degraded, it is largely void of trees and only covered in grass / lalang (*Imperata cylindrica*). If no mitigating measures are taken to rehabilitate these areas, they may degrade further as the risk of future fires is very high. Therefore, priority should be given to rehabilitate these severely degraded areas.

1.3 Root Causes of Degradation

In order to effectively rehabilitate these areas, it is important to understand the root causes of the degradation- drainages and fires.

a) Large scale logging

In the past the NSPSF was subject to widespread logging with up to 16 logging operations being undertaken at the same time in the 1980s. After the designation of the area as a forest reserve in 1990 – the number of logging licenses was decreased but several concessions continued to operate. Originally logging was undertaken using the railway system where logs were felled and winched to a railway laid on logs across the surface of the peat. This system did not result in drainage of the forest and so the risk of fire was low and regeneration generally good. Starting in the late 1980s, the “traxcavator” logging method was introduced with long canals dug by tracked excavators – permitting drainage and access of the excavators to the forest. Logs were cut and extracted to the canals with the help of the excavators and logs were floated out along the canals. A total of 500 km of these canals led to serious drainage of much of the NSPSF. The lowered water levels from the canals reduced the water levels, enhanced the fire risk and reduced the rate of natural regeneration as many PSF species require high water levels to grow.

b) Illegal land clearing

Illegal land clearing has affected the periphery of NSPSF – primarily in three Northwest and Southeast and Southwest corners. The area affected by such clearing and associated fires is about 2000 ha. Some of the encroachment has been by local communities but those in the SE and SW have been well organized by consortiums which constructed drains and roads into the forest reserve and sold land to settlers. The main use of these areas has been for the cultivation of oil palm – but also for vegetables. Depending on where the land clearing takes place, portion of good peat swamp forest or Mahang dominated secondary forest could be lost. Often, land clearing always followed by fire and drainage, both contribute further to the degradation in the long term.

c) Drainage

All activities carried out in peatlands often required the opening of drainages. This is because natural peatlands are always inundated with water. For e.g. past logging activity used canals for access and transportation. Estimated 500km of canals networks existed in NSPSF as a result of the logging in the past. Farming on peatland also required drainage to lower the water level so that the land can be planted with crops. Uncontrolled drainages caused the peatlands to dry and the forest to die as the water regime is the most important factors that control the existence of a peatlands. Changing the water regime (either too

much or too less) could lead to the disruption of the ecosystem functions, which could then effect the health of the flora and fauna in the ecosystem. As most of the plant species that were found in the peat swamp have very specific adaptation to the high water table, a drop in the water table could lead to unwanted consequences in the futures.

In addition to that, prolong drying could subsequently increase the fire risk.

d) Fires

Fire is the most serious cause of degradation in the NSPSF. All fires in NSPSF are man-made with the start either being for land clearing in and adjacent to the forest or as a result of camp fires or discarded cigarettes linked to hunting and fishing activities. Fires are almost always linked to drainage. The drains lower the water table drying out the peat surface and the vegetation and making it also more fire prone. Drains also provide areas of lower density vegetation where the fire can easily spread. The bigger the canal, the bigger the risk that a fire will occur and spread. Unlike the impacts of a drainage- which slowly “bleeds the peat to death”, the impacts of fire is more intense and serious. There are two ways fires can cause damages to a site. Firstly, fires destroy above-ground vegetation in a short time frame and secondly, fires also burn the below ground peat layer, usually lasting weeks sometimes even months. A seriously burnt area is usually very hard to regenerate naturally, as the seedbank that may be available within the peat layer is often destroyed together with the smouldering peat. This is why the area that was repeatedly burnt is usually covered with grass or ferns.

Both drainage and fires lead to GHG emission and subsequently carbon loss through oxidation and the burning of the peat layer. Big scale fires could have serious impact on global climate change as huge amount of GHG are releasing into the atmosphere. Emission from peatlands in Se Asia is about 1.3 to 3.1% of the emissions from global fossil fuel burning. This is huge considering the relatively small area of peat.

In lieu of the above reasoning, it is not surprising that rehabilitation efforts should be focused on tackling these root causes. Hydrology restoration and fire prevention hold keys to the success of any rehabilitation efforts. Once these 2 factors had been tackle then only the third step, re-vegetation can take place. If not, the planted trees could be destroyed by fires and years of effort could be gone in a blink.

In short, rehabilitation can be summarized into 3 important steps:

- A. Hydrology restoration
- B. Fire Prevention
- C. Re-forestation

As shown in the Figure 1-1below, these 3 steps are actually inter-connected and lacking either one would not have achieved the desired result. For e.g. drainage causes PSF degradation and also causes fire, fire can further damaged the area; so rehabilitation must stop drainage and fire.

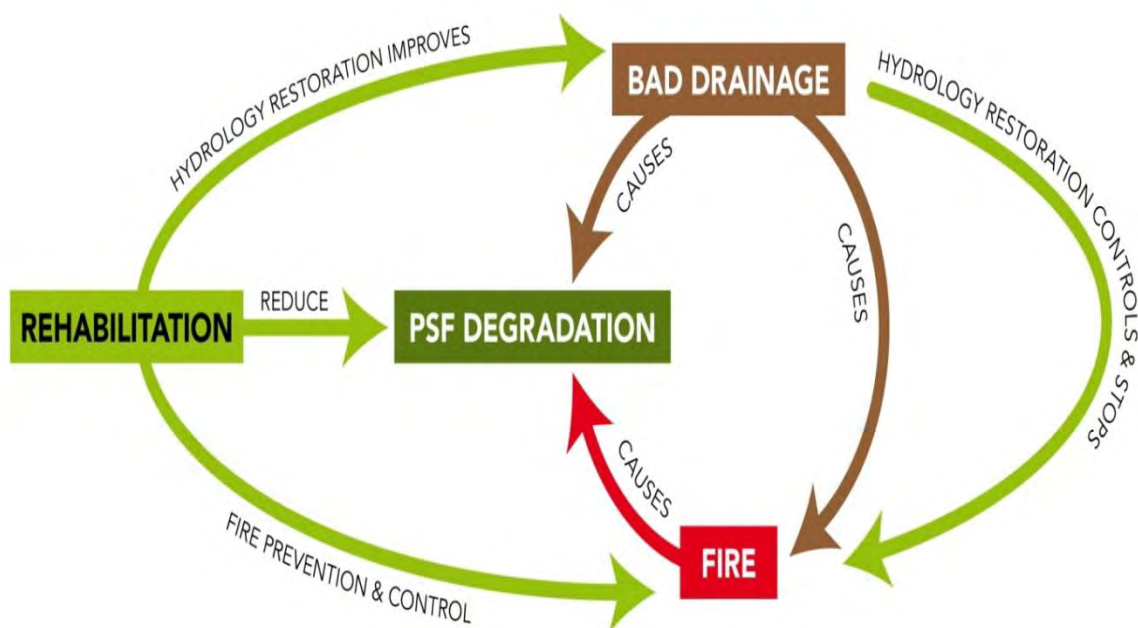


Figure B-1: Diagram showing inter-connection between drainages, fire and degradation

2.0 Management Strategy for rehabilitation in NSPSF

Five key strategies have been identified for the Rehabilitation of NSPSF:

1. Hydrology restoration/ rewetting
2. Fire prevention and control
3. Encourage natural regeneration
4. Assisted re-vegetation
5. Enrichment planting

2.1 Strategy 1: Hydrology restoration/ rewetting

Peat swamp forest is a delicate wetland ecosystem, where water can be considered the “life” of a peat swamp ecosystem, therefore, if the “life” continuously being drained out from the entire system, it is inevitably that it will “bleed” to death slowly. Since badly managed drainage is the biggest cause for PSF derogation, it is imperative that the first step in rehabilitation should focus on stopping the “bleeding” process through restoring hydrology of the degraded site. Some of the actions that can be taken are:

- a) Detail mapping of the canal network in the degraded area
- b) Identify the outlet point of water
- c) Build canal blocks at major outlet point and at appropriate points along the entire length of the Canal to increase water levels throughout the PSF
- d) Quickly establish ground cover to improve the soil moisture if the area is void of vegetation

2.2 Strategy 2: Fire prevention and control

Fire prevention and control is one of the most important parts of rehabilitation process as fire can easily destroy the rehabilitated area. Fire prevention should not only focus on the rehabilitation zone inside NSPSF, but also pay attention to the adjacent land. This is because fires associated with land clearing in adjacent areas are common and could spread inside the rehabilitation zone and damaged the area.

Some of the actions that can be taken are:

- a) Maintain high water level (link to Strategy 1)
- b) Regular patrolling and monitoring to prevent fire incident
- c) Coordination with related agencies to enable rapid response once a fire is spotted
- d) Active dialogue with adjacent land owner/ local communities to reduce the fire risk on peat

2.3 Strategy 3: Encourage natural regeneration

If the extent of degraded area is too large, it will not be practical to conduct assisted planting program to rehabilitate the whole area. Detailed assessments should be carried out at the various rehabilitation zones to gather information to determine if the area should be left for natural regeneration with minimum intervention. Past experiences had shown that if the root cause of degradation is addressed i.e. water level had increased by putting canal block, nature often will regenerate itself.

Condition where natural regeneration can take place:

- a) Area degraded is relatively small
- b) Surrounding area is forested- provide ample seeds/ seeds dispersal agents
- c) Water level is raised
- d) Fire not a threat

2.4 Strategy 4: Assist re-forestation

Nature is its best own doctor, usually PSF will recover through natural regeneration, if the extent of the damage is not too big and the damage is not recurring. However, this process may take years to achieve. Sometimes, nature needs a helping hand as the area may never recover without human intervention due to the degree of the degradation; seedbanks destroyed by fire, seeds dispersal is not available as the forested area is too far away. Established of vegetation may be slow despite high water level and prevention of fire. Often this type of assisted re-generation required high maintenance.

Some of the actions that can be taken are:

- a) Sourcing of suitable planted materials -avoid non peat swamp forest species
- b) Selected species for different site- with pioneer species in open areas
- c) Regular maintenance of the planted trees

2.5 Strategy 5: Enrichment planting

Some areas are dominated by single species i.e. Mahang or Tenggek Burung. Although this area is covered with good stands of trees, it is recommended that enrichment planting to be carried out in this area to increase the flora diversity.

Some of the actions that can be taken are:

- a) Planting of peat swamp forest species such as Meranti bakau, Ramin and Gerunggang
- b) Maintenance of the planted tree to increase survival rate

3.0 Past experiences

3.1 Rehabilitation Initiatives in Raja Musa Forest Reserve



As the first steps towards forest rehabilitation in NSPSF, the forest harvesting operations have been discontinued in 2007. Since then the Selangor State Forestry Department (SSFD) has blocked a large number of small drainage canals in areas opened up for encroachment to prevent drainage and subsequent drying of the peat swamp forest. Some of these areas have been left idle to recover after undergoing major hydrological restoration of raising the water table while other areas have been subject to assisted regeneration. To date there has not

yet been large scale blocking of ex-logging canals.

3.2 Rehabilitation of degraded peat swamp forest demonstrated in Raja Musa FR and adjacent buffer zone

In December 2008, Global Environment Centre (GEC) and the Selangor State Forestry Department (SSFD) started a partnership to rehabilitate portion of Raja Musa Forest Reserve (RMFR) – part of North Selangor Peat Swamp Forest through a community-based rehabilitation programme. The programme aims to rehabilitate the degraded forest areas within and adjacent to the Raja Musa Forest Reserve through community participation as well as protecting remaining intact areas.



The programme includes a range of actions such as canal blocks, replanting at severely degraded areas, fire prevention. The programme involves the engagement of local communities and volunteers in carrying out the seedling production, enrichment planting, post planting treatment and monitoring of threats.

Phase 1 of the programme took place between December 2008 to November 2010. During this period – many community tree planting events were organized in partnership between GEC and the Forest

Department. More than 2,000 volunteers participated in numerous tree planting events at this site and more than 30,000 seedlings were planted on 60 hectares of land. The programme was made possible with support from various corporate sponsors and well as volunteer groups.



On 1st December 2010, the second phase in cooperation was initiated when the Selangor State Government through the Selangor Forest Department and the Global Environment Centre signed a formal Memorandum of Understanding to facilitate an initial three year programme (2010-2013) to support community-based forest conservation and rehabilitation in Selangor State. In this second phase, GEC and the State Government are seeking longer term partners to support not only planting but also long-term protection and

maintenance of the forest. Since the signing of the MOU, such support has been secured from the European Union, Bridgestone Tyre Sales Malaysia Sdn Bhd and HSBC Bank Berhad. These valuable supports have enabled a new rehabilitation area on the eastern edge of the Raja Musa Forest Reserve as well as enhance cooperation with local communities and other stakeholders.

3.3 Community Based Rehabilitation Programme

The community based rehabilitation programme undertaken at RMFR was the first of its kind to be introduced at such a scale in Malaysia. The programme aims to promote local community ownership and participation in forest rehabilitation work at Raja Musa Forest Reserve. Highlighting the awareness of peat swamp forest conservation issues and effectively sharing the importance of North Selangor Peat Swamp forest to the general public.

Among the activities being undertaken by the programme are seedling production, forest planting, post planting treatment and monitoring of the threats such as encroachment and fire.

In short, Community Based Rehabilitation Programme in Raja Musa Forest Reserve focuses on three major aspects:

- a) Hydrology restoration
- b) Fire Prevention
- c) Re-vegetation

a) Hydrology restoration/ Re-wetting

Rewetting of peatlands has the highest priority for addressing peatland degradation and biodiversity loss and for mitigating CO₂ emissions from peat oxidation and peatland fires.

Canal Blocking

When the eastern portion of the RMFR was encroached, numerous canals were dug for farming activities. As a result of this, water level of this area was lowered significantly.



Canal blocking has been undertaken inside and outside of the forest reserve to prevent further drainage of the area. In areas with good access, canal blocks were made using excavators. In other areas, it was done manually by using bags filled with peat/sand and supported by mangrove poles.

The first canal blocks were established in 2008 by the SSFD shortly after the eviction of the illegal settlers. A total of more than 800 blocks have been put in drains in the

edge of the forest reserve. GEC has subsequently built a further 23 units of canal blocks at FC 99 & 100 with the help of volunteers. Currently, GEC is working with SHGSU and local communities to block drains outside of the forest area in the adjacent oil palm and agricultural land.



Water Table Monitoring Systems

To monitor the water table levels within the NSPSF, permanent sampling wells were installed along 6 transects in 2013. Once every month starting from Dec 2013, a team has been sent to 6 transects of NSPSF to collect data on a) water table level and b) subsidence rate.

b) Fire Prevention and Control

Fire prevention is considered one of major aspect of the rehabilitation programme. Fire associated with land clearing and developments in adjacent areas are common and threaten the rehabilitation process. Fire can easily destroy the rehabilitated area and also affect undisturbed forest areas.

Fire prevention: Fire Danger Rating System



Generally FDRS is one of the important tools for fire management. It is a method used to measure the potential (probability) for a fire to start, spread and the damage it can do. In addition, it can be applied in the form of forecasts. FDRS main objective is to provide an early warning of the potential of large forest fires that can cause the occurrence of haze in Southeast Asia caused either locally or transboundary. Early warning generated from FDRS can assist management in implementing operations to reduce fire before it becomes even more critical.

Monitoring the FDRS is undertaken on a daily basis and with extra precautionary measures given during the dry period.

SSFD staff and community members play a pro-active role in the prevention of fires and are essential for the success of rehabilitation programme in the long the run. Patrols are undertaken from the ground from time to time using 4WD car and motorbike.



Fire Suppression

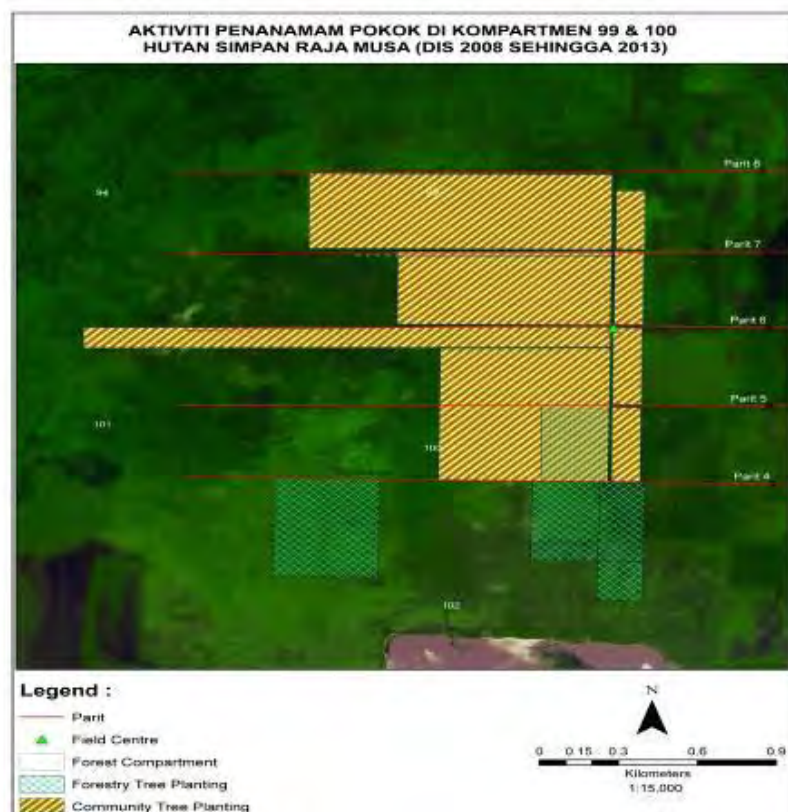
Friends of NSPSF (SHGSU) and local communities have taken their own initiative to patrol, control and extinguish forest fires in the buffer zone. Firefighting work has also been carried out by members SHGSU to support the SSFD inside the RMFR. Volunteers from SHGSU work with the SSFD to patrol the boundary, and fight fires that occur within and adjacent to the Forest Reserve.

c) Re-forestation

As the degraded area has limited vegetation, with collaboration with SSFD, GEC had taken the initiative to established vegetation for the area i.e. through assisted planting activities.

The rehabilitation sites from 2009 to 2013 in Raja Musa Forest Reserve are shown in the following figure:

Figure B-2: Rehabilitation sites in Raja Musa Forest Reserve (Dec 2009- Dec 2013)



Before Planting – year 2008



After Planting – year 2013

Planting activities by Selangor State Forestry Department (SSFD)



Since 2010, SSFD about 100 ha of degraded peatland area been rehabilitated with financial support from Selangor State Government. The seedlings consists of species such as *Shorea leprosula* (Meranti Tembaga), *Anisoptera marginata* (Mersawa paya), *Intsia palembanica* (Merbau), *Gonystylus* sp. (Ramin) *Euodia* spp. (Tenggek Burung) and *Macaranga* spp. (Mahang) and many others.

Monthly Tree Planting & Corporate Social Responsibility



Since December 2009 until June 2014, monthly tree planting activities have been organised at RMFR by SSFD & GEC. The public was invited to participate together with the local government agencies to rehabilitate the degraded peat swamp forest reserve area on monthly basis.

The initial tree-planting event held in the beginning saw a large turn-out and attracted corporate community to the tree planting events. GEC undertook this opportunity in extending the rehabilitation programme for various companies to support the conservation of RMFR.

Since the programme started in 2009, SSFD and GEC has organised more than 9000 volunteers for numerous tree planting events and about 85,000 tree seedlings have been planted in area covering approximately 150 hectares. This activity had offered hands-on experience on conservation value and a great opportunity to explore and to know better the importance and function of the Raja Musa Forest Reserve to local communities and public volunteers.

4.0 Zoning of Rehabilitation

In the IMP for the NSPSF more than 18,000 ha have been allocated in 6 areas for rehabilitation activities as shown in Figure 4.1. Table 4-1 below shows the detail of rehabilitation zone, which comprises about 83 compartments, covering about 24% of the total area of NSPSF. This figure indicates that almost one quarter of the NSPSF is in various degree of degradation and should subject to rehabilitation efforts as soon as possible.

Table B-1: Table showing the proposed management zoning for NSPSF

Management Zone	Compartment		Area	
	Number	Percent	Ha	Percent
A. Potential Production / Water catchment forest	102	29.0	22,574	27.8
B. Rehabilitation zone	77	21.8	18,547	22.8
C. Recreation/ eco-tourism and Education/ Research	40	11.3	8,299	10.2
D. Biodiversity Conservation	121	34.3	30,118	37.0
E. Community Forestry	1	0.3	226	0.3
F. Agroforestry zone	12	3.4	1,521	1.9
Total	353	100	81,304	100

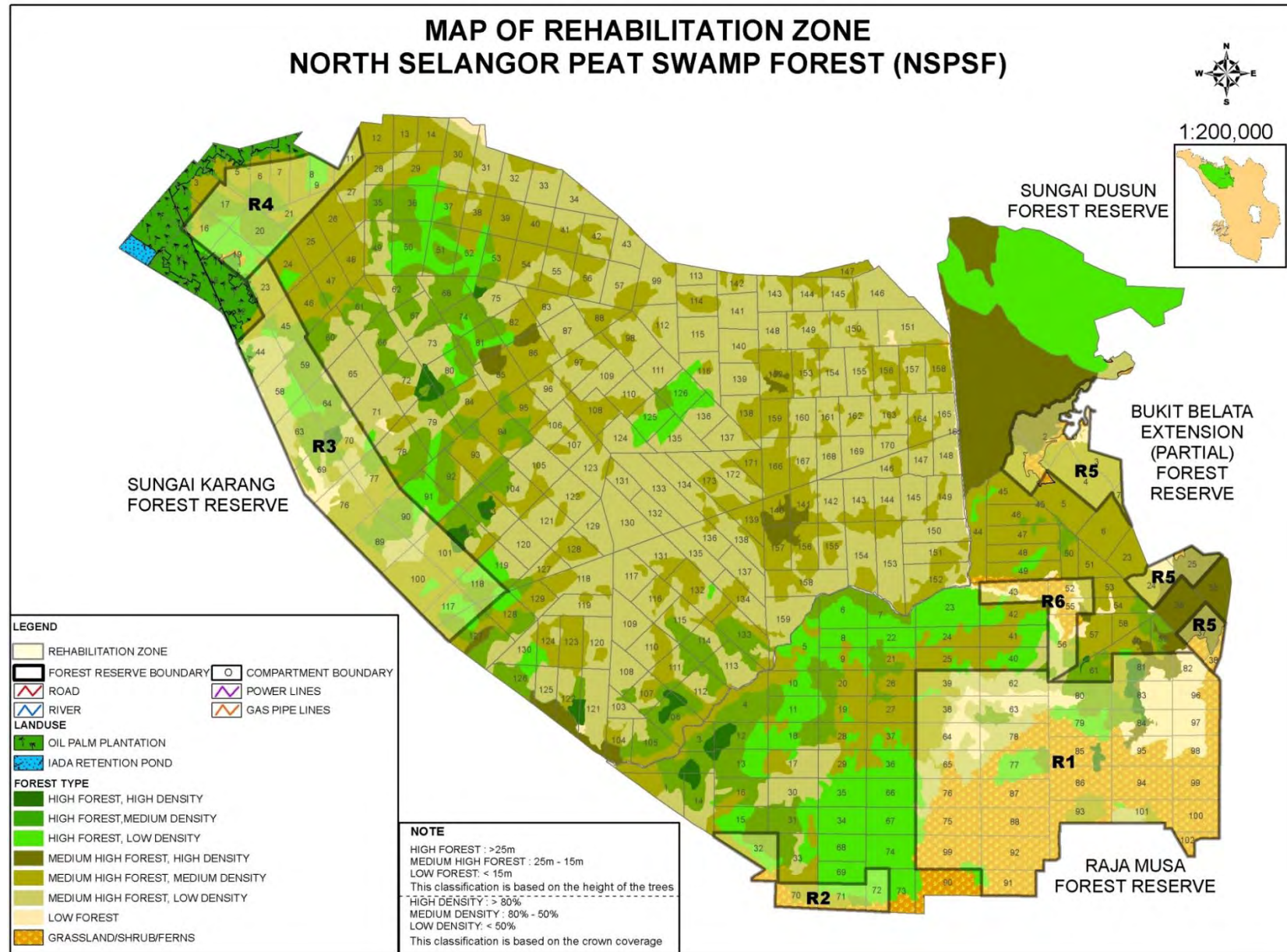
The management strategies for implementing peat swamp forest rehabilitation plan have been developed to rehabilitate the severely degraded peat swamp forest areas in NSPSF. The following are the summary of the management strategies for implementing peat swamp forest rehabilitation plan for NSPSF that are considered as most adequate and applicable:

Table B-2 below give a short description of the current situation of the 6 areas that were identified as rehabilitation zones.

Table B-2: short description of the current situation of the 6 areas that were identified as rehabilitation zone.

	Zone	Description
Rehabilitation zone	R1 (8,836ha)	Severely degraded, fire prone area in se Corner of RMFR with more than 6000ha affected by fire over the last 10-20 years. Main root cause is the extensive network of large logging canals (57km long) in the western portion.
	R2 (798ha)	Degraded portion of forest along the SW corner of RMFR. Approximately 30ha affected by fire. Other portions affected by encroachment, small scale drainage and land clearing over past 6-8 years. Collaboration established with Sime Darby Plantation and communities in the adjacent buffer zone in 2014 to better protect and rehabilitate the area.
	R3 (4,572ha)	Portion of SKFR along the western boundary adjacent to the main irrigation canal of the IADA Rice scheme. Area negatively impacted by construction of a peat/clay bund to prevent water flow from the forest to the main irrigation canal by IADA in 2010. The artificially high water levels have led to significant death of forest in an area of about 600 ha along the boundary.
	R4 (2,012ha)	Combination of forest degraded by fire and encroachment and drainage as a result of adjacent oil palm development in the NW corner of the SKFR.
	R5 (1,565 ha)	Three portions of the Bukit Belata Extension FR which have been affected by encroachment and fire.
	R6 (763ha)	Degraded forest in RMFR which has been affected by fire along an old logging canal connecting to the Sg Tenggi over the past 15 years. The western portion in Compartment 43 is recovering through natural regeneration but the eastern and southern portion has been affected by regular fires in recent times.

Figure B-3: NSPSF Map showing Proposed Rehabilitation Zones



4.1 Characterization of vegetation at the RMFR rehabilitation area

Specific mention must be made to explain the nature of each of the vegetation types:-

- a) Open grassland consist mainly of overgrown Lalang (*Imperata cylindrica*) located in dry degraded peat areas, and indicator of previous land clearing that has been subjected to repeated peat fires. In much wetter areas, aquatic species such as Rumpun purun (*Scleria sumatrana*) and Paku midin (*Stenochlaena palustris*) are quite common. These types of plants are either dispersed by wind or water.
- b) Scrublands are characterised by dense thicket of Kamunting (*Melastoma malabathricum*) species. Together with the species one can also find smaller trees of Mahang (*Macaranga pruinosa*) and Tenggek burung (*Euodia roxburgiana*). These types of plants are mainly bird dispersed.
- c) Secondary forest consists mostly of small to medium sized trees usually not more than 15m tall. In the degraded peat swamp areas this forest type can be mainly dominated by a single species; Mahang (*Macaranga pruinosa*). Other associated species can include Mengkirai (*Trema orientalis*) and Terentang (*Campnosperma coriaceum*). These plant species are also dispersed by birds.
- d) Regenerating forests are characteristic of logged-over forest but have not been subjected to fire. Here one can find many species typical of peat swamp forest. Common species can include Bekak (*Aglaia rubiginosa*), Kelat paya (*Syzygium cerinum*) and Mengkuang (*Pandanus odoratissimus*), etc. These plant species normally bears big fruits and berries and is dispersed either by large birds or small mammals.

4.2 Rehabilitation Strategy

Different sites required different rehabilitation strategies depending on its level of degradation. Table 4-3 shows the main rehabilitation strategy for the six rehabilitation zone of NSPSF. Judging from the size of the area and extend of the degradation, it is recommended that zone R1 to be given the top priority for rehabilitation.

Table B-3: Site and Vegetation description at different degraded areas and rehabilitation measures.

Rehabilitation zone	Site and Vegetation description	Rehabilitation strategy
R1 (8,836ha)	<p>As this area has been subjected to repeated fire over the years, most of the area in this zone is open grassland. Lalang grass (<i>Imperata cylindrica</i>) usually can be seen dominated area that is relatively drier. In much wetter areas, aquatic species such as Rumput purun (<i>Scleria sumatrana</i>) and Paku midin (<i>Stenochlaena palustris</i>) are quite common. At compartment 73 though, a different type of fern (<i>Blechnum indicum</i>) dominates the area. There are areas which mainly consist of ferns (<i>Blechnum indicum</i>) as well as tenggek burung (<i>Euodia roxburghiana</i>).</p> <p>A large network of ex-logging canals about 60km long runs through the area and is the main reason for degradation of the site. A few blocks have been established in the past. However, the number of blocks is not sufficient and more blocks are required at regular intervals.</p>	<p>The main rehabilitation strategy</p> <ol style="list-style-type: none"> 1) To block the large scale drainage 2) Prevent fires 3) Encourage natural regeneration.
R2 (798ha)	An area covered with combination of lalang grass, ferns and shrubs. Nearby is the stand of Mahang (<i>Macaranga pruinosa</i>) trees along the edge of the forest reserve adjacent to oil palm plantations.	<p>The main rehabilitation strategy is to continue the collaboration established with Sime Darby Plantation and communities in the adjacent buffer zone in 2014 to better protect and rehabilitate the area.</p> <ol style="list-style-type: none"> 1) To block existing canal 2) Prevent fire 3) Replanting at open area 4) Enrichment planting at Mahang stands
R3 (4,572 ha)	Logged over forest at the edge of the forest reserve has been negatively impacted by high water levels due to construction	The main rehabilitation strategy:

	of a bund by MOA/IADA. Low density forest which consists mainly of Terentang Paya (<i>Camposperma coriaceum</i>), Mahang (<i>Macaranga pruinosa</i>), Kelat (<i>Syzygium</i> sp.) and <i>Pandanus</i> sp.	<ol style="list-style-type: none"> 1) To restore the natural hydrology by removing or breaching the bund to prevent impoundment of water in the zone 2) Where necessary removal of dead trees in places where it is felt that this may impede regeneration. 3) Natural regeneration will be encouraged with planting only in those areas with serious degradation/high density of dead trees.
R4(2,012 ha)	Areas affected by recent fire have limited forest cover. Some portions have secondary forest dominated by mahang (<i>Macaranga pruinosa</i>) and tenggek burung (<i>Euodia roxburghiana</i>).	<p>The main rehabilitation strategy</p> <ol style="list-style-type: none"> 1.) Restoration of water levels 2.) Fire prevention should lead to natural regeneration.
R5(1,565 ha)	Areas in BBFR (Extension) affected by drainage and recent fire in 2013 and 2014. Nearby is the logged over forest.	<p>The main rehabilitation strategy</p> <ol style="list-style-type: none"> 1) To remove the encroachment, 2) Restore hydrology by blocking drainage canals. 3) Encourage natural regeneration with some selected enrichment planting.
R6 (763ha)	As the area had been subjected to repeated fire, the main vegetation of the area is currently ferns/ lalang grass.	<p>The main rehabilitation strategy</p> <ol style="list-style-type: none"> 1.) Natural regeneration in the western portion in Compartment 43 will be monitored and supplemented as necessary. 2.) Ex-logging canals in the eastern and southern portion will be blocked 3.) Fire prevention by blocking access to the site through Bukit Belata (extension) FR. 4.) Natural regeneration will be supplemented by planting as necessary.

Section 4.3 and 4.4 below provides some guidance on the hydrology restoration with emphasized on canal blocking.

4.3 Hydrology Restoration

Means of Blocking the Canals

Hydrological restoration is relatively straightforward but requires a large scale effort given the extensive network of canals, difficulty of access and need to construct canal blocks that will last a sufficient time. Over the last five years, a few types of canal blocks had been applied in NSPSF in an effort to increase the water level. Below are five of the canal blocks that have been set up in Raja Musa Forest Reserve with some success to increase water level of the degraded area.

I. Peat filling at 50m intervals

By far the most effective canal blocking method for relatively small drains; a peat block about 1-2m wide is put in place by an excavator and compacted. Additional blocks are placed every 50m along the drain. After 2 years of blocking, the stretch in between 2 block will slowly filled up as water flow is reduced to minimum and the block itself would be covered with vegetation. This is more applicable to agricultural drainage as found along the southern and eastern boundaries of Raja Musa FR, rather than large ex- logging canals.

II. Mangrove pole and sand/ clay bags

Another practical, cheap and highly effective blocking method. Relatively easy to set up for small to medium size drainage canals, however could be a challenge for main canals. This type of block has been put into agricultural drains in encroachment areas in the Southeast of Raja Musa Forest reserve. Such blocks can be installed by hand and so don't need access by heavy machinery which can cause damage in partly vegetated sites or are in sites far into the forest. This type of block has been places successfully 4km into the forest in compartment 76 on an 8m wide ex-logging canal.

III. Rock fill dam

This type of dam has proven to be very effective in blocking large drainage canals – for example at the edge of the RMFR compartment 73, water level was raised significantly by the rock dam initially installed in 2007 and repaired in 2012. This type of dam is sufficiently strong to withstand the high water pressure from the long logging canals. However regular monitoring is needed to ensure that the dam is intact and the water does not cut around the edge of the dam and erode the peat.

IV. Tree trunk, geotextile and clay dam

This type of block is a larger version of the type II dams above but has yet to be installed in NSPSF but has been used effectively in Indonesia. This consists of 2-3 rows of tree trunks across the canal with the gaps in between filled with either clay or sandbags wrapped in geotextile. This is suitable for large logging canals.

V. Clay bund

This is a relatively new method where a stretch of few hundred meter of peat was dug up and replaced with clay. This type of block has been used very effectively adjacent to Compartment 101 on the southern boundary of RMFR to prevent surface and subsurface drainage of the RMFR to adjacent mining areas. This method requires the usage of excavator and clay materials which is generally available along much of the southern boundary of the NSPSF.

Density and Nature of Blockages

The number of block required to achieve effective result depends on the length of the drainage canals as well as the gradient of that area.

a) Length of canals

The longer the canals, the more blockage is needed, this is to reduce pressure in between the separate blocks. Solitary blocks at the end of the canals would result in extreme water pressure – increasing the risk of failure - as well as being ineffective in raising the water level in the interior of the forest due to the domed nature of the peat.

b) Gradient

The steeper the area from the centre of the peat dome, more blocks are required to achieve the desired water level. In areas of shallow slope – maybe 1-2 blocks per km will be needed whereas with steeper slopes – maybe one block every 300m is needed. For canals that run across the slope one block every km may be sufficient. Ideally the drop (i.e. height difference in water between the front and back of the block) should be no more than 20-30cm for optimal water levels. The average water level should be about 10-15cm below the surface level of the peat.

c) Sequence

It should be noted that although estimated 500km of canals are left abandoned from past logging activity and blocking the canals will take significant time and resources. The proposed priorities for selection of canals for blocking are:

- Fire prone area over non fire prone area
- Main canal over secondary canals
- Edge of the forest over center of peat dome

d) Height and width

The canal block should preferably be higher than the surrounding land to cause the canal water to flow overbank into the surrounding landscape before it returns to the canal further downslope. A series of these canal infill points starting at the top of the canal system and moving down the canals toward their outflow points will slow the speed of drainage, reducing erosion risks. A requirement of the canal block is to also rapidly establish vegetation on top of the block and the fan walls to reduce the risk of erosion and washing away during peak rainfall events

Priority Area identified for canal block

Drainage of the NSPSF constitutes a severe threat to the PSF ecosystem, and measures to address this threat should be initiated immediately. The key steps are to:

- Prepare a work programme that stipulates that canals should be blocked when and how, and detailed cost estimates for the exercise.
- Implement the work programme using local contractors and local community as appropriate.

Table B-4 and Figure B-2 below shows the location of the priority areas for canal blocking in NSPSF. The length of canals in these priority areas is 163km or about one third of total length of ex-logging and other canals in the NSPSF. In the long term it is proposed that all canals in the forest are blocked to enhance natural regeneration and prevent fires. However in the current management plan period (2014-2023) – the priority canals should all be blocked.

Table B-4: Location of priority areas of canals for blocking in NSPSF

No	Location	Approximate length	Description	Justification
CB1	Western portion of RMFR Management Zone R1 and E5	60km	Abandoned logging canals (8-10m wide)	Root cause of regular fires and poor forest regeneration in SW portion of RMFR in an area covering about 4000ha.
CB2	Eastern portion of RMFR Management Zone R1	20km	Abandoned agricultural drainage canals (Parit 1-16) in formerly encroached area adjacent to Bestari Jaya-Sg Tenggi road	Root cause of fires and forest degradation in southwest corner of RMFR in an area of about 1000ha. 70% of canals blocked in 2008-9 but repairs and upgrading of the blocks are needed
CB3	SW corner of RMFR in Management Zone R2	10km	Abandoned agricultural drainage canals along forest boundary	80% of canals blocked in 2008-9 but repairs and upgrading of the blocks are needed
CB4	North east portion of RMFR in Management Zone R6	6km	Abandoned logging canals (8-10m wide)	Root cause of regular fires and poor forest regeneration in zone R6.
CB5	Northern end of BBFR in	6km	Drainage canal 5-8m wide for logging access	Root cause of regular fires and poor forest

	management Zone R5		and agricultural drainage of adjacent land area in Kg Tawakal	regeneration in northern section of zone R5.
CB6	Sg Tenggi/JPS diversion Canal	18km	Nine Logging canals draining RMFR and SKFR into Sg Tenggi	Poor forest regeneration along both sides of the Sg Tenggi. Drainage reduces water storage function of forest and increases fire risk.
CB7	Northern boundary of SKFR	18km	Six Logging canals draining SKFR into drains along Sg Panjang road.	Root cause of regular fire along both side of the road. Drainage reduces water storage function of forest and increases fire risk
CB8	Western SKFR and RMFR along main irrigation canal	15km	Five large logging canals draining the western portion RMFR	Poor forest regeneration Drainage reduces water storage function of forest and increases fire risk

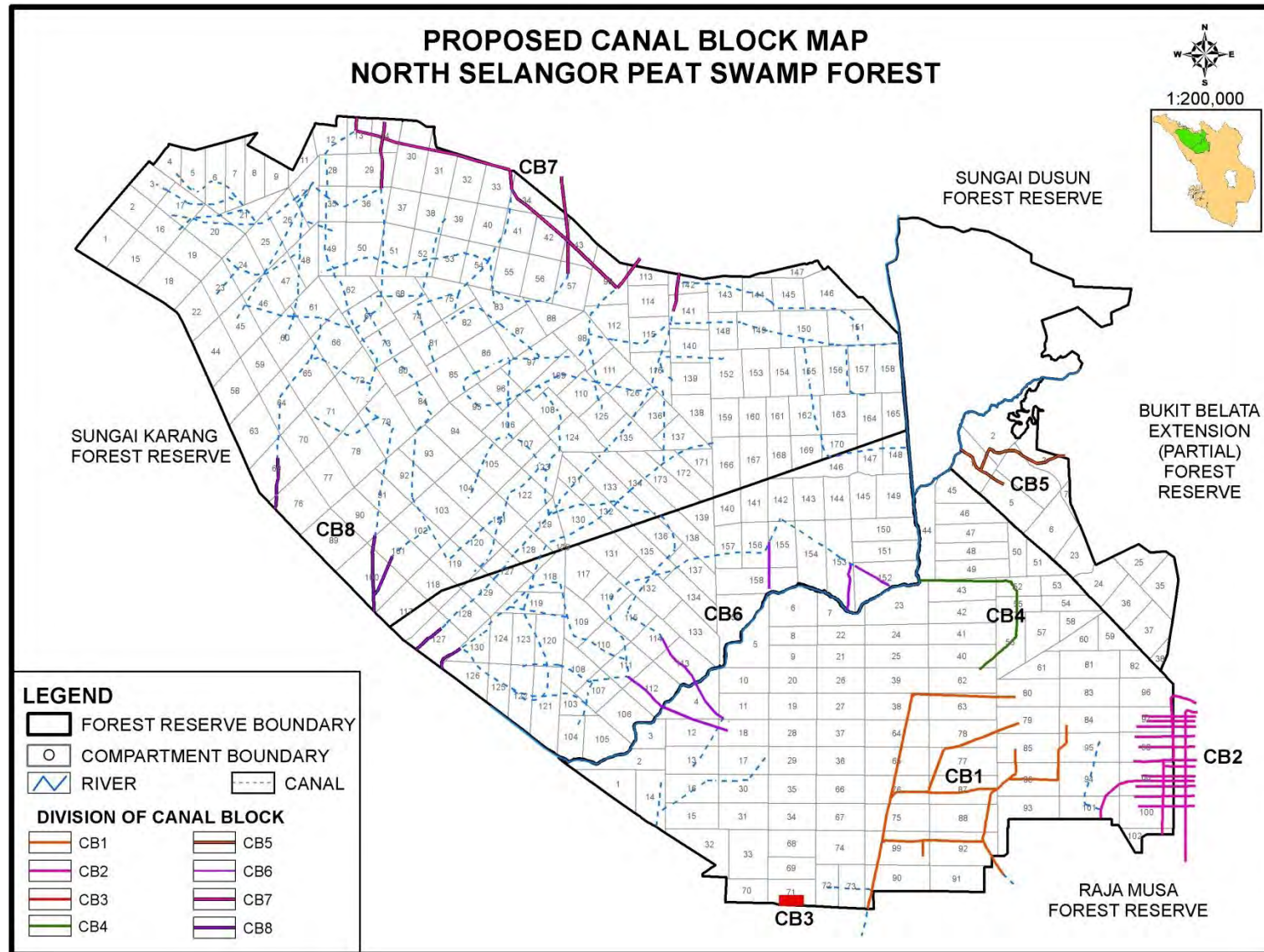


Figure B-4: Location of priority areas of canals for blocking

Figure B-5: Photos below showed the result of effective canal blocking at compartment 73

Good canal blocking would increase the water level and subsequently provide an ideal condition for vegetation to recover as shown in the 2 photos below. Photo on the left was taken on 29th August 2012 and photo on the right was taken 19 months after the fire incident, on 17th March 2014. As can be seen from the photo, natural regeneration can take place when the condition is right. Since this canal is about 9km long with a three secondary canals, a number of blocks are required to achieve the maximum results. Ideally canal blocks should be established at regular interval i.e. 300-500m/block.



Development of a Clay dyke along the southern boundary of the RMFR

As discussed earlier, the construction of a clay dyke within the buffer zone along the southern boundary of the RMFR is required to isolate the forest reserve from the adjacent ex-tin mining area. This will prevent the sub-surface drainage of the peat and maintain high water levels in the forest edge minimizing the risk of subsidence and fires and enabling the forest to recover. This will also complement the development of the proposed water retention supply scheme (HORAS 600 and HORAS 3000) in the area of ex-mining ponds to the south of the proposed clay dyke. The clay bund will increase the storage in the RMFR in the wet season – which will likely maintain and increase the water flow to the HORAS area in the dry season

The proposed location of the bund is given in Figure B-6 below.

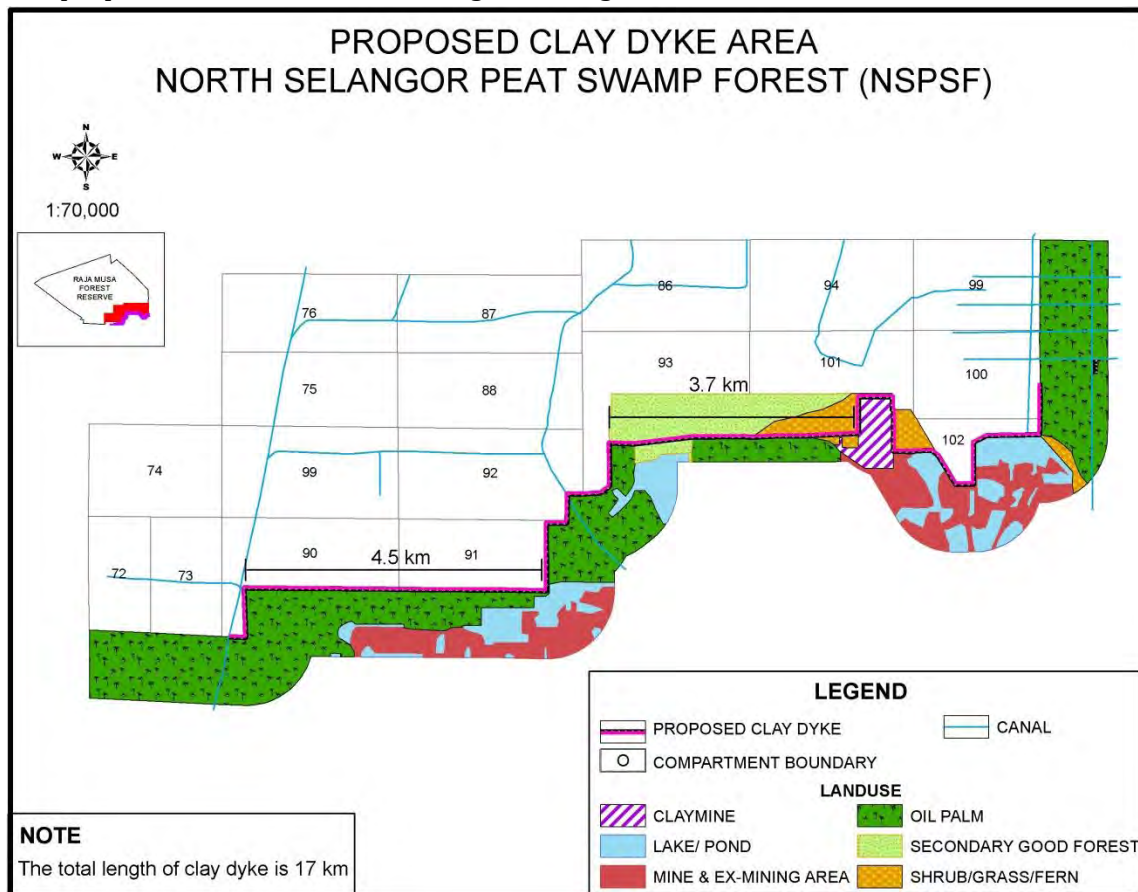


Figure B-6: Location of proposed clay bund

Figure B-7: Example of clay bund adjacent to clay mining area

Clay bund is new method that was introduced in RMFR in an effort to increased water table of that area. 2 photos below demonstrate the effectiveness of the clay bund; photo on the left was taken on 29th August 2012 just after an extensive fire impacted the area. The photo on the right was taken 12 months later, on 17th August 2013. As the water level is raised and fire prevented, natural regeneration can take place. Since the area is adjacent to clay mining, raw material for clay bund is readily available and is not a problem. However, if a long stretch of few kilometre of clay bund is to be proposed, then sourcing of clay material will be crucial. Other information that will be useful to establish clay bund includes peat depth along the southern edge of RMFR is provided in Annex1 for reference.



Water Table Monitoring

In 1997-98, piezometers were positioned in 2 transects perpendicular to a canal to measure the impacts of canals on water levels. During dry period, reading more than 1m below peat surface was recorded and none of the reading had recorded water above surface.

In 2014, more piezometers were established to look at the same impacts but from different areas around NSPSF. Altogether, a total of 38 piezometers were placed along 6 transects, all perpendicular to a canal (see Figure 3-5). There are 2 transects where piezometers are placed on both side of the canal- Tokong Cina Transect and Parit 4 Raja Musa Transect.

Table B-5 below shows the summary of each transect. Major vegetation types that were common in NSPSF were represented i.e. logged forest, grassland, shrub/ ferns and oil palm.

Table B-5 and Figure B-8 provide more details for each transects.

Table B-5: Details of the piezometer established in NSPSF in 2013-14

Transect Name	Vegetation	No of piezometer and (distance)	Canal perpendicular to
1 Jalan Sungai Panjang/ JSP	Logged over/ secondary forest	5 (5m, 50m, 150m, 250m and 500m)	Boundary canal
1 Terusan Sg Dusun/ TSD	Logged over / secondary forest	5 (5m, 50m, 150m, 250m and 500m)	Boundary canal
2 Parit 4 Raja Musa North/ P4R_N	Shrub/ lalang grass	4 (5m, 50m, 150m and 250m)	Small drainage canal from farming
3* Parit 4 Raja Musa South/ P4R_S	Lalang grass	3 (50m, 150m and 250m)	Small drainage canal from farming
4 Tokong Cina West/ TC_W	Logged over/ secondary forest	5 (5m, 50m, 150m, 250m and 500m)	Big ex-logging canal
4 Tokong Cina East/ TC_E	Ferns/ shrubs	4 (50m, 150m, 250m and 500m)	Big ex-logging canal
5 Kunci Air Sungai Burung/ KASB	Ferns/secondary forest/logged-over forest	7 (5m, 50m, 150m, 250m, 500m, 750m and 1000m)	Main Irrigation canal
6 Jalan Hj Dorani/ JHD	Oil palm	5 (5m, 50m, 150m, 250m and 500m)	Field drain

* Note: All the piezometers at Parit 4 Raja Musa South were destroyed during a fire in March 2014.

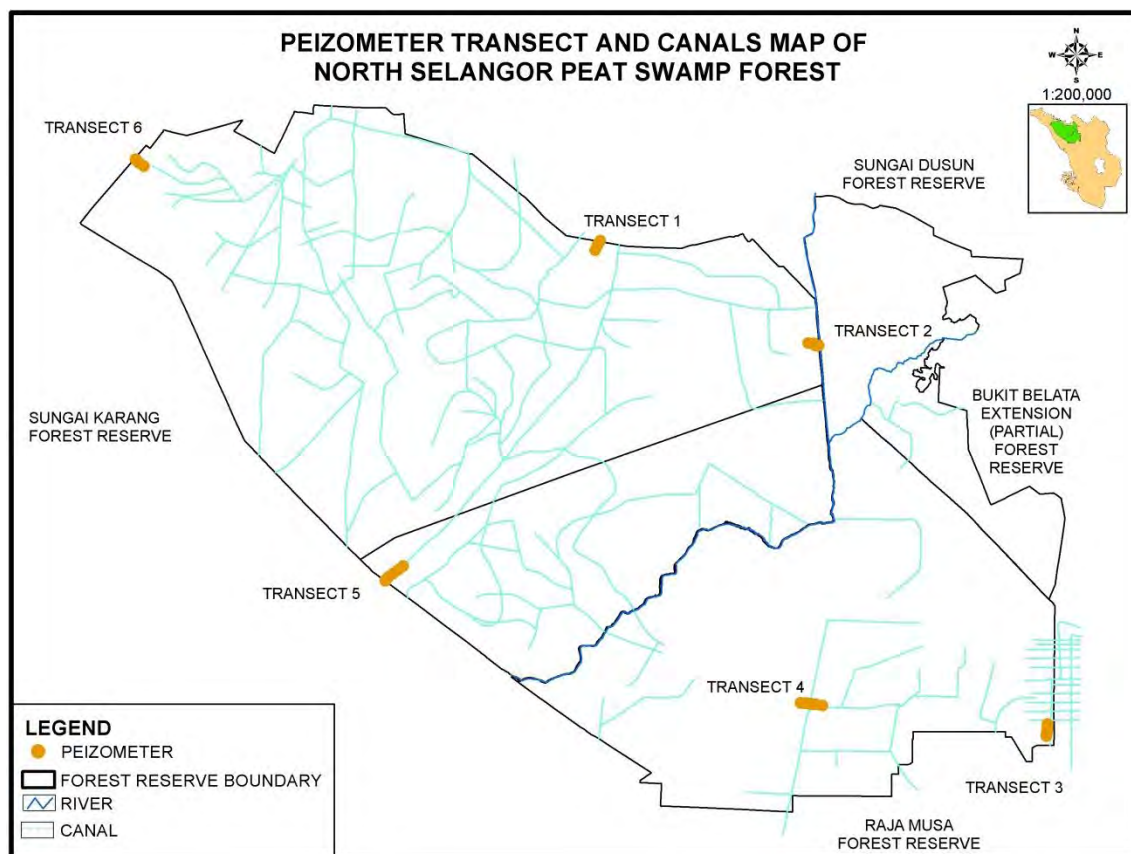


Figure B-8: Map of NSPSF showing the canals network and 6 locations of the piezometer

From December 2013 till December 2014, water tables for all the 38 piezometers were recorded manually once a month. Based on the field observation and measurements taken for 13 months, it can be summarized that in general, water tables fluctuate in sync with the wet and dry seasons, although the level of fluctuation varied greatly across the 6 transects.

There are 3 distinct peaks; December 2013, May & June 2014 and November 2014. Most of the sites recorded low water table in the month of February & March, (where Malaysia as a whole experienced an unprecedented drought) and in July & August. For more details on the water table for the 6 transects, refer to Figure B-9 to B-16.

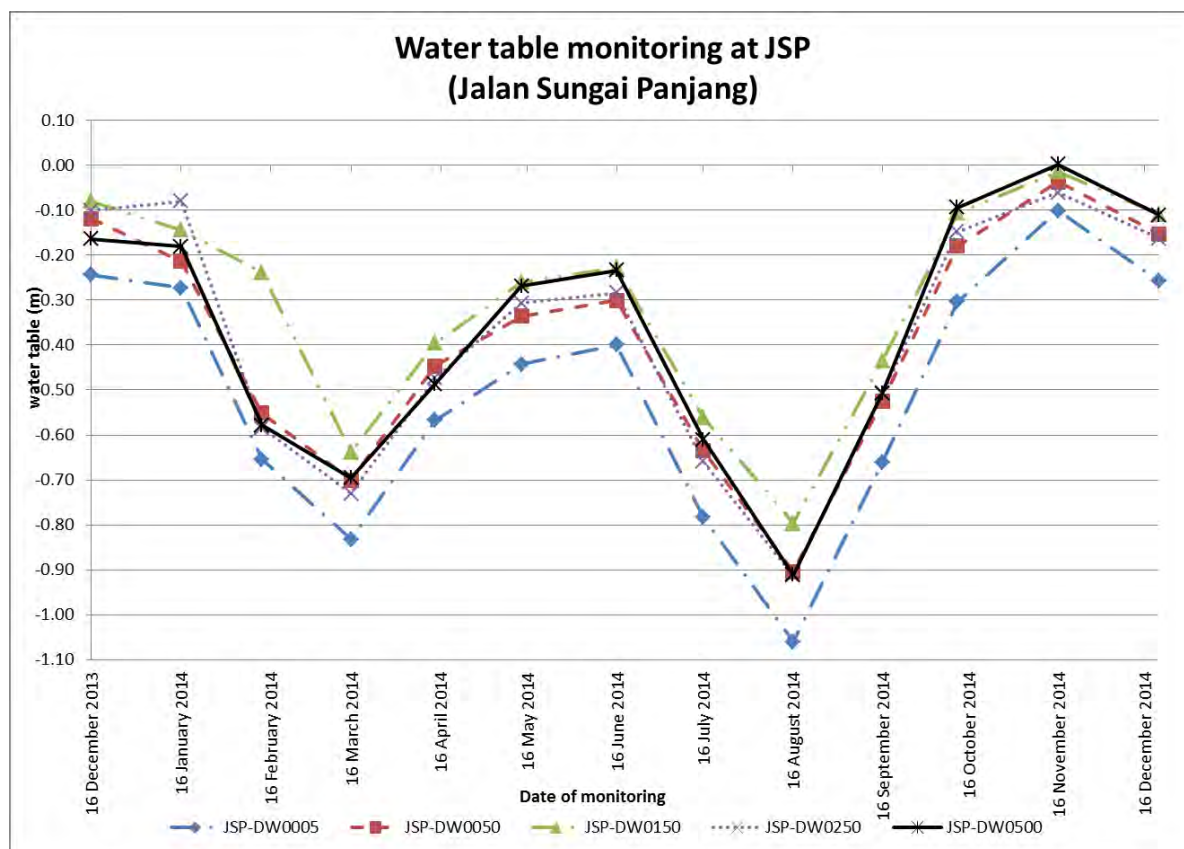


Figure B-9: water table depth at JSP from Dec 2013 to Dec 2014

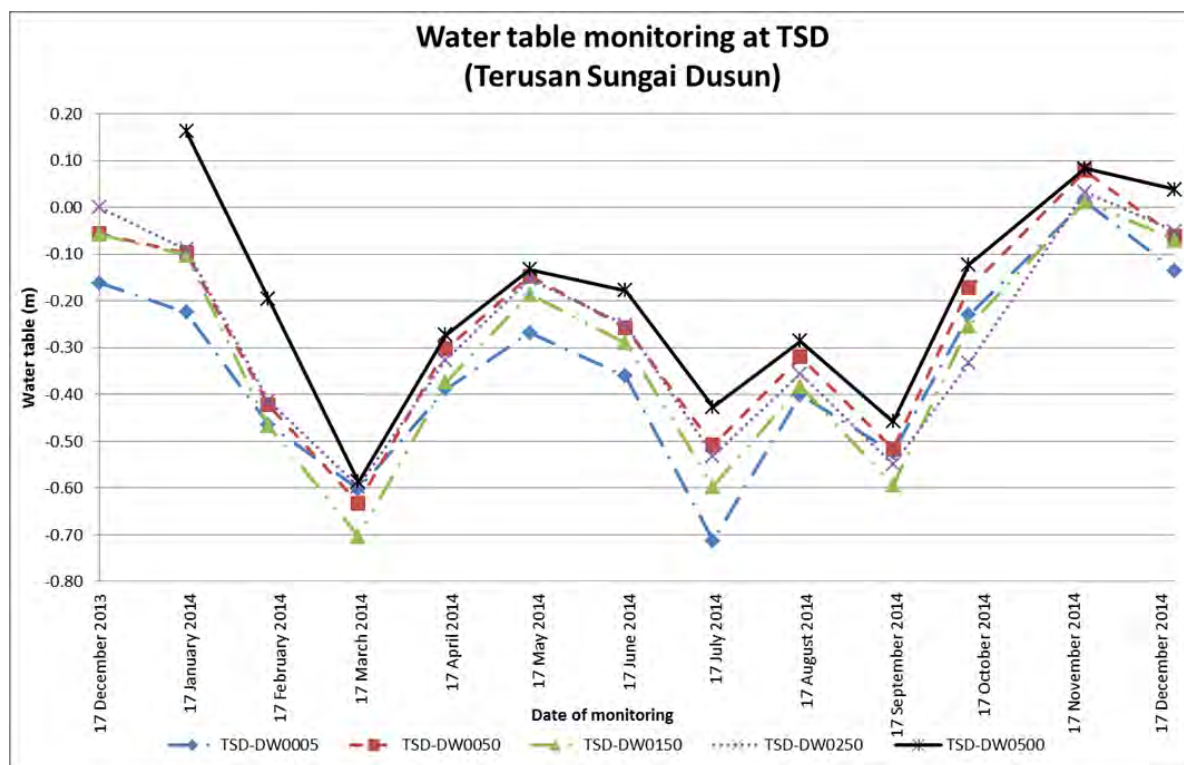


Figure B-10: water table depth at TSD from Dec 2013 to Dec 2014

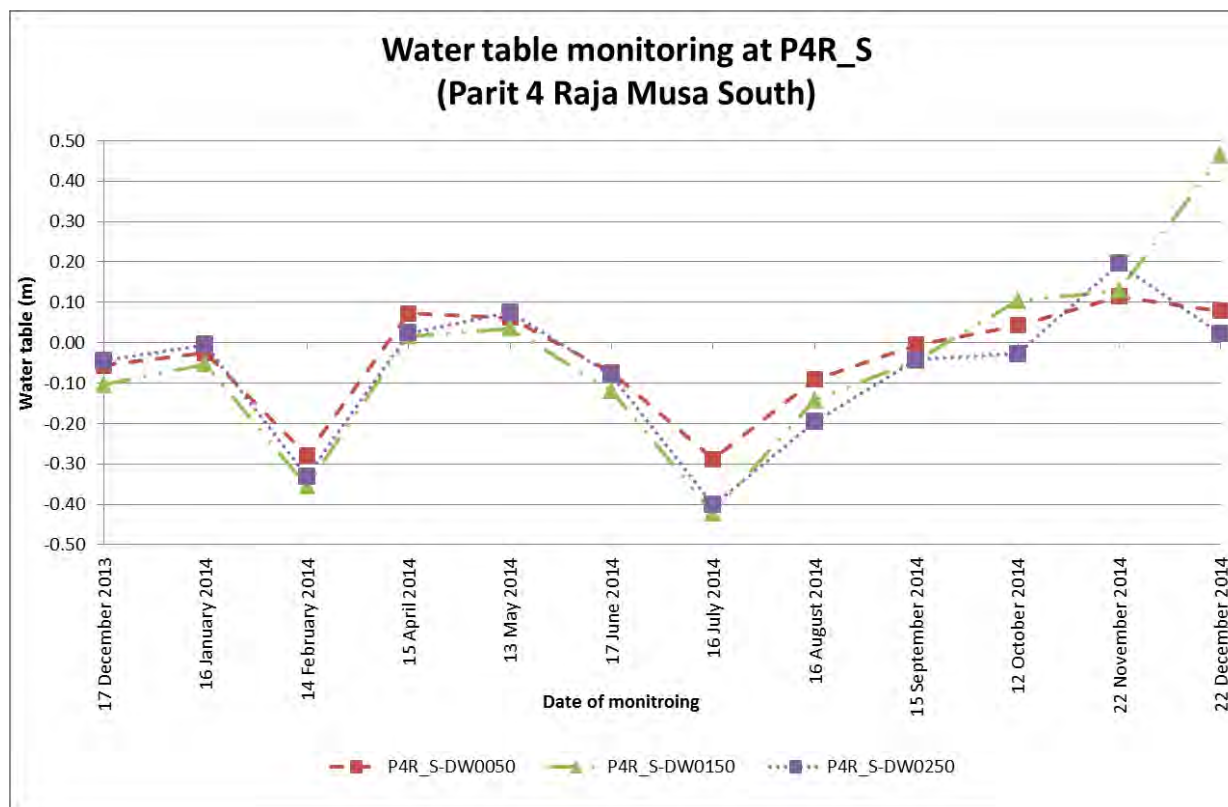


Figure B-11: water table depth at P4R_S from Dec 2013 to December 2014

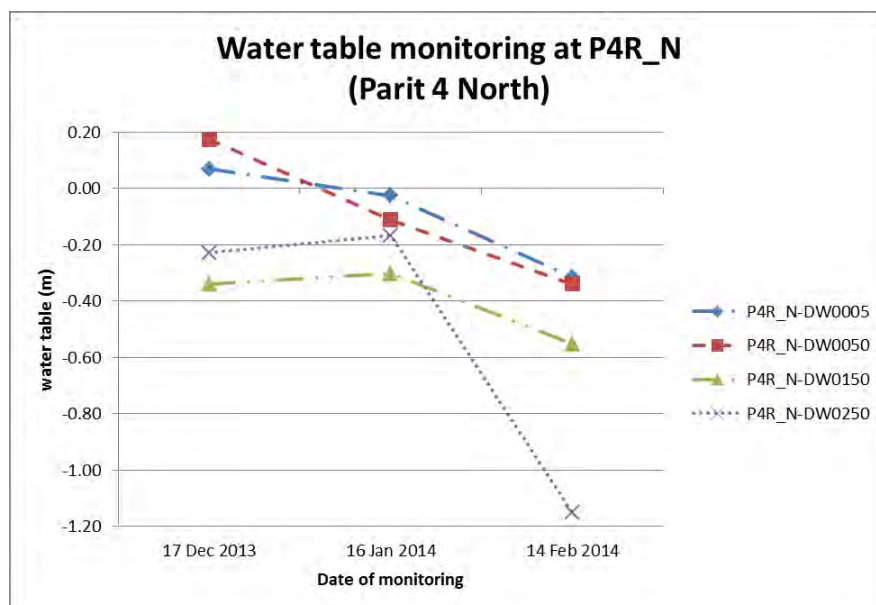


Figure B-12: water table depth at P4R_S from Dec 2013 to Feb 2014

Note: All the piezometers at Parit 4 Raja Musa South were destroyed during a fire in March 2014.

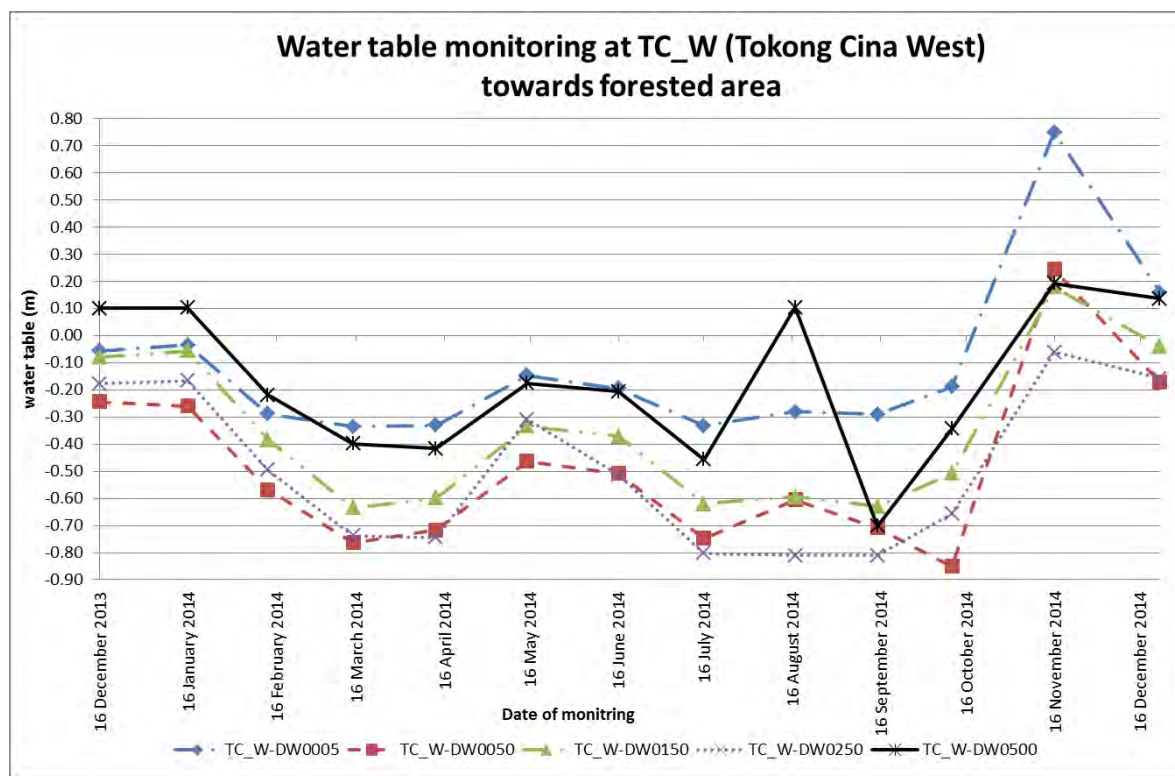


Figure B-13: water table depth at TC_W from Dec 2013 to Dec 2014

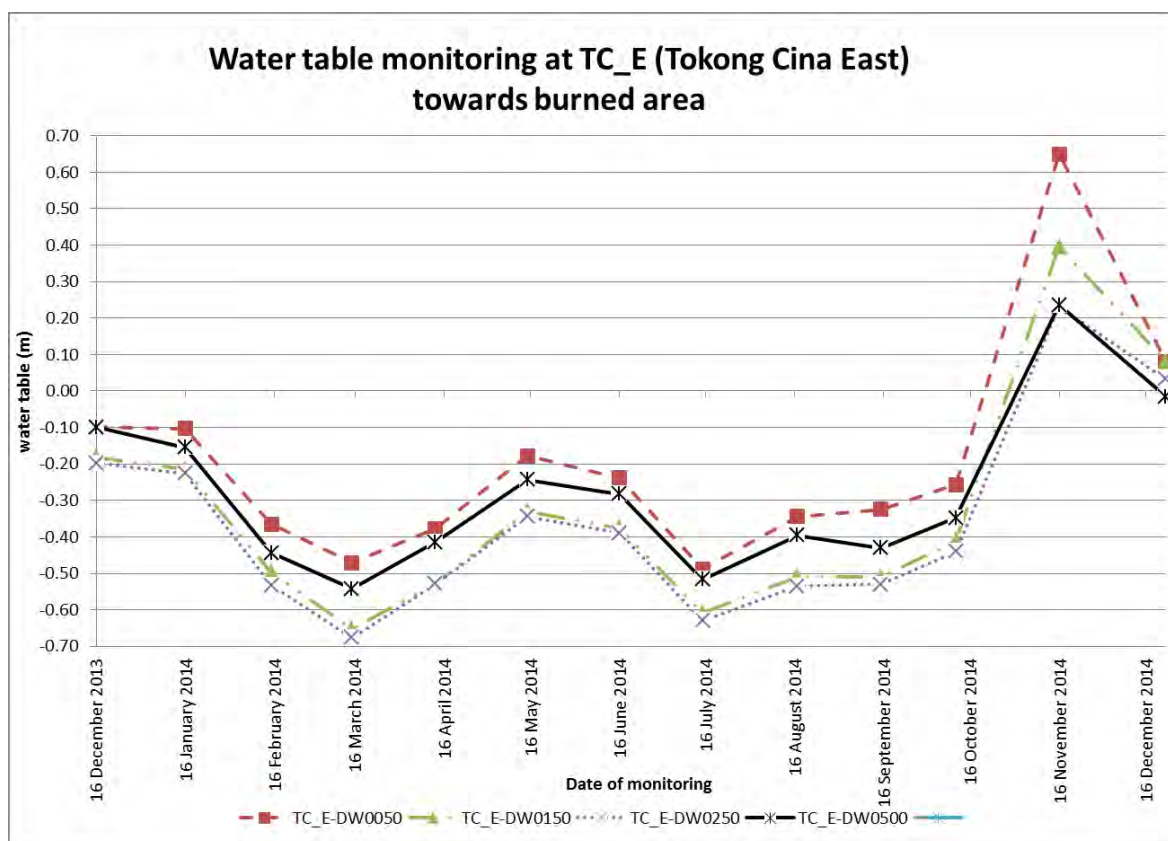


Figure B-14: water table depth at TC_E from Dec 2013 to Dec 2014

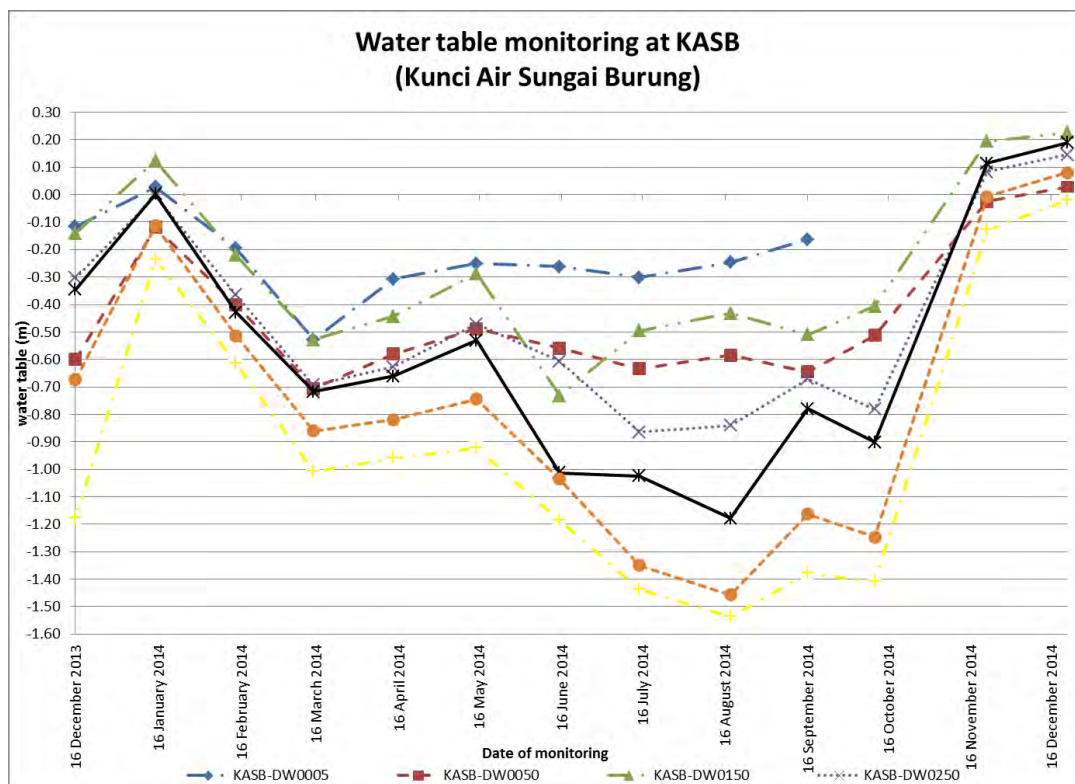


Figure B-15: water table depth at KASB from Dec 2013 to Dec 2014

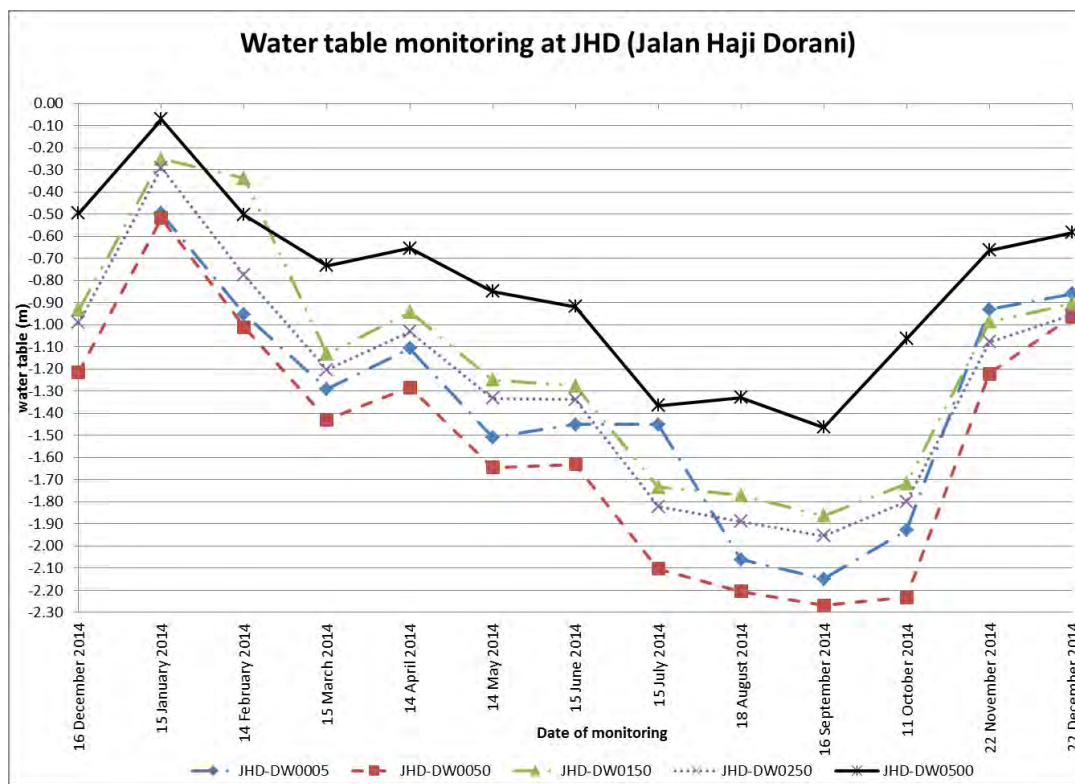


Figure B-16: water table depth at JHD from Dec 2013 to December 2014

Table B-6: Mean water table for the 6 transects in NSPSF

Transect	Number of observation	Mean water table (m)	St deviation (m)	Lowest (m)	Highest (m)
Transect 1/ JSP	65	-0.39	0.27	-1.06	0.00
Transect 2/ TSD	64	-0.28	0.22	-0.71	0.16
Transect 3/ P4R_S	36	-0.05	0.18	-0.42	0.46
Transect 4/ TC_W	65	-0.33	0.32	-0.85	0.75
Transect 4/ TC_E	52	-0.29	0.27	-0.68	0.65
Transect 5/ KASB	88	-0.54	0.43	-1.54	0.23
Transect 6/ JHD	64	-1.22	0.54	-2.27	-0.07

Referring to Table B-6, mean water table for three transects (JSP, TSD and TC_W) located inside forested area is similar, which is higher than 40cm below peat surface. The other forested transect, KASB however recorded lower mean water table at 54cm below peat surface. The lowering of water table in this transect could very well be the effect from a small canal running parallel to the piezometers. On the other hand, the two transects (P4R_S and TV_E) which are located in grassland/ fern recorded highest mean value, this may have related to the loss of surface peat due to fire and subsidence, which gave the wrong impression of higher water table. Historically, these two areas had subjected to repeated burning in the past, and fire usually associated with low water table. Transect JHD recorded the lowest mean water table, which is not surprising as the piezometer is located inside the oil palm estate which was developed on a very deep peat (7-10m) and with bad water management.

It is apparent that drainage canals (be it small or big) had significant effects on the water levels of the area; However, the effect is not uniform and depends largely on the dimension of the canal i.e. width and depth as well as whether the area has been burned or not. Considering there are 500km of ex-logging and drainage canals within NSPSF, it is not surprising that the water table recorded is low even for a forested site. Canal blocks should be established at strategic site to increase the water table of the NSPSF.

It should be noted that the water table presented in the above figures and tables are only relative to the surface. No levelling was undertaken to determine the absolute water level, i.e. the water level relative to Mean Sea Level or to the nearby drain. Areas which have subsided as a result of drainage or fire may appear to have higher water tables due to the lowering of the surface area. It is

therefore recommended to carry out contour survey in the future to understand more on the hydrology of NSPSF

4.4 Fire Prevention

Fire incident is closely linked to hydrology disturbance. Therefore, to prevent fire in the long run, hydrology restoration is a must. This is covered section 4.3 and more detailed description related to fire prevention can be found in a separate report – Corporative Fire Management Plan for NSPSF.

4.5 Re-forestation

Re-vegetation is one the important elements in restoring peatlands. If the area is void of vegetation either caused by land clearing or fire, peat surface is exposed to direct sunlight, which in turn further desiccated the peat surface. A layer of vegetation would create a cooler ambient environment with higher humidity as well as reducing penetration of sunlight. In addition to that, root system of vegetation is the natural holding force for peat as well as water.

However, re-vegetation/ is not as straight forward as in mineral soil as PSF is a unique ecosystem where tree growth is influenced by hydrological parameters besides soil productivity and light condition.

a) Selection of species

Species selection mainly depends largely on the type of degradation. Open area with full sunlight exposure will benefit pioneer species such as *Macaranga pruinosa* and *Euodia roxburgiana*. These 2 species have been used widely in the planting activities from 2008- 2013, and result had been encouraging and substantial growth can be seen for after 4 years of planting.

Since the work started in 2008, good progress had been made. Vegetation cover, especially pioneer tree species, is slowly coming back to the once degraded areas. See Figure below.



Figure B-17: Degraded area void of vegetation, in March 2009 at Parit 6, Raja Musa Forest Reserve



Figure B-18: Area well covered vegetation including trees, in August 2012 at Parit 6, Raja Musa Forest Reserve.

Study from FRIM had shown that other PSF species such as *Madhuca motleyana*, *Shorea platycarpa*, *Anisoptera marginata* and *Gonystylus bancanus* are also suitable for planting in degraded area. If these species can survive in open area, it is anticipated that a better result could be expected if it is planted as enrichment planting in shaded area.

All, species not originating from PSF should be avoided.

b) Availability of planting materials.

Generally species originated from PSF could be potential as planting materials. However, PSF species is not readily available from the conventional nursery as the demand for it is not there in the past. Past experiences from FRIM and GEC had shown that for planting experiments or activities; own supply of planting materials needs to be sourced.

Permanent nursery for supplying planting materials for PSF should be established to reduce costing and to ensure continual supply. With this in mind, working with communities such as SHGSU to establish community nurseries and supply planting materials for rehabilitation programme in RMFR is currently underway, and had shown a lot of promises. At the moment these communities nursery had focused on producing pioneer species such as for supplying *Macaranga pruinosa* and *Euodia roxburgiana*. In future, it would be beneficial to everyone involved if these communities can supply PSF species such as *Anisoptera marginata* or *Madhuca motleyana*.

c) Timing of planting

Past experiences had shown that timing of planting is crucial to increase the survival rate of the planted seedlings. It is recommended that planting should be carried out one or two months before the wet season begins. This is to give enough time for the seedlings to establish itself before the flooding starts. Figure 4-16 below shows the average monthly rainfall for Raja Musa FR area and should be consulted for suitable time for planting.

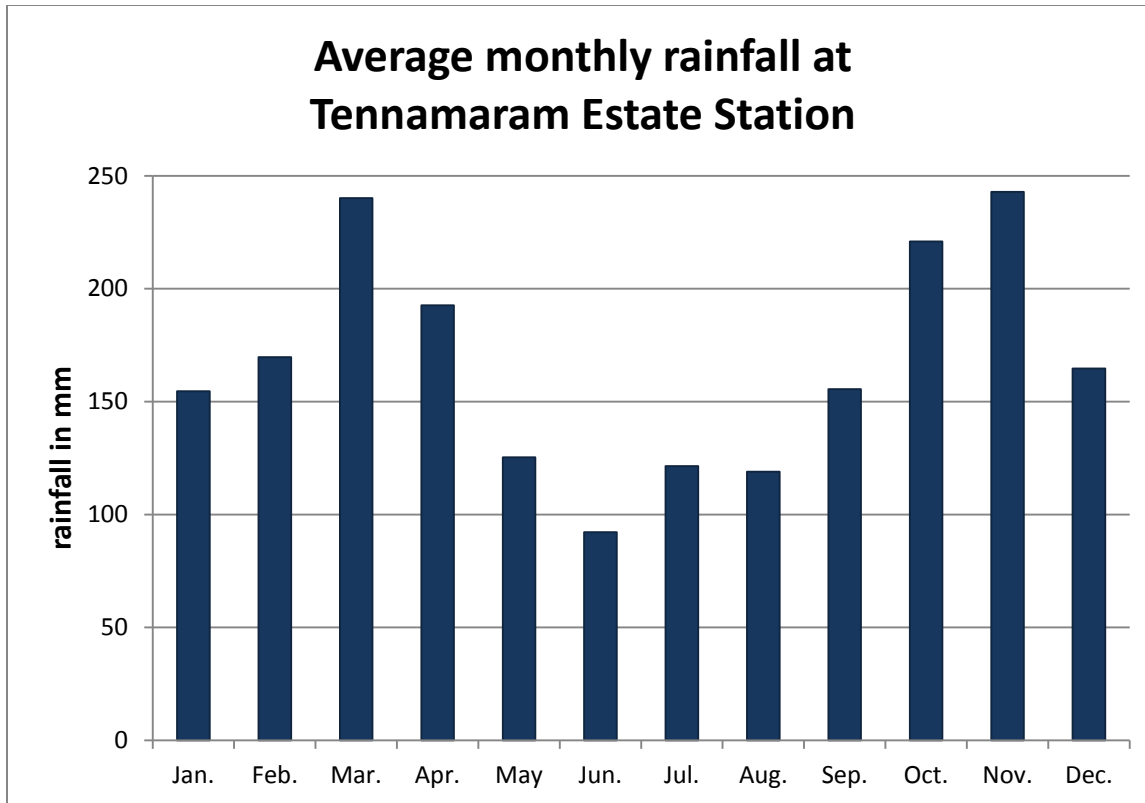


Figure B-19: Average monthly rainfall at Tennamaram Estate Station from 2005 to 2013

d) Maintenance

Weeds such as lalang grass, fern and sometimes climbers are a major problem for planted seedlings and often result in the high mortality of the seedlings. Proper maintenance including regular weeding should be carried out to eliminate the weeds from competing with the seedlings. Weeding should be carried out until the seedling is 3m tall and has established strongly and can withstand the competition from the weeds.

5.0 Aerial photos of rehabilitation Zone

Figure B-20: Rehabilitation zone 1-FC73, RMFR



Figure B-21: Rehabilitation zone 1- FC102, RMFR showing extensive areas of lalang and canals



Figure B-22: Rehabilitation zone 2- **FC32 RMFR**



Figure B-23: *Rehabilitation zone 3*



Figure B-24: Rehabilitation zone 4-FC19 SKFR



Figure B-25: Rehabilitation zone 4- FC 9/11 SKFR



Figure B-26: Rehabilitation zone 5-FC2, 3, 5 BBFR (E)



Figure B-27: Rehabilitation zone 5 - FC 37/38 BBFR (E)



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7.0 Annex 1



Summary Report of Peat Depth and Clay Depth Assessment at Forest Boundary of Raja Musa Forest Reserve

Date: 16-21 December 2013, 11-12 January 2014



Two assessments were conducted- December and January. The first assessment in December focused on the boundary of Raja Musa Forest Reserve, all the way from Parit 16 moving west towards the direction of Tokong Cina. The second assessment concentrated more from Parit 1 towards the direction of PKPS clay mining.

Method:

Peat sampler and sand auger were used to bore as far as manually possible using human power to reach the mineral layer just beneath the clay layer. In most of the locations, especially from parit 4 to parit 16, we managed to reach the sand layer. This is because the clay layer was relatively softer and thinner.

Result and Finding:

The main finding is that there is a clay layer underlying the peat. However, the thickness of the peat and clay layer is variable across the sampling site. Sand layer was found just below the clay layer. There are certain areas that it is not possible to reach the sand layer, in particular the location towards the left of Parit 1 towards Tokong Cina, this is due to the compactness and hardness of the clay layer below the peat. In addition to that, the clay layer is relatively deeper.

From Table 1 and Figure 1, it was found that for sampling site from Parit 4 to 16, clay depth was determined. The clay depth is however relatively shallow- ranging from 0.63m to 1.39m. There are 2 sampling site which recorded clay sand instead of the normal clay layer. From the second part of the same table, clay layer for 4 sites- Parit 4, comp. 72, comp. 91 and comp 92, are deeper-ranging from 1.34 to 4m. This figure is not final as the clay layer may be deeper as the auguring is stopped due to the compactness of the peat layer.

From Table 2 and Figure 2, clay layer that was able to determine is at least from 0.30 to 1.62m. Unfortunately the actual depth of the clay layer is not determined. Therefore, extra cautions should be apply if want to establish a clay bund at this area. There is one notable anomaly at location P1 C; the top 50cm is clay layer, follow by depth and then clay again. Local sources informed that the surface clay layer could come from the nearby mining area.

Table 1: Details finding from the first assessment

Location	Peat depth (m)	Clay / sandy clay depth (m)	Layer beneath clay	Notes
Parit 4	2.94	0.95	Sand	
Parit 5	2.85	1.39	Sand	
Parit 6	5.01	1.10	Sand	
Parit 7	4.47	-		
Parit 9	4.01	1.35	Sand	
Parit 10	3.45	0.32 (clay)		

		sand)		
Parit 12	2.81	0.63	Sand	
Parit 15	2.37	3.3 (clay sand)		
Parit 16	3.96	0.93	Sand	
Parit 1	4.22	> 2.31		Unable to go deeper as the clay layer is compact and hard
Comp 72	1.98	> 4.00	Not determined	Unable to go deeper as the clay layer is compact and hard
Comp 91	2.99	> 3.69	Not determined	Unable to go deeper as the clay layer is compact and hard
Comp 92	2.89	> 1.34	Not determined	Unable to go deeper as the clay layer is compact and hard

Table 2: Details finding from the second assessment

Location	Peat depth (m)	Clay depth (m)		Notes
P1 A	4.73	> 0.54	Not determined	Unable to go deeper as the clay layer is compact and hard
P1 B	2.46	>0.83	Not determined	Unable to go deeper as the clay layer is compact and hard
P1 C	2.71	>0.75		Around 0.5m of top layer is clay
P1 D	1.13	>0.30	Not determined	Unable to go deeper as the clay layer is compact and hard
P1 E	1.01	>1.62	Not determined	Unable to go deeper as the clay layer is compact and hard
P1 F	2.05	>1.44	Not determined	Unable to go deeper as the clay layer is compact and hard
P1 G	1.69	>1.20	Not determined	Unable to go deeper as the clay layer is compact and hard

Map 1: Location of the sample sites for first assessment

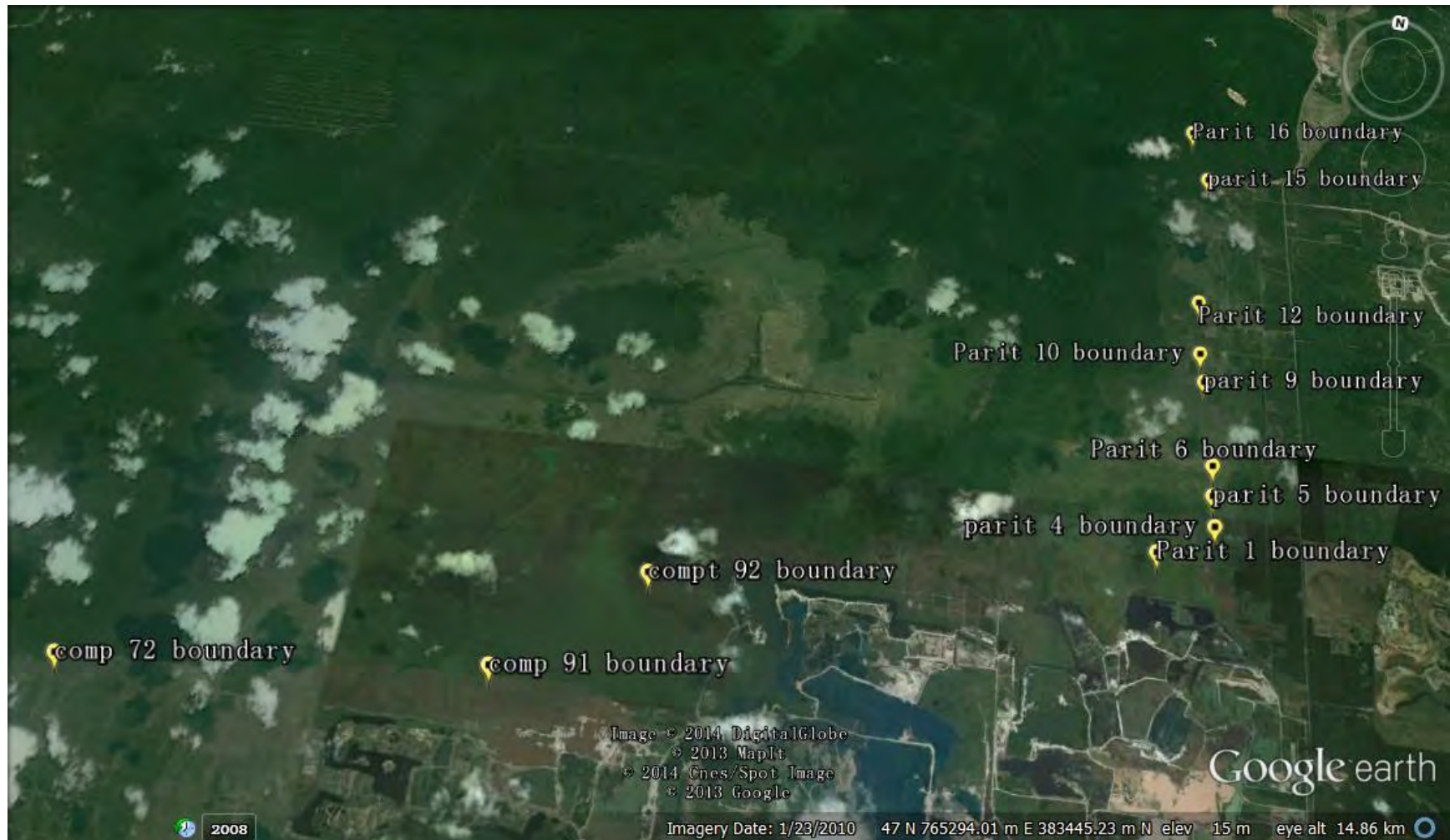


Figure1: PEAT AND CLAY PROFILE OF THE FOREST BOUNDARY OF RAJA MUSA FR- Parit 4 to Parit 16

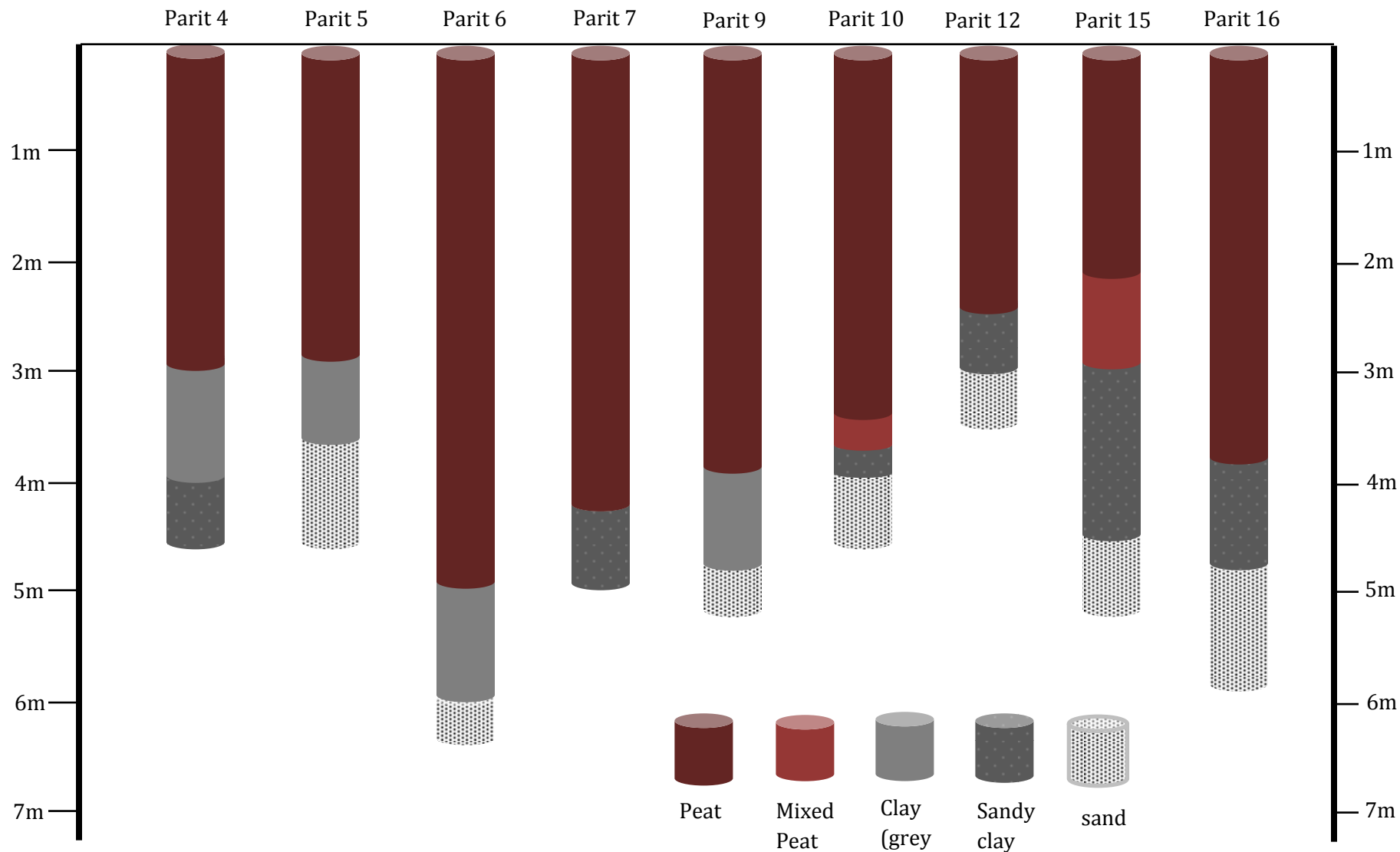
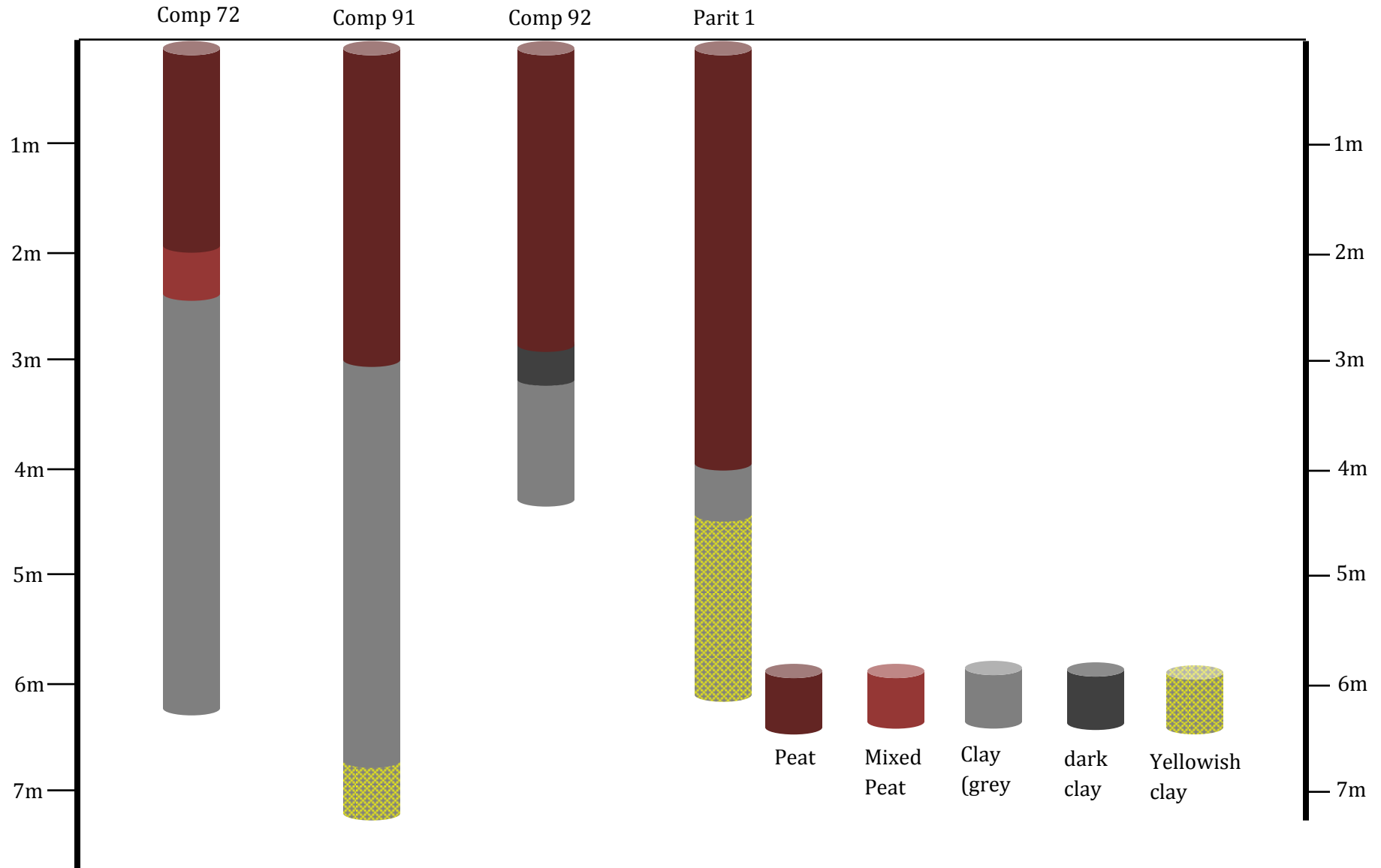
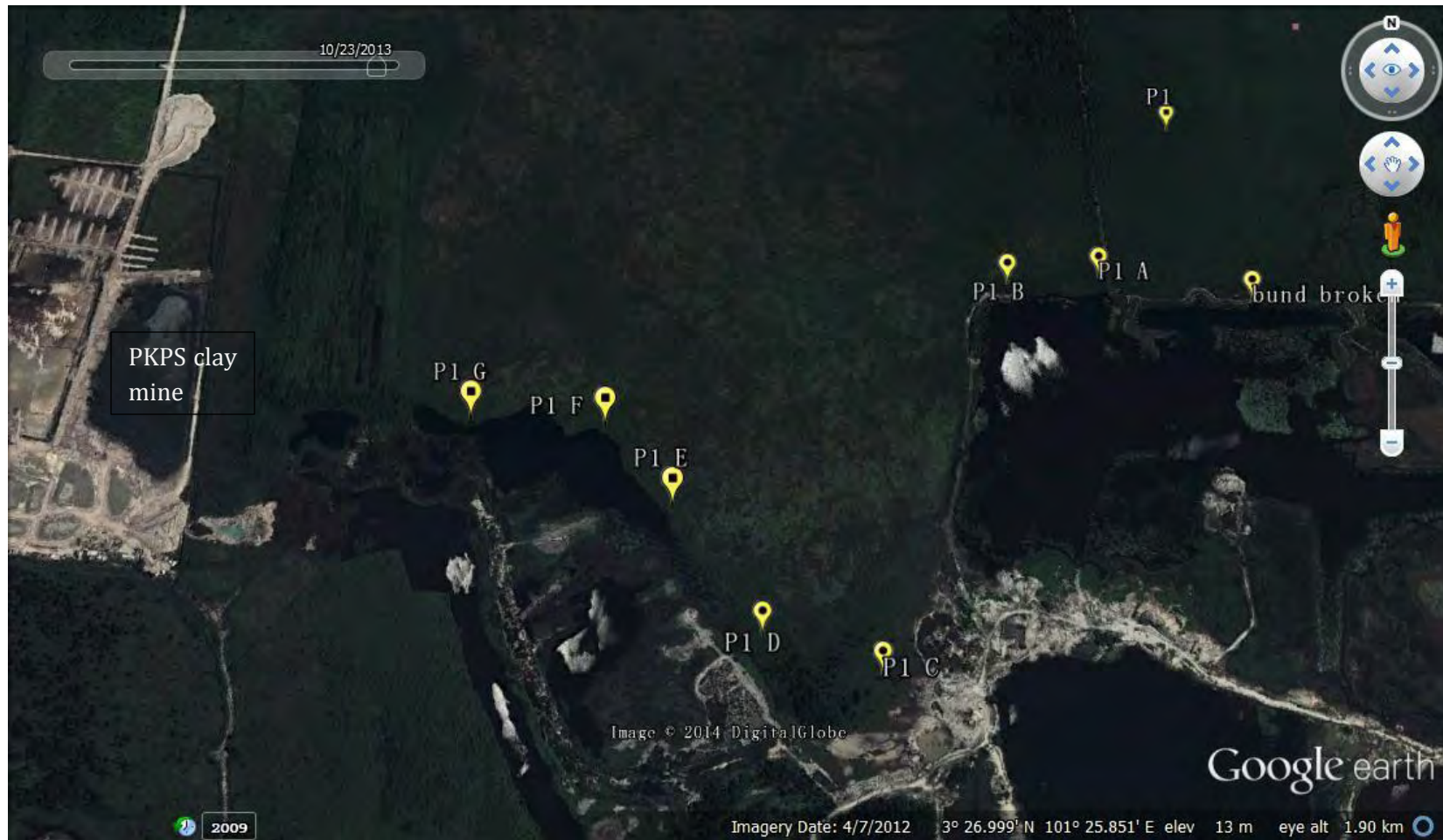


Figure 2: PEAT AND CLAY PROFILE OF THE FOREST BOUNDARY OF RAJA MUSA FR- Comp 72 to Parit 1

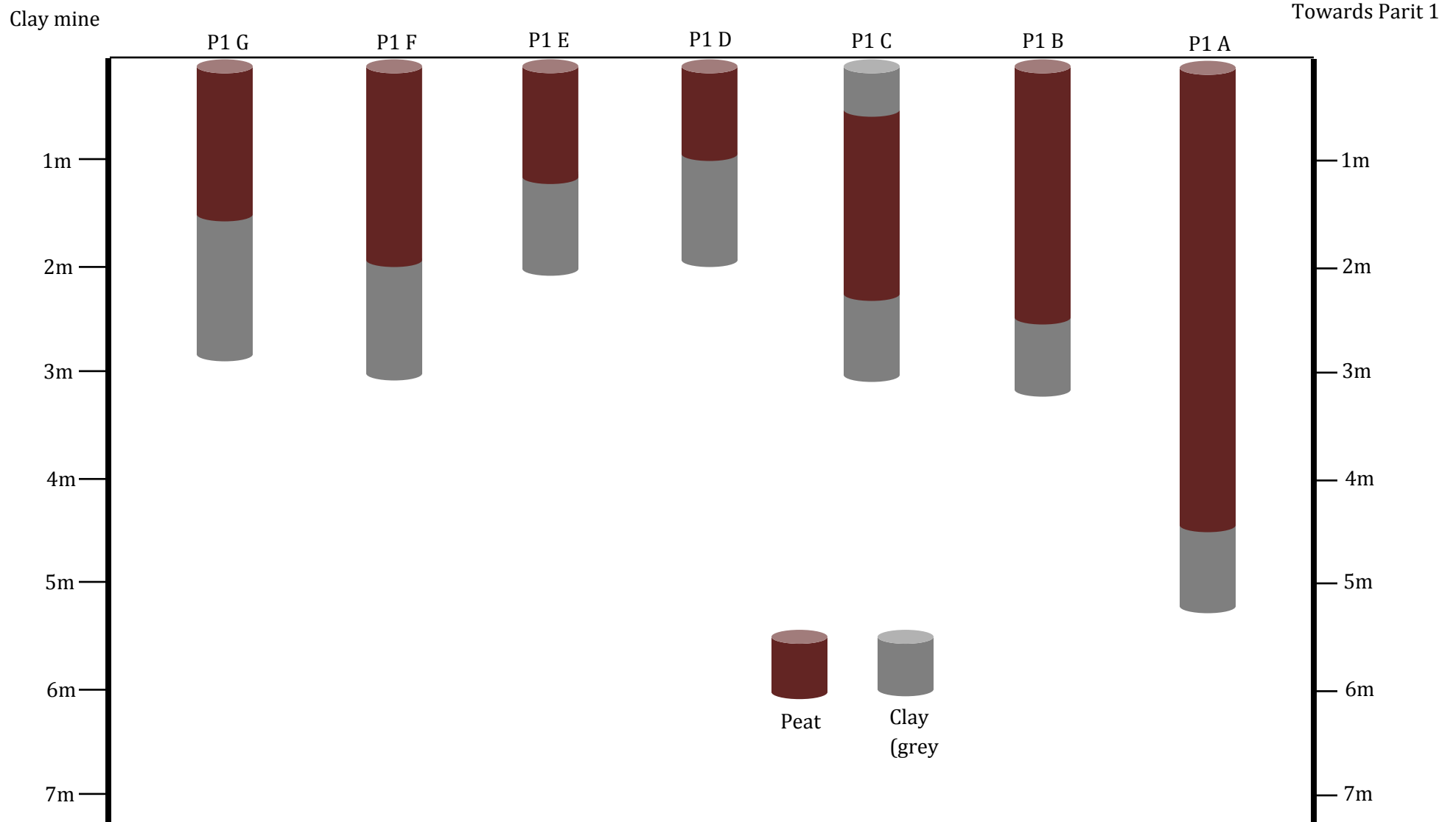


Map 2: Location of the sample sites for second assessment



PEAT AND CLAY PROFILE OF THE FOREST BOUNDARY OF RAJA MUSA FR

(from Parit 1 towards PKPS clay mine)



Pictures of clay sample and sand sample



grey clay



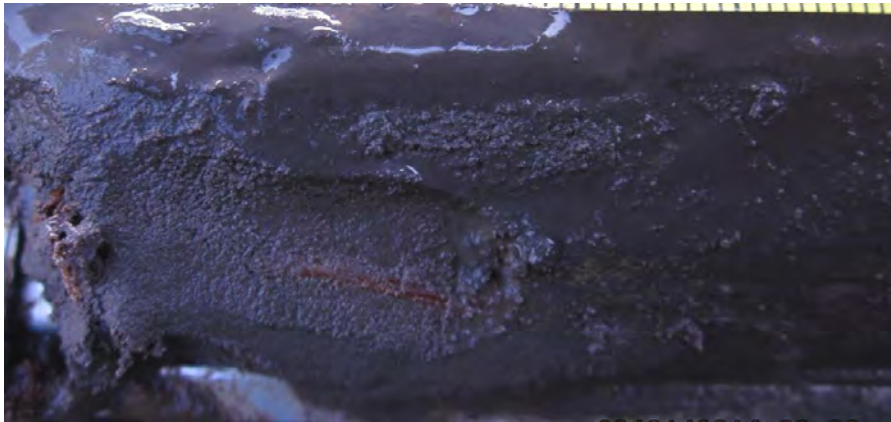
yellow clay



dark clay



sand



clay sand



mixed peat



peat



peat



INTEGRATED MANAGEMENT PLAN

FOR NORTH SELANGOR PEAT SWAMP FOREST 2014-2023



VOLUME 2

C: BUFFER ZONE PLAN

EXECUTIVE SUMMARY

Forming the backbone of Integrated Management Plan for North Selangor Peat Swamp Forest (NSPSF), three supported documents were developed at the request of the Forestry Department of Peninsular Malaysia and Selangor State Forestry Department. The three documents are Cooperative Fire Management Plan for NSPSF, Rehabilitation Plan for NSPSF and Buffer Zone Management Plan for NSPSF.

This document summarizes the Buffer Zone Management Plan for the NSPSF.

Buffer zone management is a relatively new integrated development approach for forest reserves, protected areas, and national parks. It is seen as an important tool in addressing issues related to both conservation and development.

The buffer zone of the NSPSF consists of both agricultural and state lands, creating unique issues and concerns. The area of peat swamp forest adjacent to Forest Reserve has been declining as a result of rampant development, including agriculture (oil palm), mining (sand and clay), and livestock farming. With this in mind, and in line with the National Physical Plan 2020 and Selangor State Structure Plan 2020, it is necessary to establish an appropriate buffer zone management plan for the NSPSF.

The NSPSF was classified as Environmentally Sensitive Areas Class 1 (ESA 1) under the National Physical Plan 2020 and Selangor State Structure Plan 2020, meaning that development is prohibited within the area. It is surrounded by a 500m width buffer zone of ESA Class 2 where no land clearance is permitted. There is an additional 500m buffer zone of ESA Class 3 where only controlled development is allowed.

The buffer zone plan management aims to reduce and mitigate the negative influences of the activities taking place adjacent to the Forest Reserve. This concept has been widely recommended, including in the operational guidelines of local district plans, as well as by policy makers and land managers (government, private lands owners, local communities, etc.).

The buffer zone for the NSPSF covers about 15,000 hectares and is divided into 9 zones for effective implementation. The zone selection was made according to the district, current land use, and type of economic activity. The District of Kuala Selangor has 4 zones; Sabak Bernam has 3 zones; and Hulu Selangor has 2 zones. For each of the zones there is a map, a description of the land use history, and a recent photograph of the area.

Ten management strategies have been identified for the buffer zone of the NSPSF. The 10 strategies are:

- 1) Determine the boundary of the buffer zone and develop guidance for each buffer zone section within the frame work of a buffer zone plan.
- 2) Integrate the buffer zone plan into the District Local Plans for the three related districts.

- 3) Ensure that management of water resources in the buffer zones does not disrupt the hydrology of the adjacent NSPSF.
- 4) Support and promote buffer zones activities that are compatible with the objectives of the NSPSF.
- 5) Promote BMPs for the existing legal development within buffer zone.
- 6) Stop any new development in the buffer zone or adjacent areas in which biodiversity and ecological function would be adversely affected.
- 7) Support the development of community-based forestry management initiatives as part of a broader set of approaches to land-use planning and local sustainable development strategies.
- 8) Promote the development of partnerships with key stakeholders for planning and managing the use of resources within the buffer zone while optimizing benefits for the local people.
- 9) Enhance the capacity of communities adjacent to the NSPSF to participate in buffer zone management by providing appropriate training and education, as well as through recognizing local expertise and traditional institutions.
- 10) Improve benefit flows to people in and around NSPSF (HMMMM)

These strategies – while primarily addressing the improved protection and conservation of the NSPSF – have implications to a wide range of role players. Accordingly, these strategies will not be implemented without the active support and collaboration of the key agencies involved. Hence, key agency details and the relevant laws and legislation are also given in this plan.

RINGKASAN EKSEKUTIF

Tiga dokumen sokongan telah dibangunkan atas permintaan Jabatan Perhutanan Semenanjung Malaysia dan Jabatan Perhutanan Negeri Selangor untuk membentuk tulang belakang kepada Pelan Pengurusan Bersepadu (IMP) untuk Hutan Paya Gambut Utara Selangor (HPGSU). Tiga dokumen ini adalah Pelan Pengurusan Kebakaran Secara Bekerjasama bagi HPGSU, Pelan Pemulihan bagi HPGSU dan Pelan Pengurusan Zon Penampian bagi HPGSU.

Dokumen ini meringkaskan Pelan Pengurusan Zon Penampian bagi HPGSU.

Pengurusan zon penampian adalah satu pendekatan pembangunan bersepadu yang agak baru bagi kawasan hutan, kawasan yang dilindungi dan taman negara. Ia dilihat sebagai satu alat yang penting dalam menangani isu-isu yang berkaitan dengan kedua-dua pemuliharaan dan pembangunan.

Zon penampian HPGSU terdiri daripada tanah pertanian dan tanah negeri dan mewujudkan isu dan hal yang unik. Kawasan hutan paya gambut yang bersebelahan dengan Hutan Simpan telah berkurangan akibat pembangunan yang tidak terkawal, ini termasuk pertanian (kelapa sawit), perlombongan (pasir dan tanah liat) dan penternakan. Berdasarkan maklumat tersebut dan selaras dengan Rancangan Fizikal Negara 2020 dan Rancangan Struktur Negeri Selangor 2020, pengurusan zon penampian bagi HPGSU perlu diwujudkan.

HPGSU diklasifikasikan sebagai Kawasan Sensitif Alam Sekitar Kelas 1 (KSAS 1) di bawah Rancangan Fizikal Negara 2020 dan Rancangan Struktur Negeri Selangor 2020, ini bermakna bahawa pembangunan adalah dilarang dalam kawasan tersebut. Ia dikelilingi oleh 500m zon penampian KSAS Kelas 2 di mana pembukaan tanah tidak dibenarkan. Ini ditambah lagi dengan zon penampian KSAS Kelas 3 (500m) di mana hanya pembangunan terkawal dibenarkan.

Pengurusan pelan zon penampian bertujuan untuk mengurangkan dan menyelesaikan kesan negatif daripada aktiviti yang dijalankan bersebelahan dengan Hutan Simpan. Konsep ini telah disyorkan dengan meluas, termasuk dalam garis panduan rancangan daerah tempatan, serta oleh pembuat dasar dan pengurus tanah (kerajaan, tanah pemilik swasta, komuniti tempatan, dan lain-lain).

Zon penampian HPGSU meliputi kira-kira 15,000 hektar dan dibahagikan kepada 9 zon untuk pelaksanaan yang berkesan. Pemilihan zon dibuat mengikut daerah, guna tanah semasa dan jenis aktiviti ekonomi yang dijalankan. Daerah Kuala Selangor mempunyai 4 zon; Sabak Bernam mempunyai 3 zon; dan Hulu Selangor mempunyai 2 zon. Bagi setiap zon terdapat peta, penjelasan tentang sejarah penggunaan tanah serta gambar terkini bagi zon berkenaan.

Sepuluh strategi pengurusan telah dikenal pasti untuk zon penampian HPGSU itu. Sepuluh strategi tersebut adalah:

- 1) Memuktamadkan penentuan sempadan zon penampian dan membangunkan panduan bagi setiap bahagian zon penampian dalam rangka kerja-kerja pelan pengurusan zon penampian.

- 2) Menyepadukan pelan zon penampian ini ke dalam Rancangan Tempatan Daerah bagi tiga buah daerah yang berkaitan.
- 3) Memastikan pengurusan sumber air di zon penampian tidak mengganggu hidrologi kawasan berhampiran dengan HPGSU.
- 4) Menyokong dan mempromosikan aktiviti zon penampian yang bersesuaian dengan objektif HPGSU.
- 5) Menggalakkan penggunaan 'BMPs' bagi kawasan pembangunan yang rasmi dan sedia ada pada zon penampian.
- 6) Hentikan sebarang pembangunan baru dalam zon penampian atau kawasan-kawasan yang bersebelahan di mana kepelbagaian biologi dan fungsi ekologi akan terjejas.
- 7) Menyokong pembangunan inisiatif pengurusan perhutanan berasaskan komuniti merupakan antara set yang lebih luas pendekatan bagi perancangan guna tanah dan membangunkan strategi pembangunan tempatan yang mampan.
- 8) Menggalakkan pembangunan perkongsian dengan pihak berkepentingan utama untuk merancang dan mengurus penggunaan sumber dalam zon penampian, dan mengoptimumkan manfaat bagi orang-orang tempatan.
- 9) Mempertingkatkan kapasiti komuniti yang tinggal bersebelahan dengan HPGSU untuk mengambil bahagian dalam zon penampian dengan menyediakan latihan dan pendidikan yang memuaskan dan menerusi pengiktirafan kepakaran tempatan dan institusi tradisional.
- 10) Meningkatkan aliran faedah kepada rakyat di dalam dan sekitar HPGSU.

Walaupun tujuan utama strategi-strategi ini adalah menangani isu berkaitan perlindungan dan pemuliharaan HPGSU, ia mempunyai implikasi kepada pelbagai pihak yang berkenaan. Dengan itu, strategi ini tidak akan dapat dilaksanakan tanpa sokongan aktif dan kerjasama daripada agensi-agensi yang terlibat. Oleh itu, butiran agensi utama dan undang-undang berkaitan juga diberikan di dalam pelan ini.

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LIST OF ABBREVIATIONS

NSPSF	North Selangor Peat Swamp Forest
HCV	High conservation value
PKPS	Selangor Agricultural Development Corporation
KDEB	Kumpulan Darul Ehsan Berhad
MBI	Menteri Besar Incorporation (MBI)
UNISEL	University of Selangor
SEMESTA	Kumpulan SEMESTA Sendirian Berhad
GLC	Selangor State Government Link Corporations
ESA	Environmentally Sensitive Area
DLP	District Local Plan
EMP	Environmental Management Plan
EIA	Environmental Impact Assessment
CBNRM	Community based natural resource management
CBO	Community based organisation
BMP	Best Management Practice
UPEN	Selangor State Economic Planning Unit
SFD	Selangor Forestry Department
SSFRD	Selangor State Fire and Rescue Department
DOA	Department of Agriculture of Selangor
LUAS	Selangor Water Management Authority
IADA	Integrated Agriculture Development Area of Selangor Northwest Project
DID	Department of Irrigation and Drainage of Selangor
DOE	Department of Environment of Selangor
DTCP	Department of Town and Country Planning of Selangor
PERHILITAN/DWNP	Department of Wildlife and National Park of Selangor
DOH	Department of Health

MMD	Malaysia Meteorological Department
HORAS	Hybrid of River Augmentation System
KSDLO	Kuala Selangor District and Land Office
KSDC	Kuala Selangor District Council
NAHRIM	National Hydraulic Research Institute of Malaysia
MGD	Department of Mineral and Geoscience of Selangor
SBDLO	Sabak Bernam District and Land Office
SBDC	Sabak Bernam District Council
GEC	Global Environment Centre
SHGSU	Sahabat Hutan Gambut Selangor Utara
MPOB	Malaysian Palm Oil Board
NFTP	Non Forest Timber Product

Buffer Zone Plan for North Selangor Peat Swamp Forest

C. BUFFER ZONE PLAN FOR NSPSF

1.0 Introduction

This Buffer zone management plan has been prepared at the request of the Forestry Department of Peninsular Malaysia and Selangor Forestry Department as part of the revision of the integrated management plan for North Selangor Peat Swamp Forest. This Buffer zone plan has been developed through a participatory approach in the period November 2013 – May 2014 with a large number of site assessments and consultations with more than 246 stakeholders and four stakeholder meetings.

The preparation of this plan is in line with the National Physical plan and the Selangor State Structure Plan which call for establishment of a buffer zone of at 1000m wide around the North Selangor Peat Swamp Forest. It is hoped that the final plan can be incorporated into the State structure plan 2025 and the local plans for the districts which are currently under revision as well as being part of the integrated management plan for the North Selangor Peat Swamp Forest.

1.1 Background

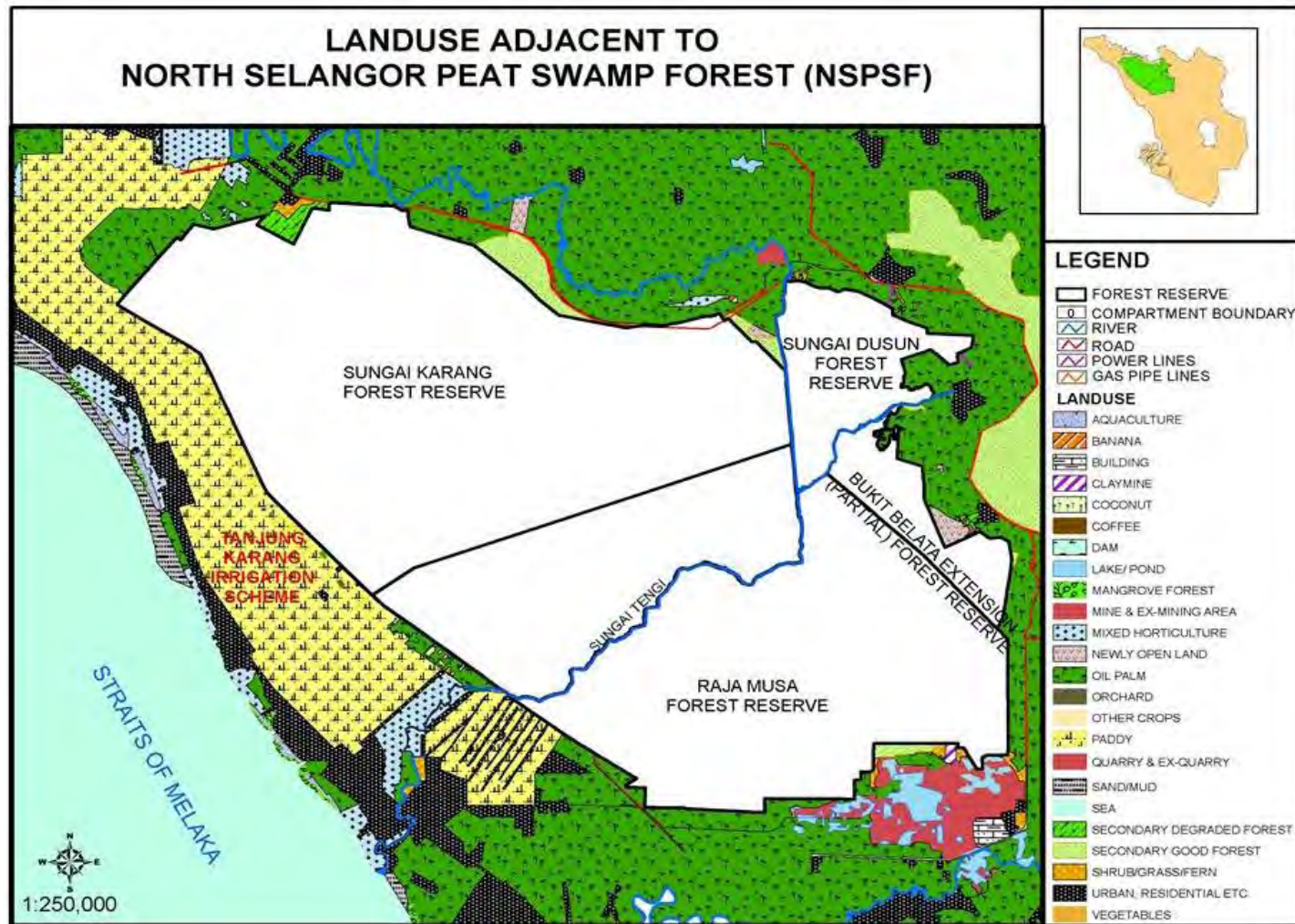
The North Selangor Peat Swamp Forest (NSPSF) is situated on the west coast of Peninsular Malaysia about 50km Northwest of Kuala Lumpur. The North Selangor Peat Swamp Forest (NSPSF) is located on a flat coastal plain in the north western part of the State of Selangor and is approximately 81,304 hectares (see Table C-1). Before being constituted as forest reserve in 1990, the forests were state lands and have been selectively logged on a rotational basis. The first logging operation started about 65 years ago. In the previous Integrated Management Plan (2001-2010), NSPSF was described as including only two forest reserves - namely Raja Musa Forest Reserve & Sungai Karang Forest Reserve. Based on the assessment for the revision of the IMP as well as stakeholder discussions it is proposed that Bukit Belata (extension) Forest Reserve and Sungai Dusun Forest Reserve/Wildlife Reserve (Hulu Selangor District) are to be included as part of NSPSF. With this, the strategies are developed to be applied on both the forest reserves to manage and protect the forests and biodiversity from further threats. Tables C-1 give details of the NSPSF which is made up of four Forest Reserves.

Table C-1: Details of the North Selangor Peat Swamp Forest

No.	Forest Reserve	Civil District	Size (ha)
1.	Raja Musa Forest Reserve	Kuala Selangor	36,938 ha
2.	Sungai Karang Forest Reserve	Kuala Selangor & Sabak Bernam	36,654 ha
3.	Bukit Belata Forest Reserve (extension) (1635 ha –peat area)	Hulu Selangor	2,821 ha
4.	Sungai Dusun Forest / Wildlife Reserve (45% of the land is peat)	Hulu Selangor	4,891ha
		total	81,304 ha

NSPSF is surrounded by state land and private land that is largely cultivated for agricultural purposes (see Figure C-1). The main land-uses adjoining the forest reserve are Tanjung Karang Rice Irrigation Scheme to the Southwest and West, sand and clay mining in the South, in the oil palm plantations in the south east and north. The forest is separated from the irrigation scheme to the Southwest by the Main Irrigation Canal whereas the Bernam River forms the Northern boundary. Sungai Tengi acts as the natural divider between Sg Karang Forest Reserve and Raja Musa Forest Reserve. NSPSF is under the jurisdiction of three civil districts in Selangor State, namely Kuala Selangor District, Sabak Bernam District & Hulu Selangor District. The three Forest Reserves (except for Sungai Dusun Forest Reserve) are managed by the State Forestry Department; the Sg Dusun Forest/Wildlife reserve is managed by the Department of Wildlife and National Parks - while the adjacent lands are managed under the respective districts.

Figure C-1: Land use Adjacent to North Selangor Peat Swamp Forest (NSPSF)



1.2 General Function of North Selangor Peat Swamp Forest

Peat Swamp Forests have many ecological functions such as a) a sources of freshwater supply b) flood mitigation c) carbon sink and store and d) safeguarding biodiversity. The NSPSF plays an important role in carbon storage (Kumari, 1995) and in the hydrology of the surrounding area (Low and Balamurugan, 1989).



NSPSF are characterized by high soil permeability and high water retention capacity. This makes them effective in stabilizing water levels, hence mitigating floods and droughts in the surrounding areas. During periods of heavy rainfall, peat swamp acts as natural reservoirs, able to absorb and store water, in the depressions and channels within the swamps, release it slowly during the drier period.

1.3 The current uses and values

The main use of the NSPSF at present is for conservation for biodiversity conservation, ecotourism, water supply and flood control as well as climate regulation.

Since Malayan Independence (1957), the NSPSF has been used in various ways (Lim *et al.*, 1999). The peat swamp forest was heavily logged before its establishment as a forest reserve in 1989 (Chan, 1989), but logging intensity has progressively reduced in the last 10 years and was stopped in 2009. The other important use is the water supply for the adjacent land used for agriculture. There is water shortage in Selangor; the peat swamp forest is an important reservoir for water. Adjacent areas around the NSPSF have been cultivated for agriculture or undergone various development projects.

1.4 Management issues, threats and root causes for buffer zone of NSPSF

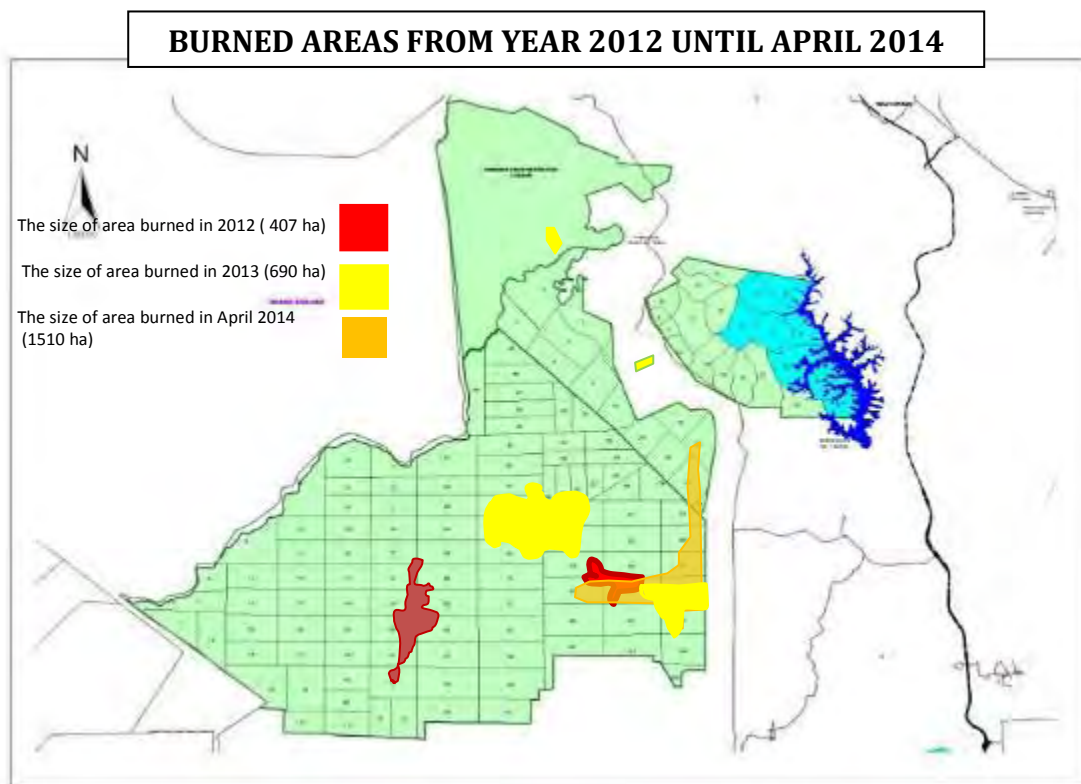
a) Fire

Several part of the NSPSF especially in the Raja Musa FR, for example, has been susceptible to fire in the past 10 years. An area of about 4,000 ha of forest reserve has been burnt regularly over the last 10 years and has become grassland (dominated by ferns). Fires have been recorded in this area in most years during dry periods and with each fire, the area of degraded peatlands has



expanded.

Figure C-2: Burned Areas from Year 2012 until April 2014



b) Land conversion

Increasing pressures for land development (e.g. logging, agriculture (including plantation), infrastructure and etc.) have affected the peatlands in NSPSF over the past 10 years. A number of these threats directly stem from or are associated with land conversion, especially for agricultural plantations (mainly, small holders and plantation companies) that have been managed in an unsustainable manner.



These threaten the integrity of peat ecosystem and have resulted in significant loss of their ecological support services and values e.g. flood mitigation, prevention, of saline water intrusion, sediment and toxic removal, ground water recharge, micro-climate regulation etc. Many agricultural and other crops on peatlands have poor production due to unsustainable management and the application of inappropriate methods. The land conversions have had direct negative physical impacts on peatland ecosystem and its associated biodiversity. These impacts also have associated effects on remaining peat swamp forest due to drainage, such as peat compaction and subsidence, fire hazard, and loss of vital ecological services.

c) Drainage

Over-drainage of peatlands can have detrimental effects to the ecosystem. Agricultural and forestry practices generally result in poor water management in peat lands, which significantly lower the water table and result in the drying and breaking-down of peat soils leading to emission of greenhouse gasses and loss of the peat soil (i.e. peat oxidation). A lack of understanding on the nature of peat ecology has often led to the mismanagement of this ecosystem. Lack of integration and proper



planning between development agencies has also resulted in the fragmentation of peat, hence causing its degradation and destruction. A key element of future management is good water management to reduce land subsidence, risk of fires and GHG emissions as well as avoid any negative impact on adjacent forest areas.

d) Buffer Zone Management

The NSPSF has been identified as an Environmentally Sensitive Area Class 1 (ESA 1) according to the National Physical Plan 2020 (Figure 1-3) and Selangor State Structure Plan 2020 (Figure 1-4), published by the Federal and State Department of Town & Country Planning. The government has defined the entire area of the NSPSF as an ESA Class 1 and 500m buffer area surrounding the NSPSF has been defined ESA Class 2. Surrounding the ESA Class 2 is a further 500m buffer of ESA Class 3 given a total buffer zone of 1km width. The management of the ESA is to be guided by the following criteria:

- **ESA Level (Rank 1):** No development, agriculture or logging shall be permitted, except for low impact nature tourism (eco-tourism related activity)
- **ESA Level (Rank 2):** No development or agriculture. Sustainable logging and low impact nature tourism may be permitted subject to local constraints.
- **ESA Level (Rank 3):** Controlled development where the type and intensity of the development shall be strictly controlled depending on the nature of the constraints.

An Integrated Management Plan for NSPSF has been prepared which incorporates the buffer zone management. With this plan the buffer zone can be managed more effectively and sustainably.

This buffer zone management plan has been prepared for incorporation into the Kuala Selangor and Sabak Bernam District Local Plan 2025 under the Town and Country Planning Act, 1976. However, it is recommended that the buffer zones also be gazetted under section 62 of the National Land Code 1965. This action will further strengthen the protection of the NSPSF.

Although NSPSF has its own forest management plan, however, this may not be sufficient to ensure the protection of NSPSF. Often, what happens in buffer zone area will inevitably have negative impacts on the forest reserve.

Table C-2: Rank and Criteria under ESA (from National Physical Plan 2010)

Rank	Criteria
Protection of Biodiversity	
1	Existing and proposed Protected Areas (PA) Important small habitats outside the PA system: Turtle landing sites, salt licks, important plant areas, limestone outcrops and natural wetlands of high conservation value
2	All other forests and wetlands outside of Protected Areas 500m buffer zone around rank 1 areas
3	Marine Park islands 500m buffer zone around rank 2 areas
Life Support System	
1	Catchments of existing and proposed dams
3	Catchments of water intake and groundwater recharge zones
Hazard Risk Area	
1	Areas above 1,000m contour
2	Areas between 300m -1,000m contour
3	Areas between 150m -300m contour Areas with erosion risk above 150 ton/ha/yr. Areas experiencing critical or significant coastal erosion

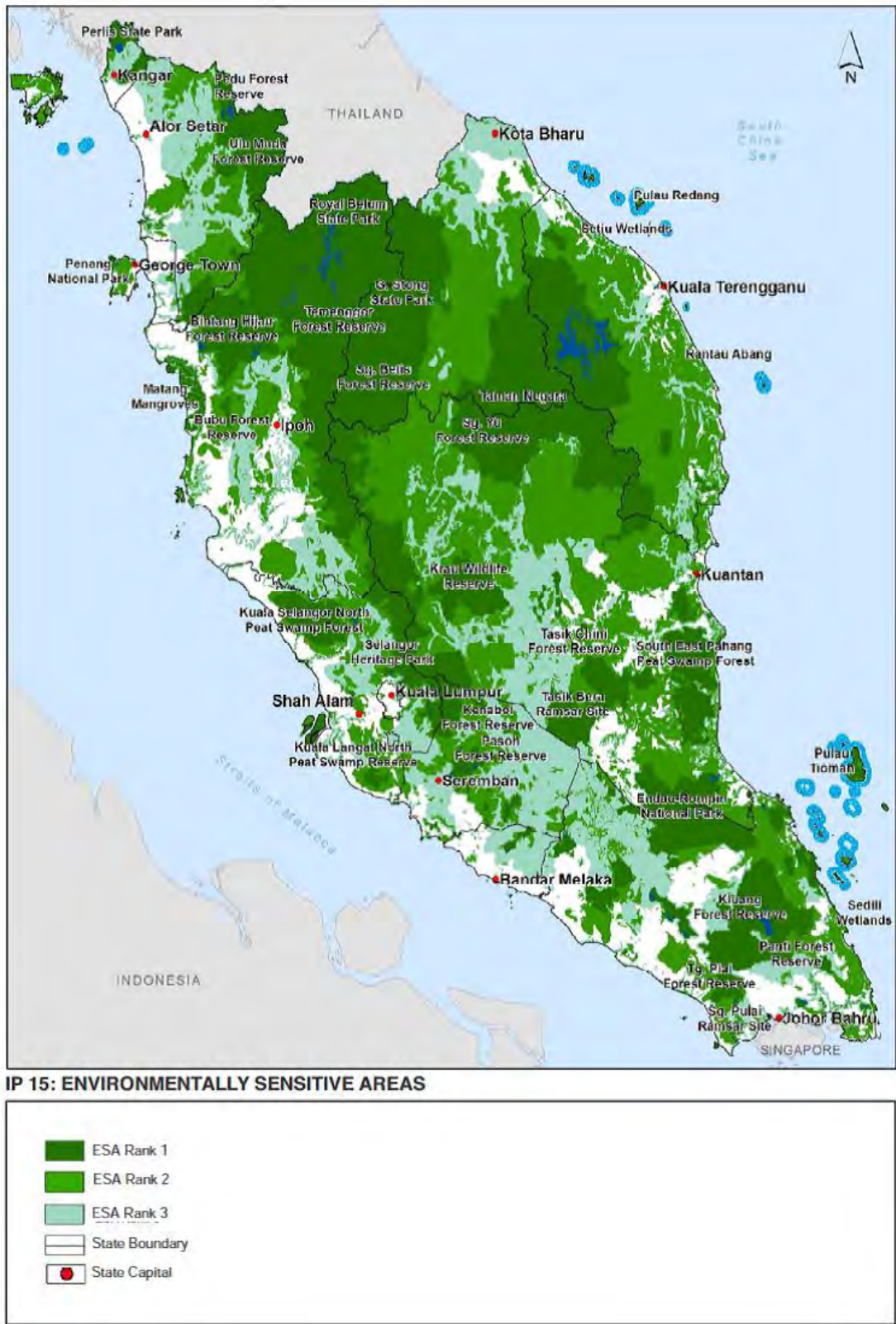


Figure C-3: Map showing ESA Areas including NSPSF, source: NPP 2010

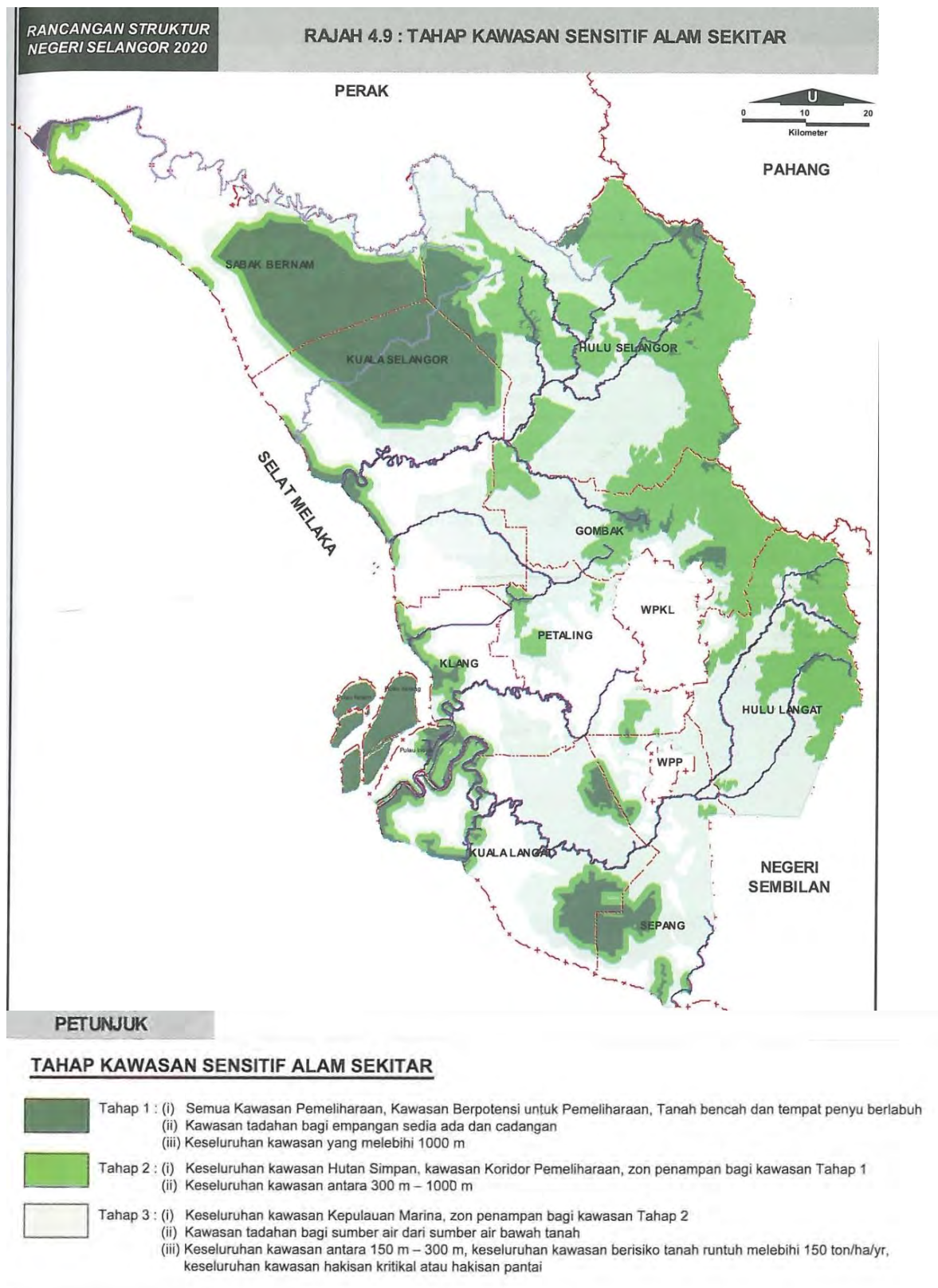


Figure C-4: Map showing ESA areas including NSPSF for State of Selangor, source: SSSP 2020

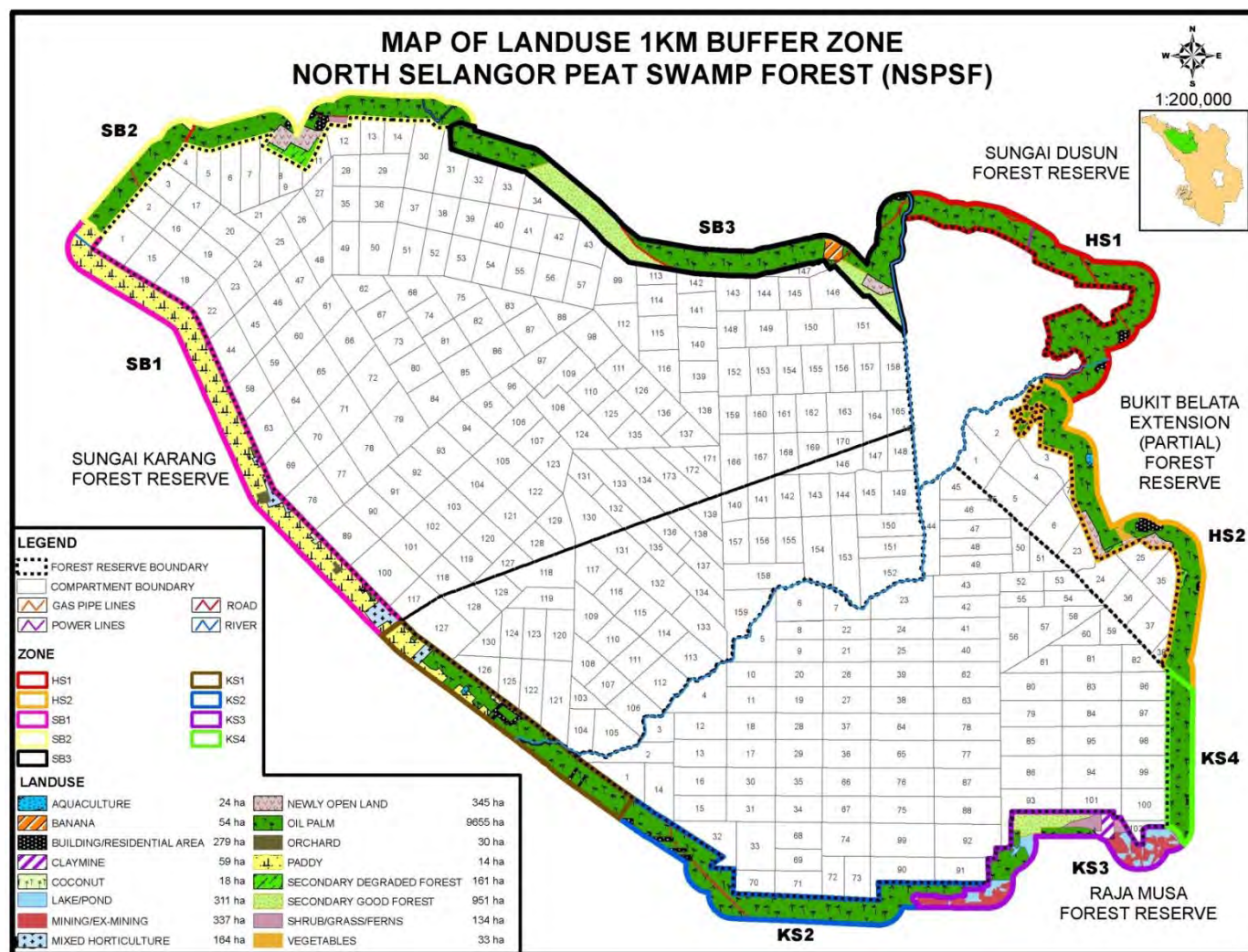


Figure C-5: Map of 1KM Buffer Zone of NSPSF

2.0 Description of proposed buffer zone area adjacent to NSPSF

Table C-3: Land use type in 1km buffer zone

No	TYPE OF LANDUSE	AREA (ha)
	Agriculture/ Aquaculture	
1	Paddy	2132
2	Oil Palm	9655
3	Mixed Horticulture	164
4	Banana/ coconut/ vegetables/ orchard	135
5	Aquaculture	24
	Mining	
6	Mine & Ex-Mining/clay mine	396
7	lake and Pond	311
	Forested land	
8	Secondary Degraded Forest	161
9	Shrub/Grass/Fern	134
10	Secondary Good Forest	951
	Other	
11	Urban, Residential etc.	279
12	Newly Open Land	345
TOTAL AREA		14687

Figure C-5 and Table C-3 show the details of the 1km land use surrounding NSPSF. The NSPSF is to the south-east, south, west, and north surrounded by private land, used for farming and mining. To the south-west, the boundary follows the Main Irrigation Canal, while the remaining external boundary to private land does not follow any distinctive geographical feature. Records show that the external boundaries to the south west - south east of NSPSF and to the north west – north-east are subject to highest external pressure from fires, farming, and encroachment and so the requirements to demarcation and field inspections are less than to the other external boundaries. If the development is continue without proper buffer zone management plan it will lead to serious problems including:

- Increased risk of fire in the development site and the adjacent forest and wildlife reserves
- Increase land subsidence and flooding risk along the Tg Malim to Sabak Bernam & Raja Musa roads which is already known flood prone.
- Loss of significant wildlife habitat
- Disruption of the hydrological regime in the adjacent North Selangor Peat Swamp Forest

A concept of 1km buffer zone adjacent to NSPSF has been proposed. This buffer's function is to reduce or mitigate the negative influences of activities taking place outside the forest reserve. This concept has been widely recommended, including in the operational guidelines of local district plans, policy makers and land managers (including government and private lands owners including local communities). The overall buffer zone areas for NSPSF were identified in 9 zones to implement the concept of 1km buffer zone management effectively. These zones selection was made according to the district, current land use and types of economic activity being carried out around the buffer zone for NSPSF.

Here are the existing roads in the buffer zone adjacent to North Selangor Peat Swamp Forest:-

- The Tengi River, that forms the boundary between Raja Musa and Sungai Karang Forest Reserves.
- The Main Canal, that runs along the south-east boundary of the forest.
- The Feeder Canal that separates Sungai Karang from the Sungai Dusun Wildlife Reserve to the east.
- The public road, that runs through and along the north-eastern boundary of Sungai Karang.

2.1 Kuala Selangor District

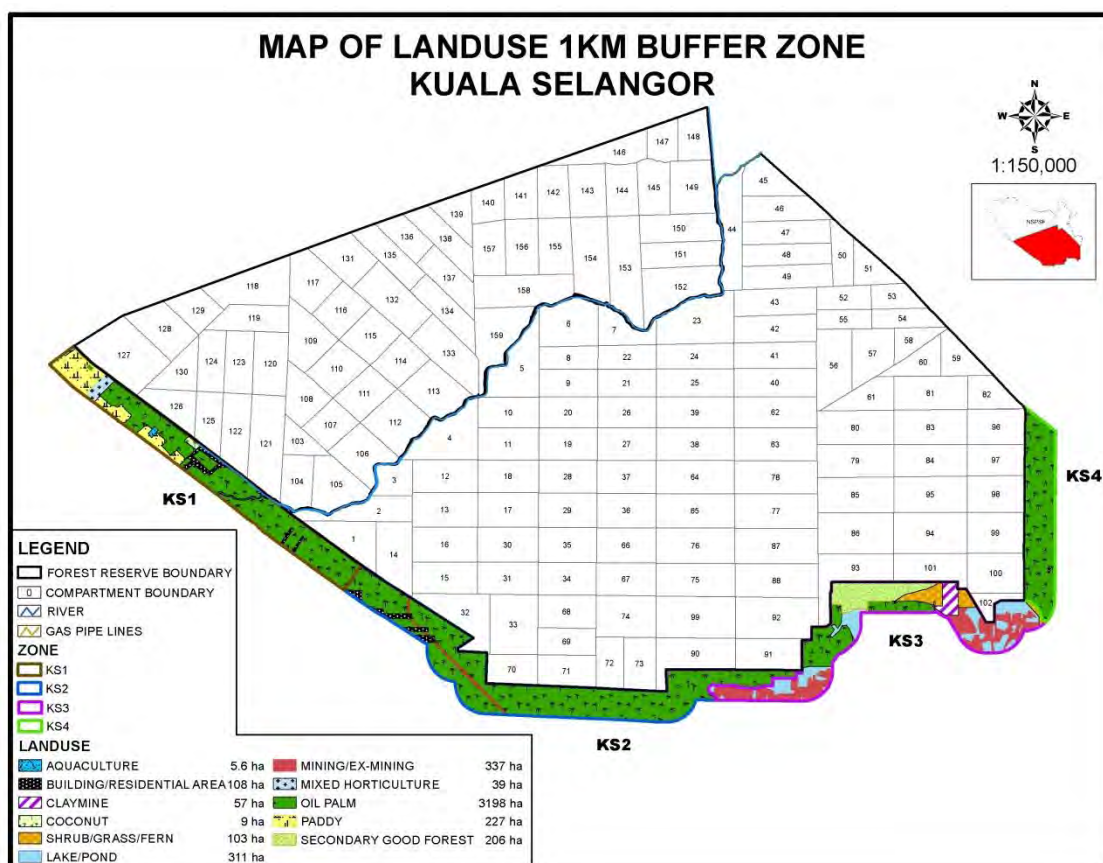


Figure C-6: Land use of 1KM Buffer Zone Area for Kuala Selangor

This buffer zone map was divided into 4 zones. Zone partitioning is based on current economic activities within 1 km. The following zones are:

- I. Kuala Selangor Zone 1 (KS 1) - Tiram Buruk and Sawah Sempadan
- II. Kuala Selangor Zone 2 (KS 2) - Sime Darby Plantation / Kampung Raja Musa & Kampung Seri Tiram Buruk Community land / Forest Compartment 73 and
- III. Kuala Selangor Zone 3 (KS 3) - PKPS clay mines and oil palm plantation / KDEB land / MBI land / UNISEL Land / SEMESTA
- IV. Kuala Selangor Zone 4 (KS 4) - Jalan Timur Tambahan (Parit 1-15)

a) Kuala Selangor Zone 1

Location Name: Tiram Buruk and Sawah Sempadan

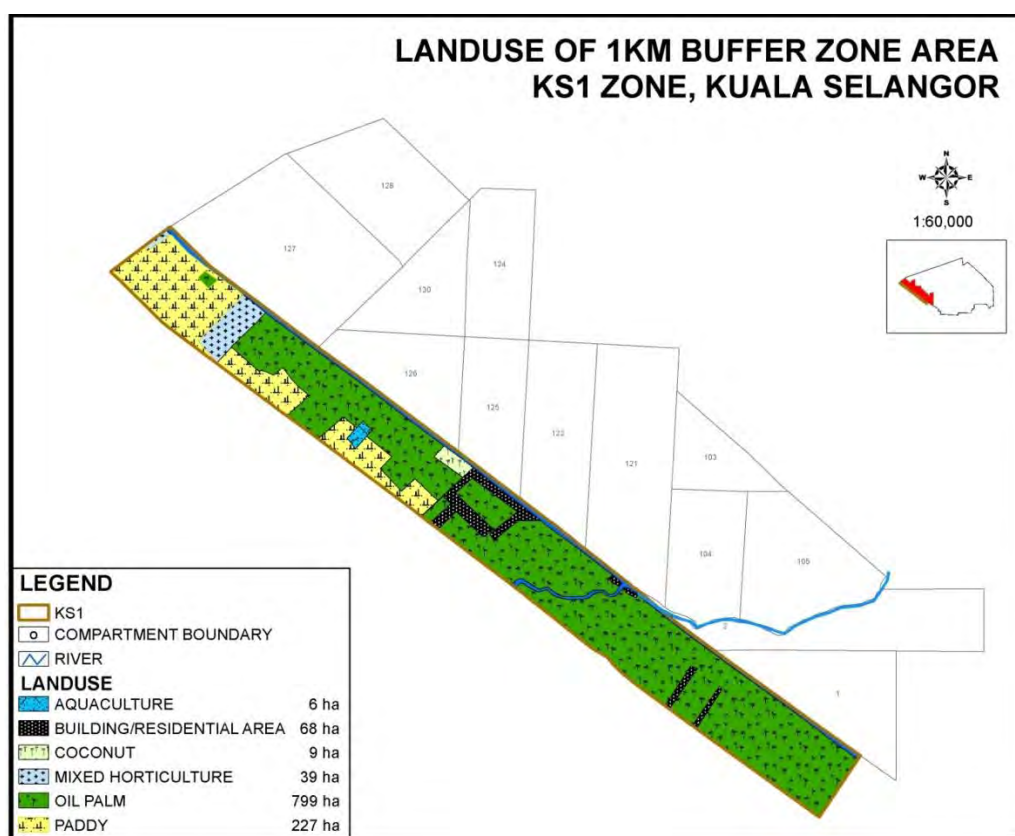


Figure C-7: Map of Kuala Selangor Zone 1

Kuala Selangor Zone 1 is located in the district of Kuala Selangor (Mukim Tanjung Karang 1 & 2) and West of NSPSF.

The land-uses adjoining the forest reserve are paddy field under the Tanjung Karang Rice Irrigation Scheme and smallholder oil palm plantation to the west of the NSPSF. The peat

swamp forest already functions as a buffer for the water supply for this scheme, and it was recognized that to sustain this function the forest needs to be protected. The yield in the paddy fields under the irrigation scheme is significantly higher than that in any other area in Malaysia. The paddy farmers are using modern farming methods and good farm management for paddy cultivation. Paddy fields, smallholder oil palm and Raja Musa Forest Reserve are separated by the main irrigation canal which acts as a buffer against impact on the forest hydrology. Thus, this zone has relatively few problems for NSPSF, such as encroachment, fires and others. Some local people here, using the main canal to generate extra income through fishing freshwater fish and sold at local markets. Local community members also graze cattle on the banks of the main canal and in some locations keep the cattle overnight – this leads to some impacts on the forest reserve and risk of fires. Along the eastern side of the main canal there is a gas pipeline and also a TNB transmission line. The periodic clearing of vegetation along the pipeline and transmission line can enhance the risk of fire. Therefore some controls are needed to reduce fire risk.



b) Kuala Selangor Zone 2

Location Name: Sime Darby Plantation / Kampung Raja Musa & Kampung Seri Tiram Buruk Community land / Forest Compartment 73.

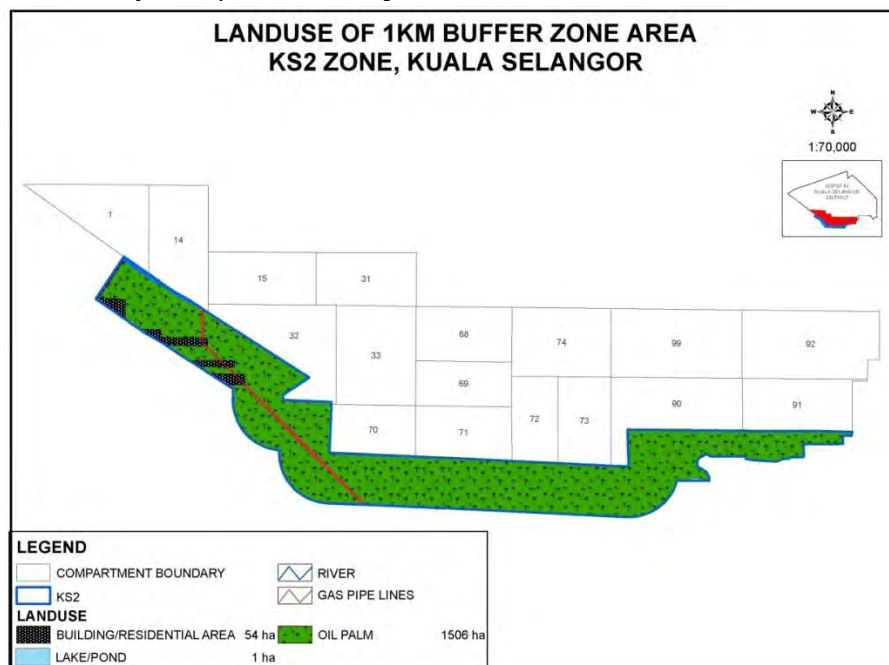


Figure C-8: Map of Kuala Selangor Zone 2

Kuala Selangor Zone 2 is located in the district of Kuala Selangor (Mukim Tanjung Karang 1 & Pasangan) and South - West NSPSF.

The land-uses adjoining the forest reserve are the oil palm plantation managed by Sime Darby Plantation, local communities from Kg. Raja Musa and Kg. Sri Tiram Buruk local communities (small-holders) to the South-West NSPSF. Activities undertaken at community-owned lands are not following good management practices for peat. They work and develop this area with their own limited capacity, technical knowledge and low capital. As a result there are negative impacts to forest reserves especially drying out peat swamp forest through poor water management and forest fires.



c) Kuala Selangor Zone 3

Location Name: PKPS clay mines and oil palm plantation / KDEB land / MBI land / UNISEL Land / SEMESTA Land

Kuala Selangor Zone 3 is located in the district of Kuala Selangor (Mukim Ulu Tinggi) and South NSPSF.

The area has been leased to the Selangor State Government Linked Corporations (GLC) to carry out mining activities of clay, sand and palm oil plantations under management of PKPS, KDEB, MBI and others. Such activities have been carried out not in accordance with the existing Kuala Selangor District Local Plan 2015 and no Environmental Management Plan been prepared. These activities impact negatively to Raja Musa Forest Reserve, especially drying out peat swamp forest through poor hydrology management. Fires are very frequent in this area. Some areas has a buffer of 20m- 50m between the development and the forest reserve and other areas do not have any buffer and are developed until the forest reserve boundary. This area has been identified as the location of a new water supply area under the proposed HORAS 3000 project. Under this scheme, it is understand that plantation and other activities will be stopped and most of the area converted to large ponds.



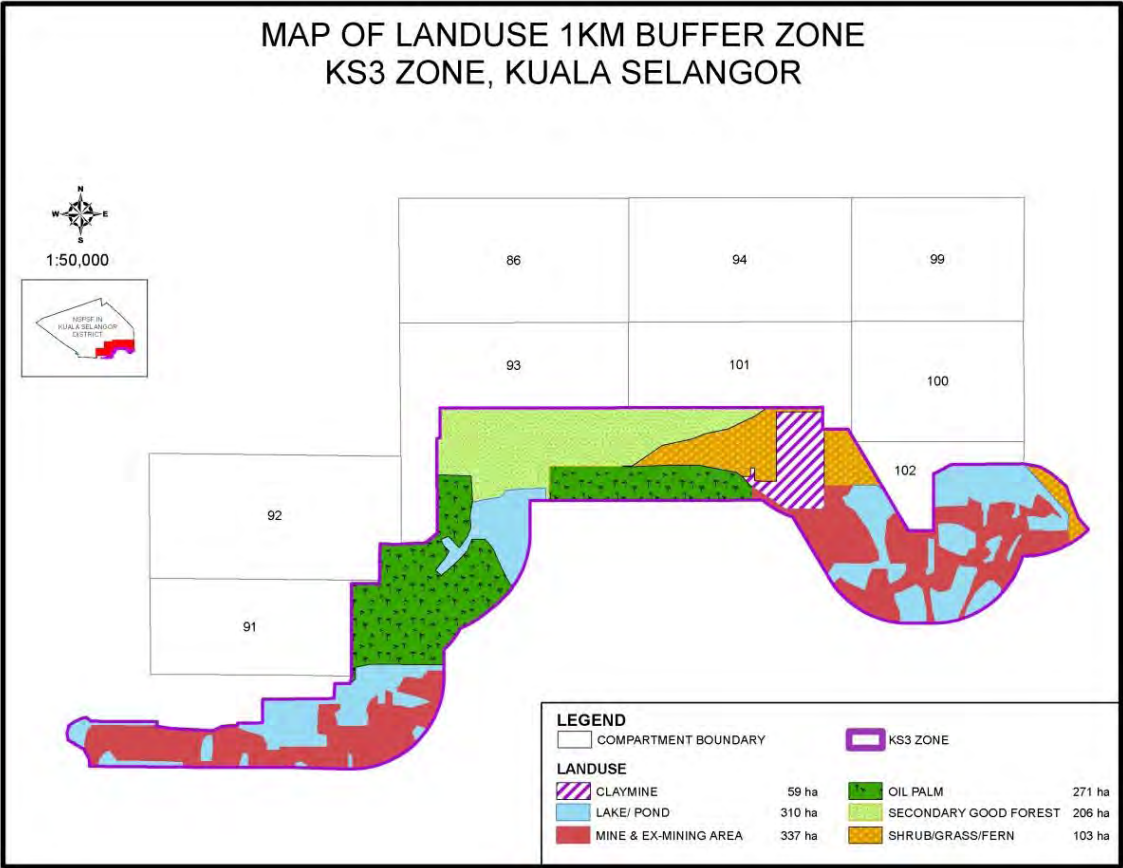
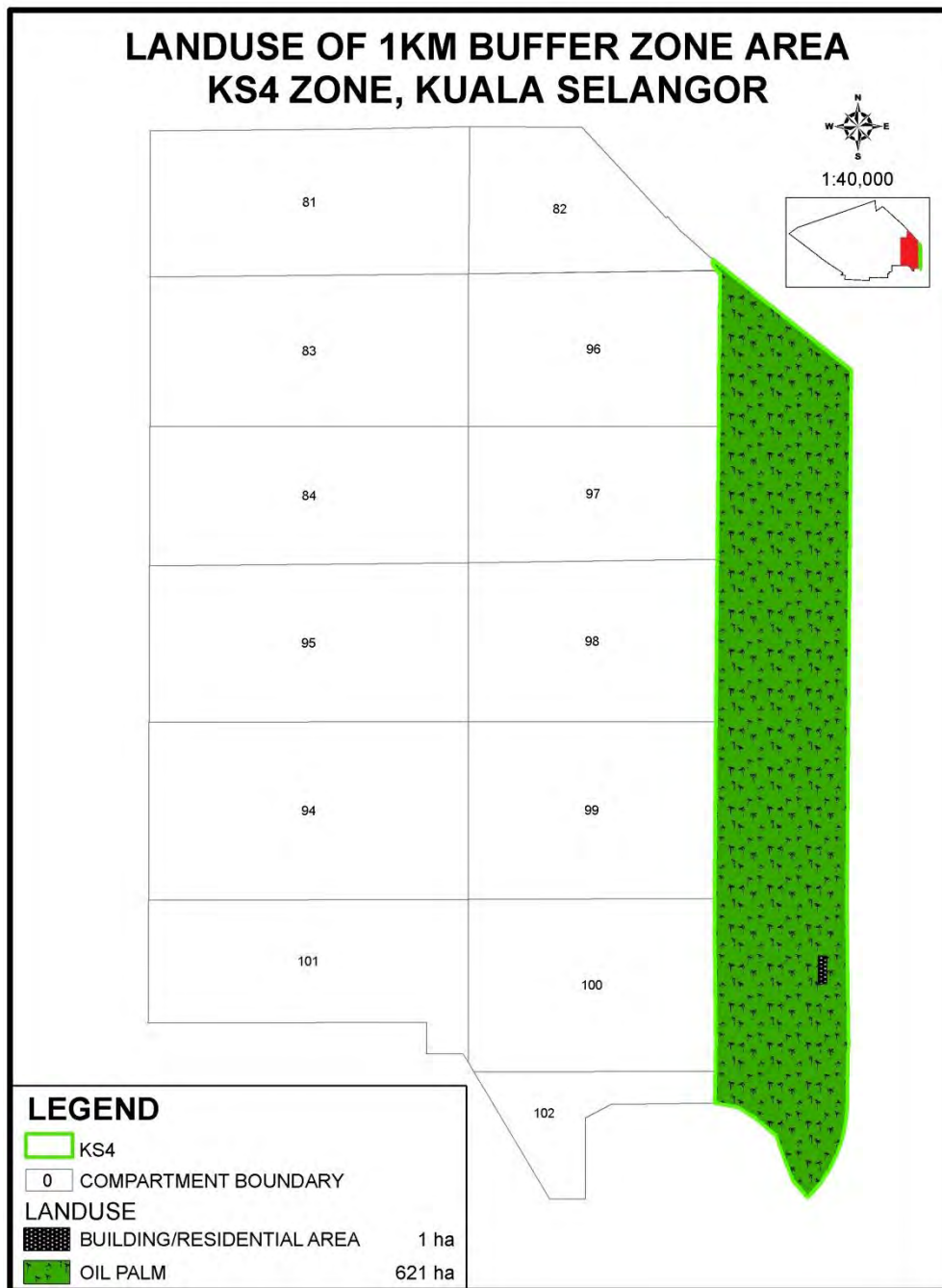


Figure C-9: Map of Kuala Selangor Zone 3

d) Kuala Selangor Zone 4

Location Name: Jalan Timur Tambahan (Parit 1-15)

**Figure C-10: Map of Kuala Selangor Zone 4**

Kuala Selangor Zone 4 is located in the district of Kuala Selangor (Mukim Ulu Tinggi) and is to the south east of East NSPSF.

The land-uses adjoining the forest reserve are oil palm plantation primarily controlled by small holder/ local community. Activities are undertaken not following good management

practices for peat. The areas are over-drained with little or no water management and subject to subsidence and periodic fires. The owners have worked and developed this area with their owned capacity, lack of technical knowledge and limited capital and as a result there is a negative impact to forest reserves especially drying out peat swamp forest through poor hydrology management and forest fire.



2.2 Sabak Bernam District

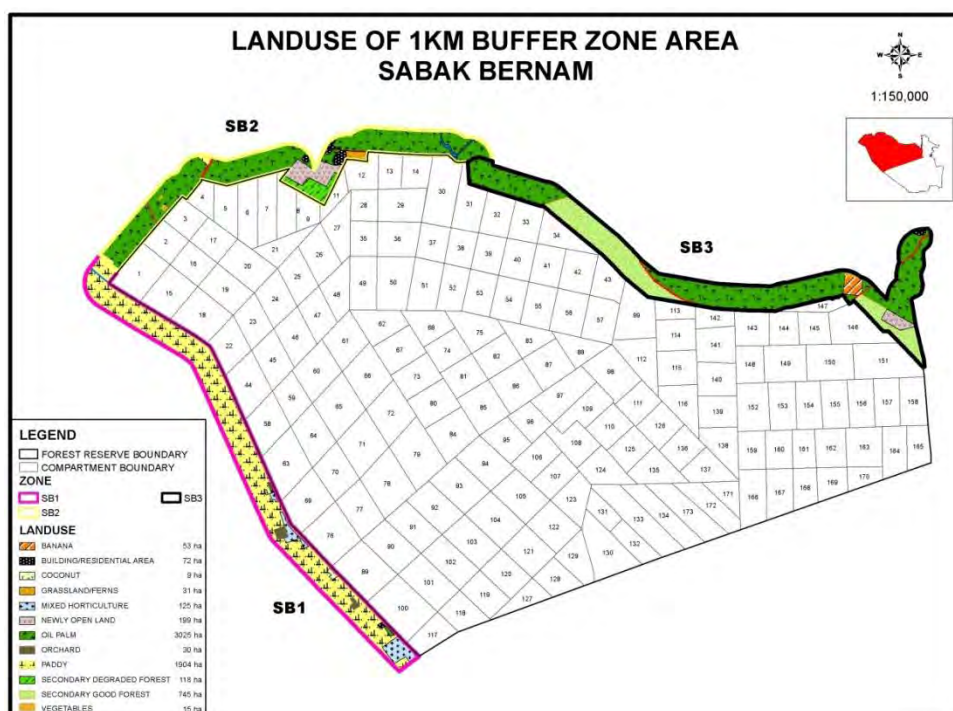


Figure C-11: Land use of 1KM Zone Area Sabak Bernam Map

This buffer zone map was divided into 3 zones. Zone partitioning is based on current economic activities within 1 km. The following zones are:

- I. Sabak Bernam Zone 1(SB 1) - Sungai Burung, Sekinchan, Sungai Hj Doraini
- II. Sabak Bernam Zone 2 (SB 2) - Project IADA (Water Retention Pond), Kampung Sungai Hj Doraini (Parit 9-14) and Kampung Merpauh Berdarah

III. Sabak Bernam Zone 3 (SB 3) – Kampung Merbauh Berdarah, Jalan Sungai Panjang & PKPS Plantation

a) Sabak Bernam Zone 1

Local Name: Sungai Burung, Sekinchan, Sungai Hj Doraini

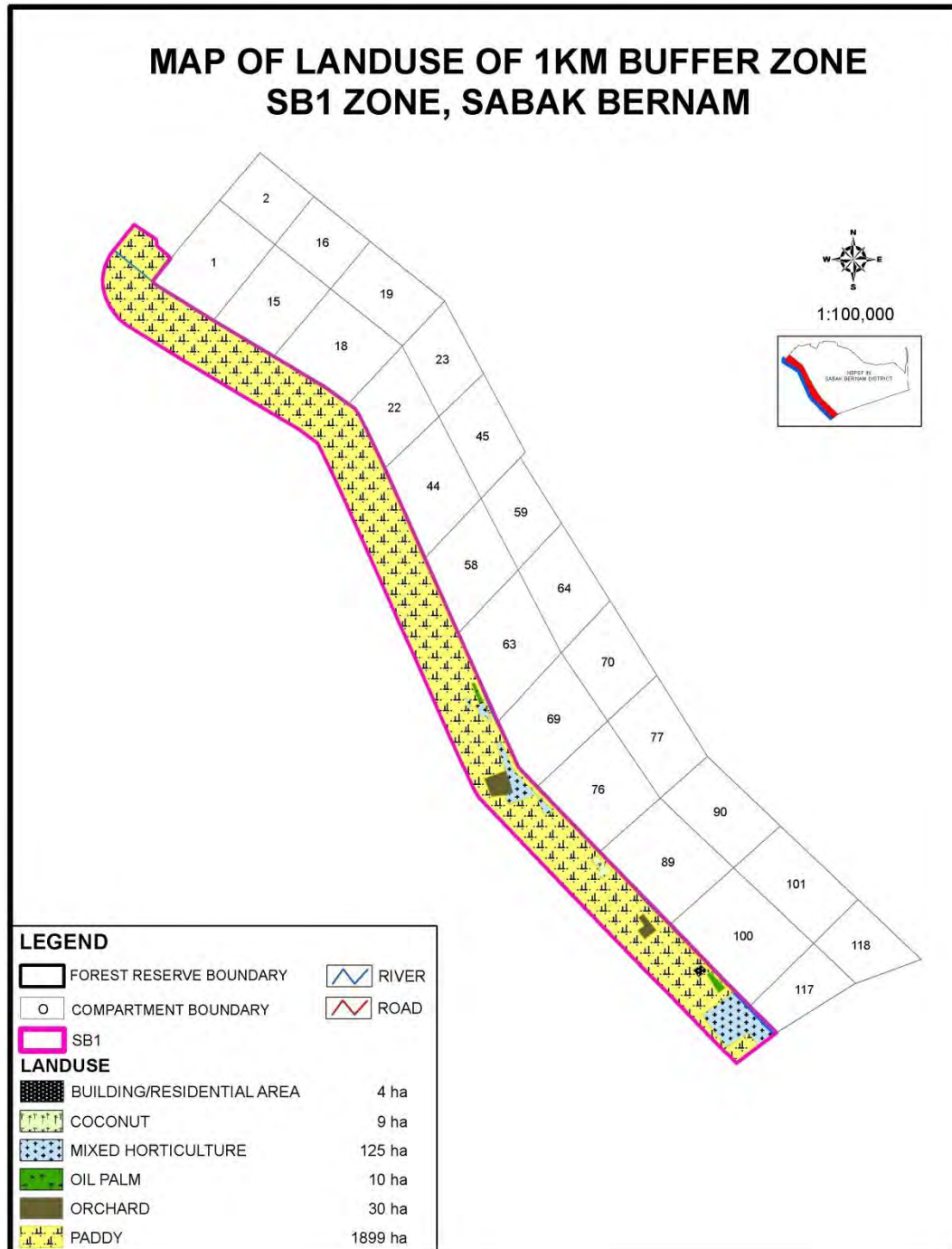


Figure C-12: Map of Sabak Bernam Zone 1

Sabak Bernam Zone 1 is located in the district of Sabak Bernam (Mukim Sungai Panjang) West NSPSF.

The land-uses adjoining the forest reserve are mainly paddy field under the Tanjung Karang Rice Irrigation Scheme to the west of the NSPSF. The peat swamp forest already functions as a buffer for the water supply for this scheme, and it was recognized that to sustain this function the forest needs to be protected. The yield in the paddy fields under the irrigation scheme is significantly higher than that in any other area in Malaysia. The paddy farmers are using modern farming methods and good farm management for paddy cultivation.



Paddy fields and Sungai Karang Forest Reserve are separated by the main irrigation canal which acts as a buffer against impact on the forest hydrology. Thus, this zone has relatively few problems for NSPSF, such as encroachment, fires and others. Some local people here, using the main canal to generate extra income through fishing freshwater fish and sold at local markets. Local community members also graze cattle on the banks of the main canal and along the banks of Sg Tenggi and in some locations keep the cattle overnight – this leads to some impacts on the forest reserve and risk of fires. Along the eastern side of the main canal there is a gas pipeline and also a TNB transmission line. The periodic clearing of vegetation along the pipeline and transmission line can enhance the risk of fire. Therefore some controls are needed to reduce fire risk. Construction of a bund by the IADP Project along the eastern bank of the main canal has led to impoundment of water and flooding of the forest leading to the death of significant forest areas. This problem needs to be addressed.

b) Sabak Bernam Zone 2

Location Name: Project IADA (Water Retention Pond), Kampung Sungai Hj Doraini (Parit 9-14) and Kampung Merpauh Berdarah

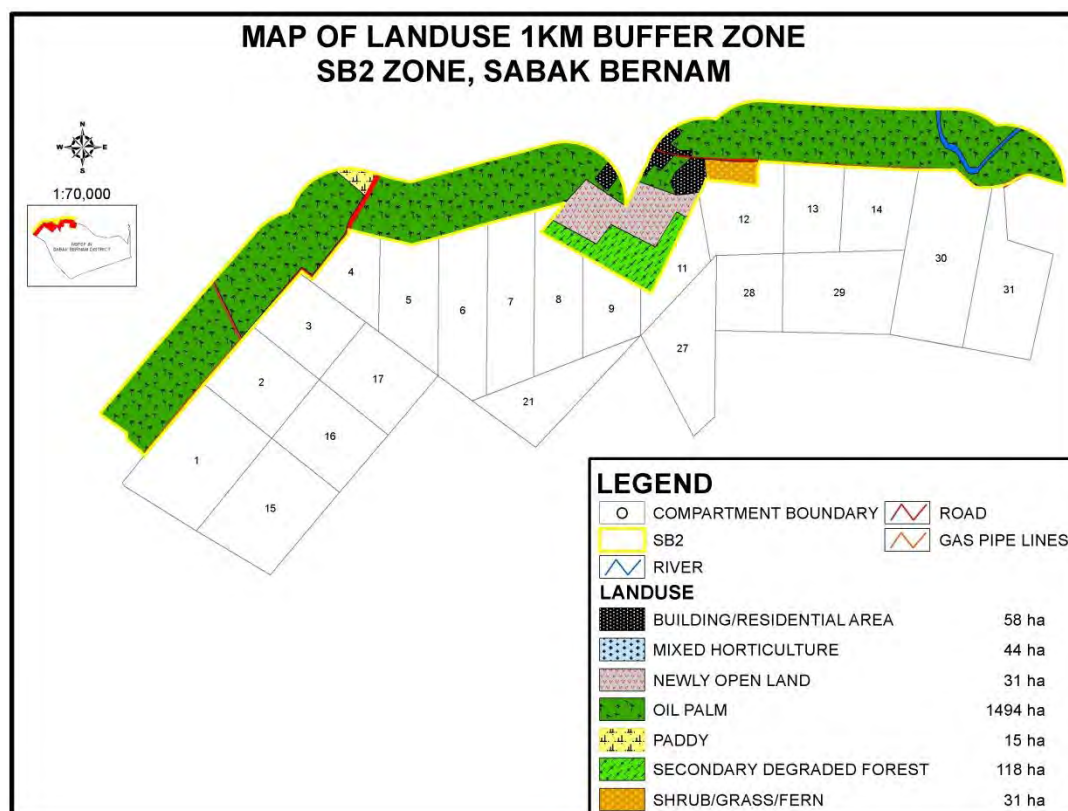


Figure C-13: Map Of Sabak Bernam Zone 2

Sabak Bernam Zone 2 is located in the district of Sabak Bernam (Mukim Sungai Panjang) and North-West portion of the NSPSF.

The land-uses adjoining the forest reserve are oil palm plantations and agriculture by small holders. The planting of oil palm and yam was carried out by farmers who settled in the area mainly prior to the establishment for the Forest reserve. Activities undertaken at community-owned lands are not following the good farming practices for peat. They work and develop this area with their own limited capacity, technical knowledge and low capital.

As a result there are negative impacts to forest reserves especially drying out peat swamp forest through poor water management and forest fires



Construction of a 90ha reservoir by IADA within the Sg Karang Forest Reserve at Kampung Sungai Hj Doraini adjacent to the feeder canal to store the water during the rainy season and supply to the rice fields during the dry season. This has resulted in 90ha of forest being cleared and excavation/disposal of up to 4 metres of peat, construction of an earth bund and drainage/disruption of the hydrology of adjacent forest areas.



c) Sabak Bernam Zone 3

Location Name: Kampung Merbauh Berdarah, Jalan Sungai Panjang & Selangor Agricultural Development Corporation (PKPS) Plantation

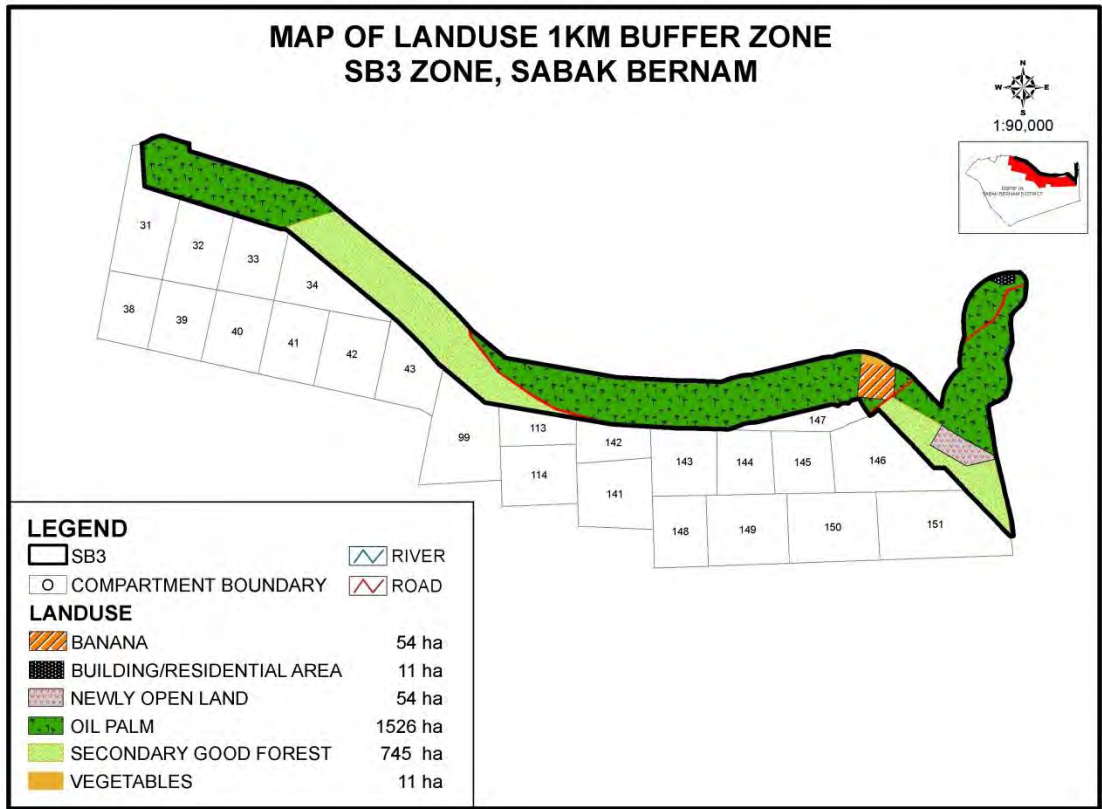


Figure C-14: Map Of Sabak Bernam Zone 3

Sabak Bernam Zone 3 is located in the district of Sabak Bernam (Mukim Sungai Panjang) and North-West NSPSF.

MARA Junior Science College (*Maktab Rendah Sains Mara-MRSM*) is under the construction process. The project is expected to be completed in early 2015. Surrounding area MRSM encroached by the local community, said by Sabak Bernam District Office for the purpose of planting oil palm except Forest Reserve areas. Local people involved in the clearing work at the area by using fires. This activity should be stopped immediately by the way good adaptability (strategic).



Along the Jalan Sungai Panjang adjacent to the Sungai Karang Forest Reserve is state land that has very good intact peat swamp forest. The area was classified under the existing local plan (to 2015) as a state land peat swamp forest which has to be preserved to create the environmental balance of the area. This area is the area of natural forest, and is a good habitat for wildlife and prevents flooding. In addition, inadequate environmental management consideration on the use of agro-chemicals, over-drainage and subsidence, use of fires for land preparation will bring negative impacts in the long term. The area is in the process of being gazetted as an extension of the Sg Karang Forest Reserve.



The oil palm plantation is located near Sungai Dusun Forest (Wildlife Conservation Centre Sungai Dusun) and managed by PKPS. There has no buffer zone has been reserved for this area. This area should prepare the environmental management plan that can be managed perfectly well without any impact on conservation areas and forest reserve. In this area there's another status forested state land which acts as buffer zone between the PKPS oil palm plantation & Sungai Karang Forest Reserve. The area is in the process of being gazetted as an extension of the SKFR.



2.3 Hulu Selangor District

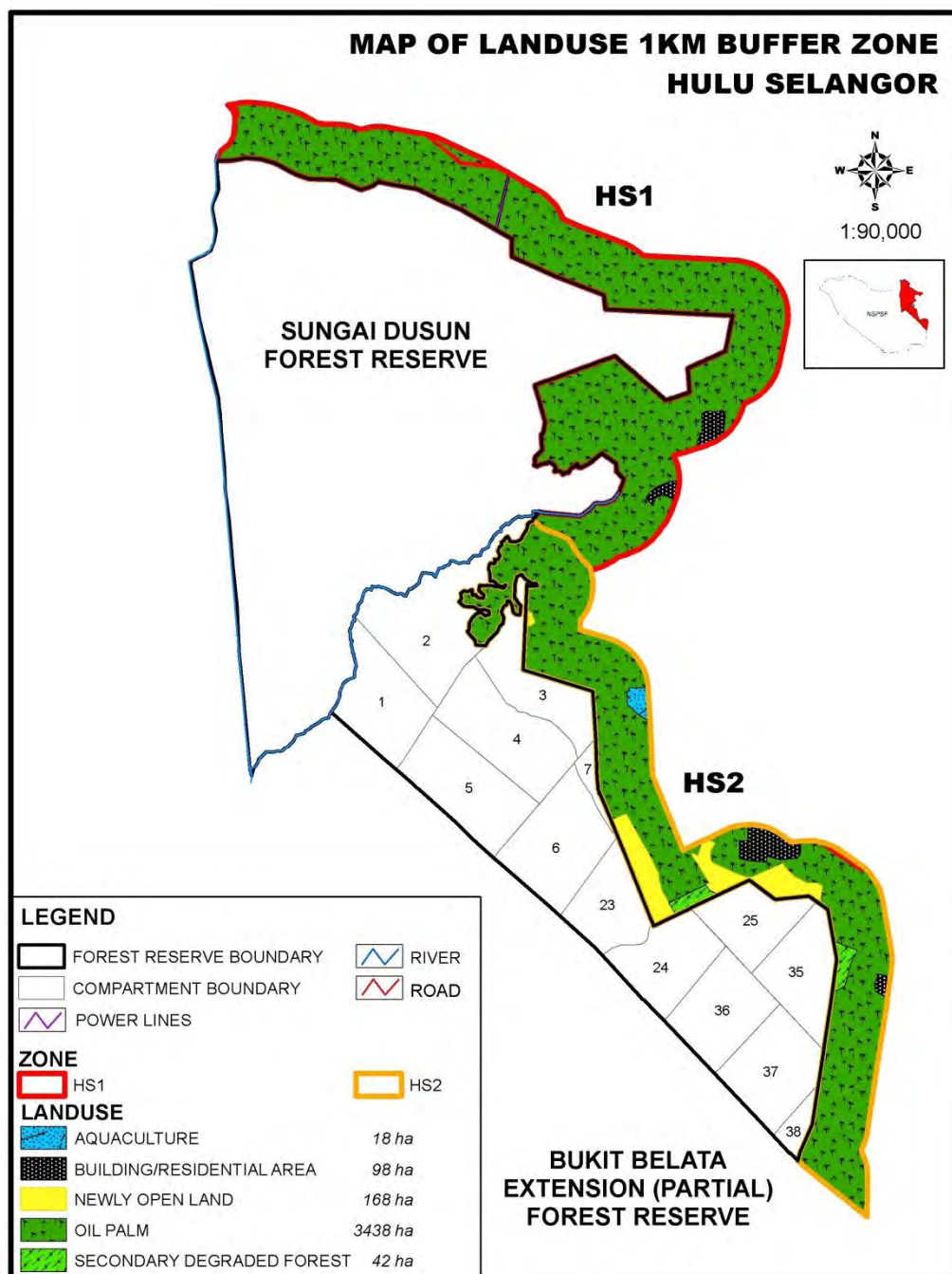


Figure C-15: Land use of 1KM Buffer Zone Area for Hulu Selangor

This buffer zone map was divided into 2 zones. Zone partitioning is based on current economic activities within 1 km. The following zones are:

- a) Hulu Selangor Zone 1 (HS1)- Sungai Tenggi Selatan, Sungai Tenggi Plantation, local communities from Kampung Tawakal A & B & Parit 16
- b) Hulu Selangor Zone 2 (HS2)- Felda Sungai Tenggi, Felda Soeharto Plantation & JPS feeder canal

a) Hulu Selangor Zone 1

Location Name: Felda Sungai Tenggi Selatan, Sungai Tenggi Plantation, local communities from Kampung Tawakal A & B & Parit 16

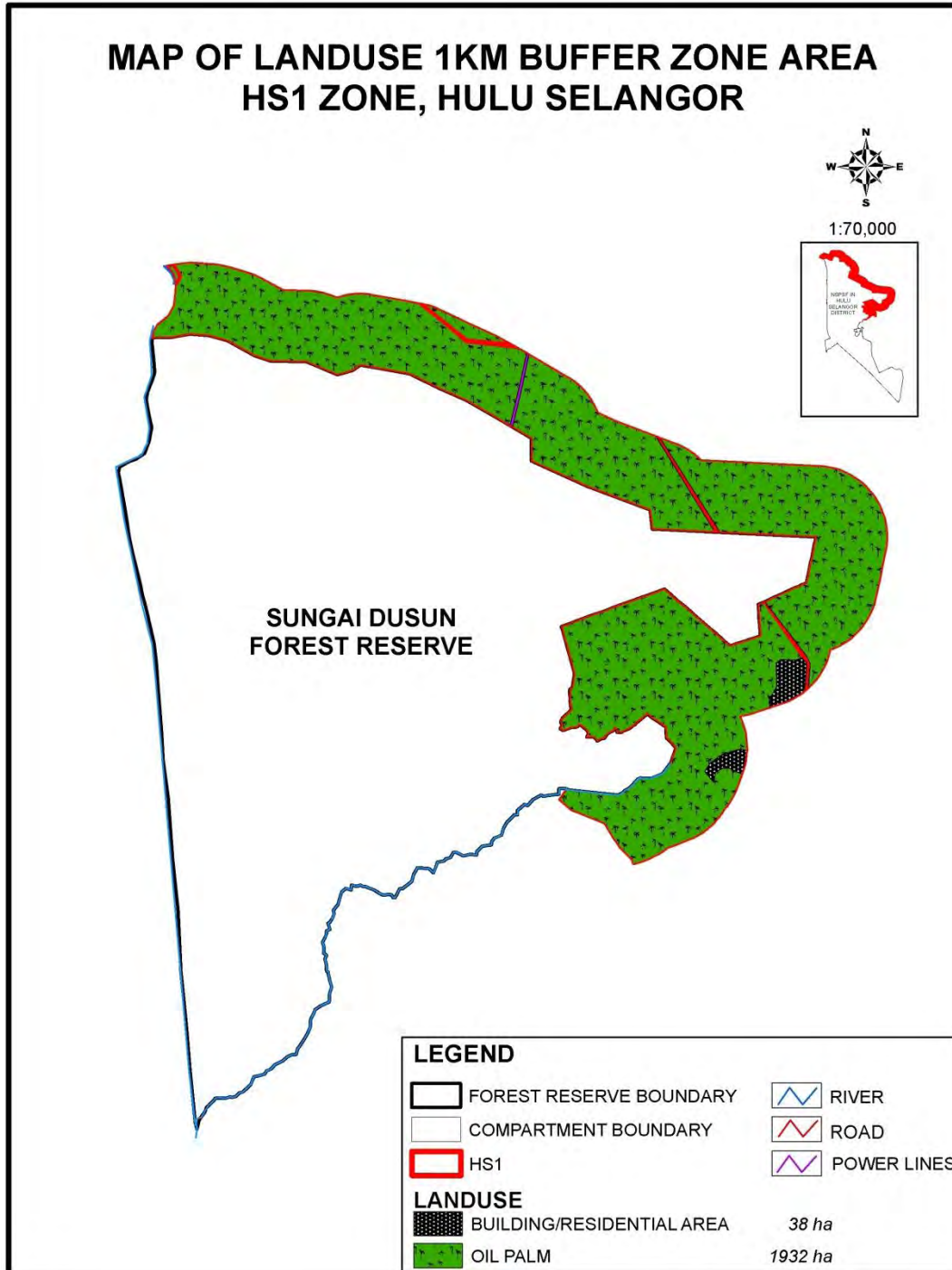


Figure C-16: Map of Hulu Selangor Zone 1

Hulu Selangor Zone 1 is located in the district of Hulu Selangor (Mukim Hulu Selangor) and North-East NSPSF.

The land-uses adjoining the forest reserve are oil palm plantations developed and managed by Felda Sungai Tenggi Selatan, Sungai Tenggi Plantation and local communities from Kampung Tawakal A & B. The area developed by the local community includes a mixture of legal and illegal land development. There has been significant encroachment and fires affecting the forest reserves. . This area boundary should re-demarcate with the help from Selangor Forestry Department and Hulu Selangor District and Land

Office. Activities undertaken at community-owned lands are not following the good farming practices for peat. They work and develop this area with their own limited capacity, technical knowledge and low capital. As a result there are negative impacts to forest reserves especially drying out peat swamp forest through poor water management and forest fires.



b) Hulu Selangor Zone 2

Location Name: Felda Sungai Tenggi, Felda Soeharto Plantation & JPS feeder canal

Hulu Selangor Zone 2 is located in the district of Hulu Selangor (Mukim Hulu Selangor) and North-East portion of NSPSF.

The land-uses adjoining the forest reserve are oil palm plantations developed and managed mainly by Felda Sungai Tenggi & Soeharto Plantation. At the north end, PKPS has leased the State Land for cattle farm project. This development must be carefully regulated to avoid any pollution to the Tenggi River, diseases to the wildlife breeding programme at Sg Dusun Wildlife Reserve and further illegal encroachment.



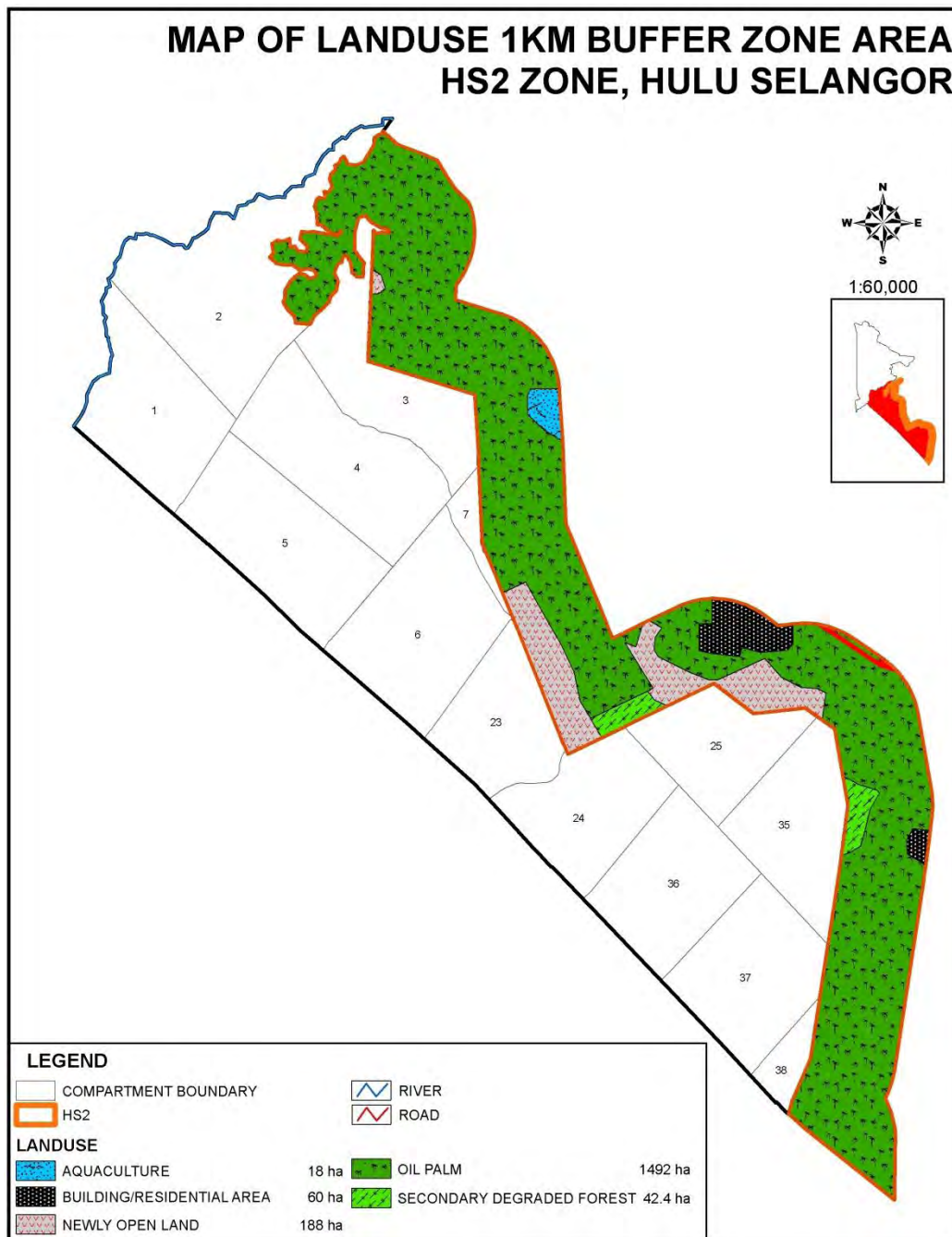


Figure C-17: Map of Hulu Selangor Zone 2

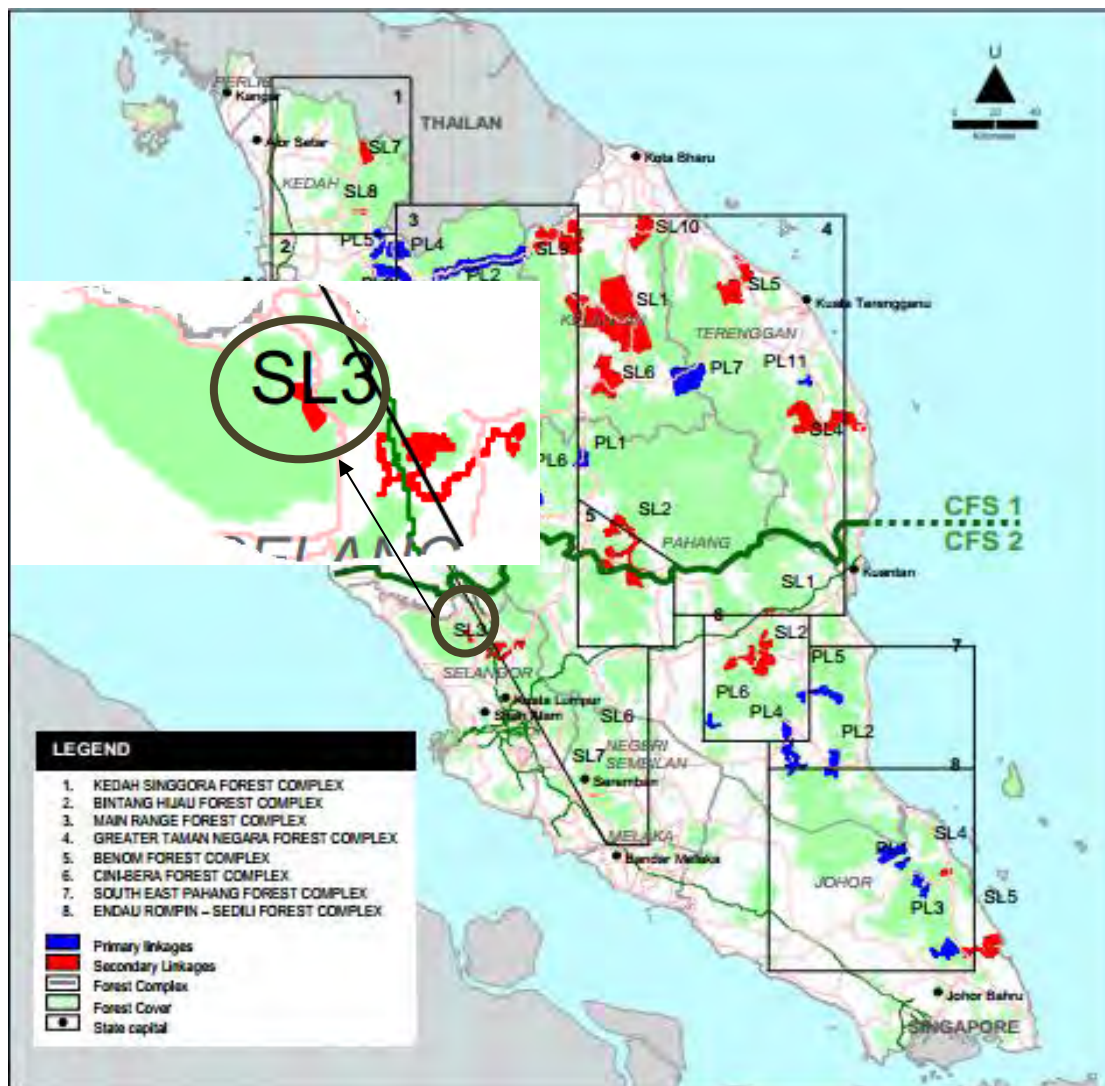


Figure C-18: Primary and Secondary Linkages in the Central Forest Spine

Hulu Selangor zone 2 also located in the Central Forest Spine (CFS) 2 and the network 2 (SL3: Bukit Gading Forest Reserve - Bukit Belata (Tambahan), Forest Reserve- Raja Musa Forest Reserve). This area is important in sustaining the ecological networks. This will serve as the backbone network of Environmentally Sensitive Areas (ESA), which strengthen the network of protected areas and help protect the health of ecosystems (including wildlife population) to reduce the damaging effects of fragmentation. Implementation strategies have been proposed for each of these ecological networks in general. Further details are available on the Hulu Selangor District Local Plan 2020 (pages 3-97).

3.0 Proposed management strategies for buffer zone management adjacent to NSPSF

3.1 Buffer Zone management strategies for NSPSF

Strategy 1: Finalize the determination of the boundary of the buffer zone and develop guidance for each buffer zone section within the frame work of a buffer zone plan

NSPSF is classified in National Physical Plan (NPP) and Selangor State Structure Plan (SSSP) as Environment Sensitive Area (ESA) Class 1 where no development is allowed. It is surrounded by buffer zone of ESA Class 2 with a width of 500m (no land clearance). This is further surrounded by a 500m buffer zone of ESA Class 3 (controlled development). The function of the buffer zone is to reduce or mitigate the negative influences of activities taking place outside the forest reserve. This concept has been widely recommended, including in the operational guidelines of local district plans, policy makers and land managers (including government and private lands owners including local communities). The overall buffer zone areas for NSPSF has been divided into 9 zones to enable effective implementation These zones selection was made according to the district, current land use and types of economic activity being carried out in the buffer zone of NSPSF

Strategy 2: Integrate the buffer zone plan into the District local Plans for the three related districts

Develop and introduce appropriate strategies, mechanisms and incentives to integrate ESA Class 1 & 2 components in buffer zones and NSPSF within the broader ecological and social landscape, and encourage conservation in adjacent private and communal areas.

Existing good forested areas in state land under the jurisdiction of local authorities should be proposed for forest reserve expansion as well as reasonably natural forest areas of high conservation value which are critical for the long-term persistence of biodiversity within the NSPSF. These include adjacent natural areas (especially high priority habitats) which function as an ecologically integrated unit with the forest, as well as areas critical for maintaining ecological links and connectivity with the broader landscape. These areas may include:—



Possible areas for expansion of the forest reserve;

Corridors for the movement of wildlife; or

Areas under similar management (e.g. forest reserves) which contribute to the conservation of biodiversity.

To establish buffer zones around NSPSF:-

- Establish these buffer zones by publication in the District Local Plan & State Structure Plan;
- Integrate the buffer zones into municipal spatial development frameworks as special control/natural area where appropriate; and
- Where necessary or appropriate, declare the buffer zones or parts thereof as protected environments in terms of the Act or/and Enactment

Strategy 3: Ensure that management of water resources in the buffer zones does not disrupt the hydrology of adjacent NSPSF

The hydrological functions and the natural water balance of the NSPSF need to be re-established. It is the key to ensure that management of water resources in the buffer zones does not disrupt the hydrology of adjacent NSPSF.

To this end any further drainage of the forest should be stopped, and the strategy is to block existing canals and to restrict the establishment of new canals.

Strategy 4: Support and promote buffer zones activities that are compatible with and which complement the objectives of the NSPSF.

The activities identified compatible with and which complement the objectives of NSPSF may include:-

- Nature conservation;
- Agro tourism ;
- Sustainable resource use. This may include fishing, controlled harvesting of Non Forest Timber product including food items, medicinal plants, craft, or any other appropriate form of sustainable use; or
- Nature based tourism or/and eco-tourism
- Community forestry
- Agroforestry tourism

To support these activities, the establishment of community conservation areas (or community forestry) within the buffer zone and NSPSF will be actively encouraged.



The Government within the buffer zone will:-

- a) Support the establishment of:-
 - protected environments conservation area
 - Community based conservation areas.
- b) Include these areas into the district development frameworks as special protected areas or/and conservation areas.

- c) Continue to explore innovative ways to encourage land owners and communities to apply conservation on land in the buffer zone including:-
 - Establishment of voluntary conservation areas (within ESA 2 area)
 - Identifying and applying incentives for conservation.
- d) Strongly encourage agricultural producers to incorporate biodiversity considerations in plantation / farm management practices and plans.
- e) Investigate, formulate and implement integrated land-use planning approaches that include multiple natural resource activities which are compatible with and which complement the conservation and sustainable use of biodiversity.

Strategy 5: Promoting BMPs for the existing legal development in ESA Class 2 area adjacent NSPSF

To provide practical guidance based on field experience and current knowledge on the BMPs to the existing legal development in ESA 2 area adjacent NSPSF.

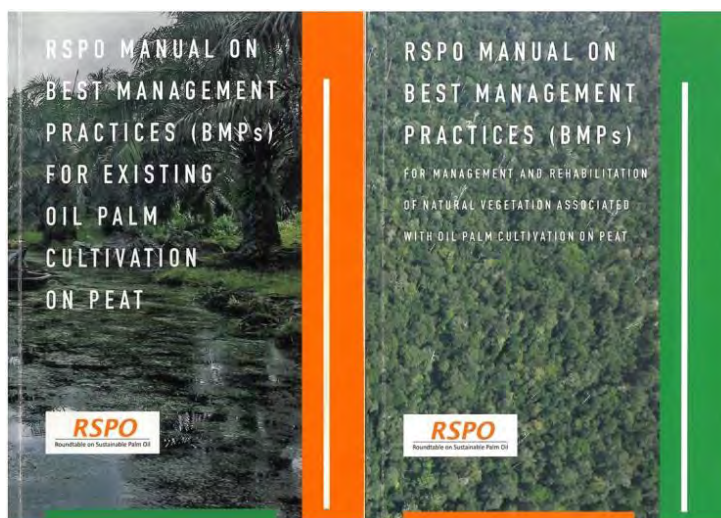
Identify, evaluate, and incorporate into the plan documents the appropriate BMPs.

The recommended BMPs for the guidance and reference are as follows: -

RSPO Manual on Best management Practices (BMP's) for existing oil palm cultivation on peat.

RSPO Manual on Best Management Practises (BMPs) – For management and rehabilitation of natural vegetation associated with oil palm cultivation on peat

Guidelines for the development of a standard operating Procedure for oil palm cultivation on peat (MPOB).



The most important BMPs are those related to water management. The BMPs adopted in the buffer zone should be such as to prevent any drainage of the NSPSF. This can include:

- Construction of clay bunds to isolate the buffer zone from the NSPSF
- Maintenance of high water levels (e.g. at the surface or no more than 20cm below the surface) in perimeter drains of developments in the buffer zone.
- No deepening of existing canals and construction of new drainage canals in the buffer zone
- Avoiding use of any pesticides in the buffer zone that could spread by wind-drift to the NSPSF
- No Use of fire in the buffer zone.

Strategy 6: Stop any new development in areas in which biodiversity and ecological function would be adversely affected.

All development in the buffer zone which may have negative impact on NSPSF will be strictly controlled. Development which may have a negative impact or effect on NSPSF includes:-

- a) Mining;
- b) Agricultural development & Urban development;
- c) Industrial development;
- d) housing development;
- e) Transport infrastructure development;



In line with the provisions of the NPP and the SSSP – the only activities permitted in the mandatory 500m buffer for the NSPSF are sustainable forest management, ecotourism and research.

Strategy 7: Support the development of community-based forestry management initiatives as part of a broader set of approaches to land-use planning and developing local sustainable development strategies.

Local communities' use of natural resources often plays a vital role in the household economics of many of these communities. Ensuring the conservation and sustainable use of natural resources in NSPSF buffer zones, and minimizing adverse impacts on the ecosystem of such areas will require several common approaches to be adopted.

Partnerships need to be developed to enhance and ensure the sustainability of the natural resources (see also Goal 5). An active partnership between Selangor State Forestry Department, local district office, local community and other relevant is encouraged. All district offices have District Local Plans (DLP) which is plans for the development of the local area. These plans aim to:—

- enhance sustainable livelihoods
- Develop the area to provide long lasting economic opportunities and a better quality of life; and
- Protect the natural resources of the NSPSF

These goals are shared with the efforts of community based natural resource management (CBNRM) or community based organisation (CBO) for example Friends of North Selangor Peat Swamp Forest. By working closely with Local and District Office, Districts Council and Local

Agenda 21 programme become part of the district council local plan and benefit from the support that district, state and national government can provide. The main thrust of this partnership is the promotion of the establishment, development and management of community conservation areas in which the aim is to:-

- Promote wise use of natural resources
- Promote the BMPs application on the existing agricultures practices on peat
- Provide benefits and commercial opportunities to local communities
- Control excess use of resources where the resource is not being renewed

In the development of such community forestry (conservation) areas in the buffer zone, Selangor Forestry Department will provide assistance with the development of management plans, assessment of fire prone areas and development of fire prevention and control plan, gathering information on impacts of socio economic activities in buffer zone and developing management strategies.

Strategy 8: Promote the development of partnerships with key stakeholders for planning and managing the use of resources within the buffer zone, and optimising benefits for local people

Partnership between Selangor State Forestry Department (NSPSF management authority) and the State authority or authorities responsible for preservation and conservation is essential as these organizations are all working towards the same goal. Written agreements or mutual understanding between the organizations are encouraged to ensure collaboration and cooperation in sustainable management of peatlands, especially in the buffer zones or in state land.



Partnerships between the NSPSF management authority (Selangor State Forestry Department) and district offices will be guided primarily through the integration of the NSPSF and its buffer zone into the district council development frameworks and the integrated development plans.

Partnerships between the NSPSF management authority and its neighbouring communities are encouraged through this strategy.

Strategy 9: Enhance the capacity of communities residing adjacent to NSPSF to participate in protected area management through providing appropriate training and education, and through recognising local expertise and traditional institutions.

Capacity development continues to be critical to the continued successful existence of NSPSF. Development of



the communities' capacity in the buffer zone management for the conservation of biodiversity both in the NSPSF and in its buffer zone will enhance the long term viability of the NSPSF.

A number of programmes are already in place, namely enhance sustainable livelihoods programmes- especially to improve buffer zone by rehabilitation of systems (e.g. community based rehabilitation), as well as the development programmes such as the extended public volunteering programme.

Government will continue to provide support for these programmes. Additional assistance to communities will be provided to ensure best practice methods of buffer zone management, as well as developing strategies and programmes for the promotion of enterprise which will support the NSPSF and their management as well as provide opportunities for economic development in the buffer zone.

Strategy 10: Improve benefit flows to people in and around NSPSF.

NSPSF must be seen and must operate as local economic drivers which contribute substantially to the long term sustainability of the district and state. People living nearby NSPSF who are providing both protection and support for NSPSF should see direct benefits accruing to them from the NSPSF.

The NSPSF management authority will promote local and social development in the state by:-

- Where possible, securing goods and services from the communities living nearby NSPSF;
- Employing personnel from nearby communities
- Providing communities services
- Providing environmental education and opportunities within protected area
- Promoting community management of conservation areas in the buffer zone
- Where relevant promoting co-management agreements for the management of NSPSF
- Where appropriate, designating areas for sustainable resource use in NSPSF



In summary, this buffer zone management plan for NSPSF highlights the importance goals and strategies to implement at the buffer zone area adjacent to NSPSF. This buffer zone management plan has to be adopted as a guide or/and regulation. Without this adoption, any activity in the buffer zone will result in problems between the SSFD and land owners.

4.0 Implementation of the strategy

4.1 Key Agencies

This strategy, while primarily addressing the improved protection and conservation of NSPSF, has implications to a wide range of role players. Accordingly, the strategy will not be implemented without the role players, active support and collaboration. Key agencies involved in integrated management of buffer zones adjacent to NSPSF, listed in Table C-4:

Table C-4: Key agencies involved in integrated management of buffer zones adjacent to NSPSF

No.	Agency	Functions
I.	Selangor State Economic Planning Unit (UPEN)	<ul style="list-style-type: none"> Responsible for economic planning at state level. To be effective, the planned activities in the NSPSR must be coordinated with development proposals and plan, for example for land development in the state land.
II.	Selangor State Forestry Department (SSFD)	<ul style="list-style-type: none"> Administer and manage the state's forest resources for State Forest Management concept in order to benefit the social, economic and environment to the people. Act as the implementing agency policies and enforcement of laws and forestry regulations. Act as the implementing agency's development efforts, rehabilitation and reforestation through proper silvicultural practices for optimum production of forest products and sustainable.
III.	Selangor State Fire and Rescue Department (SSFRD)	<ul style="list-style-type: none"> SSFRD is responsible for suppress fire and provide training for the small holder famer on the firefighting operation on peatland.
IV.	Department of Agriculture of Selangor (DOA)	<ul style="list-style-type: none"> Provide consultation services and technical support in a package format to entrepreneurs, private organizations and agriculture development agencies. Development of trained and skilled workforce to cater to the needs of the agriculture industry. Develop Agriculture Food and Soil Information Centre for planning purposes and implement development programmes for the agriculture sector. Conduct training at the agriculture Institute and Training Centre to fulfil the requirements for skilled workforce within the agriculture sector. Monitor and control the quality of the country's agriculture resource and seedlings. Implement the enforcement of Pesticide Act 1974 to ensure that pesticides which are imported distributed and sold in our country are of quality and will not cause harm to consumers, livestock, food crops and the environment. Implement the enforcement of Plant Quarantine Act 1976 to prohibit the entrance of deadly foreign pathogen into our country and also to facilitate the export of our country's products so that they comply with the quarantine regulations imposed by the

		<p>importing country.</p> <ul style="list-style-type: none"> • Implement the Custom Order (Export Restriction) 1988 and CITES regulation (International Trade Convention for Endangered Animal Species and Wild Plants) to ensure that agriculture resource and plasma generation are not threaten with extinction.
V.	District Offices (Kuala Selangor/ Hulu Selangor & Sabak Bernam)	<ul style="list-style-type: none"> • Management development and disposal of land. • Provides technical services and enforcement. • Management of land title registration. • Management of land revenue. • Management Services include administration, human resources, finance and information technology. • Management of socio-economic development and the implementation of small-scale rural infrastructure projects. • Implement the new Government Policy namely <i>Merakyatkan Ekonomi</i> Selangor (MES).
VI.	Local district councils: Majlis Daerah Kuala Selangor (MDKS) Majlis Daerah Sabak Bernam (MDSB) Majlis Daerah Hulu Selangor (MDHS)	<ul style="list-style-type: none"> • Their functions are as local government of respective areas.
VII.	Selangor Water Management Authority (LUAS)	<ul style="list-style-type: none"> • Responsible to ensure the state's water resources, including river basin, groundwater and surface water, lakes and coastal area is protected. • These functions and responsibility are executed through Integrated River Basin Management (IRBM) and Integrated Coastal Management (ICM) approaches.
VIII.	Integrated Agriculture Development Area of Selangor Northwest Project (IADA)	<ul style="list-style-type: none"> • Increase agricultural infrastructure, particularly irrigation and drainage system for certain agricultural • Strengthen and expand support services for agriculture and agricultural management. • Coordinate the activities of advisory and extension services to target groups through human development/ training.
IX.	Department of Irrigation and Drainage of Selangor (DID)	<ul style="list-style-type: none"> • Conserve, manage and develop water resources, land and related resources across all sectors within a river basin. • Establish a Centre for Coastal Engineering in the Department of Irrigation and Drainage (DID) in 1987 to implement erosion control plans across the country. • Integrated River Basin Development and Integrated Flood Management for flood management plans. • Provide "Planning and Design Procedure No. 1: Standards and Procedure for Urban Drainage Design for Peninsular Malaysia. • Agricultural drainage:

		<ul style="list-style-type: none"> • Ensure drainage department always work effectively. • Investigate within 72 hours and take action accordingly. • Taking action emergency repairs to essential facilities in at least 48 hours in the event of damage.
X.	Department of Environment of Selangor (DOE)	<ul style="list-style-type: none"> • To administer and enforce the Environmental Quality Act, 1974 including section 29(A), and Section IV of the Exclusive Economic Zone Act, 1984. • To ensure and sustain sound environmental management in the process of nation building. • DOE's mission is to promote, enhance, and sustain sound environmental management in the process of state development and building. • A key activity is to study and assess development projects subject to the Environmental Impact Assessment order. • DOE also provides environmental inputs to state agencies to ensure that use of land and other natural resources is carried out in a manner that complies with the concept of sustainable development.
XI.	Department of Town and Country Planning of Selangor (DTCP)	<ul style="list-style-type: none"> • Act as the principal adviser to the State Government on all matters of planning, including the preservation of land use and development. • Act as advisors to local authorities on town and country planning, and development and land use. • Implement and coordinate the standardization of the full implementation of the Town and Country Planning Act 1976 (Act 172) in all local planning authorities in Selangor. • Coordinate the preparation of the development plan of the State Structure Plan, Local Plan and Special Area Plan and research / special projects either ordered or on the initiative of the department based on ESA component adoption. • Serves as the secretariat for the State Planning Committee, under the Town and Country Planning Act, 1976 (Act 172). • Acting as the Local Planning Authority (LPA) for the area outside the Local Authority in accordance with the requirements of Section 5 (2), Act 172. • Implementing application standardization of rules, standards and guidelines, for all local planning authorities in the State of Selangor. • Performs functions of the Board of Appeal in accordance with section 36 of Act 172. • Provide advice to departments / agencies of the town and country planning. • Perform other duties as may be entrusted by the state authorities from time to time.

XII.	Department of Mineral and Geoscience of Selangor	<ul style="list-style-type: none"> • To undertake systematic mineral exploration. • To undertake systematic investigations in various geoscience disciplines such as geological mapping, groundwater resources, engineering geology, geological hazards, environmental geology, marine geology, geophysics, and others. • To provide geochemical analyses and physical tests on rock materials and minerals. • To act as the national depository for all information related to geoscience and mineral resources of the country. • To collect, analyse and disseminate data and information pertaining to mineral exploration, mining and related activities. • To provide technical advisory and expertise services in the fields of mineral, geoscience, mining and quarrying. • To assist and co-operate with the private sector and industry to develop further the mineral sector. • To ensure that mining of minerals and related activities are carried out safely, efficiently and systematically. • To implement government policies and directives with regards to the mineral industry and geoscience, besides administration and enforcement of regulations. • To carry out research and development (R&D), technology transfer, mineral resources development and promotion of research products so that they are acceptable to the industry.
XIII.	Department of Wildlife and National Parks of Selangor (PERHILITAN)	<ul style="list-style-type: none"> • DWNP is responsible for the management of the Sungai Dusun Wildlife Reserve. Conservation measures and monitoring of wildlife in the NSPSF should be co-ordinated with the activities and plans of DWNP in Sungai Dusun Wildlife Reserve and elsewhere. • Coordinate the enforcement of wildlife protection in Peninsular Malaysia. • Objectives of department: <ul style="list-style-type: none"> ✓ Protection, management and preservation of biodiversity for production benefits. ✓ Protection and development of protected areas for the purpose of research, education, economic, aesthetic, recreation and ecological purposes. ✓ Enhancement of knowledge, awareness and public support on the importance of biodiversity conservation.
XIV.	Department of Veterinary Services of Selangor	<ul style="list-style-type: none"> • Control, prevent and eradicate animal and zoonotic diseases. • Production of livestock, livestock produce and

		<p>animal feed.</p> <ul style="list-style-type: none"> • Inspection of meat, milk, eggs, animal feed, abattoirs and veterinary product processing plant. • Control of import and export of livestock and animal produce and quarantine services. • Training for the livestock and domestic animal industries. • Expand livestock production and animal health as well as general veterinary health. • Research on animal diseases and animal genetic sources. • Control the welfare of animal's welfare and conservation of animal's genetic materials.
XV.	Department of Health (DOH)	<ul style="list-style-type: none"> • DOH is responsible for a healthy community through:- <ul style="list-style-type: none"> ✓ Provision of high quality, affordable and accessible healthcare service ✓ Prevention and control disease ✓ Protection of health of the population ✓ Sustainable and continual health promotion in smart partnership with various agencies, organizations and the community
XVI.	Malaysia Meteorological Department (MMD)	<ul style="list-style-type: none"> • The Malaysian Meteorological Department has provided meteorological and geophysical services of high quality to meet the needs of socio-economic and national security. • The department also provides seismological & tsunami warning, cloud seeding activities, marine meteorology & oceanography, climate services, agro-meteorological services, Fire Danger Rating System (FRDS) and meteorological services environment.
XVII.	Selangor State Government linked corporation <ol style="list-style-type: none"> I. Mentei Besar Incorporated (MBI) II. Selangor Agricultural Development Corporation (PKPS) III. Kumpulan Darul Ehsan Berhad (KDEB) IV. Kumpulan SEMESTA 	<ul style="list-style-type: none"> • Responsible for the development of farming and agro-based industry to improve the socio-economic and development State of Selangor also conducting commercial projects for the benefit of the people. • Involved with commercial agricultural projects, palm plantation development and mining (clay & sand) for the State of Selangor.
XVIII.	SIME Darby Plantation Sdn Bhd & FELDA Plantation Sdn Bhd	<ul style="list-style-type: none"> • Involved in oil palm plantation management cultivation and downstream activities, agribusiness and food, as well as R&D.
XIX.	Other relevant authorities	<p>Interested parties (NGOs, JKK kampung, Head of Village, CBOs)</p> <ul style="list-style-type: none"> • Work together with government and others agencies to protect and support the government in conserving the forest reserved.

		<ul style="list-style-type: none"> Land owners, local community involvement and support is important for a successful management programme that will involve the protection, monitoring, development, conservation and promotion in the buffer zone adjacent to NSPSF.
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4.2 Legislation of Relevance to Buffer Zone Management for NSPSF

This strategy reflects on a range of environmental legislation already in place. The environmental legislation falls within the competencies of a range of authorities in all three levels of government (Federal, State & District).

Several Acts and Codes are relevant to development of Buffer zone management plan for NSPSF. Of particular relevance are the Environmental Quality Act of 1974, the National land Code of 1965, the Town and Country Planning Act of 1976, the Local Government Act of 1976 and other relevant codes.

a) The Environmental Quality Act of 1974

The Environmental Quality Act of 1974, together with the Waters Act of 1920, deals with regulations for pollution of inland waters and wetland areas. Orders passed pursuant the act contain provisions for Environmental Impact Assessments (EIA). The Environmental Quality Order of 1987 makes an Environmental Impact Assessment mandatory for 19 prescribed activities. Orders of special relevance for Peat Swamp Forests are Orders 3b, 8b, and 8c. A description of the orders is provided in Table C-5 below:

Table C-5: Selected orders passed under the Environmental Quality Act (Modified from: Forestry Department, Peninsular Malaysia-DANCED, 1999)

Order	Instruction:
Schedule 3b	Drainage and Irrigation: An EIA is mandatory for drainage of wetlands, wildlife habitats or virgin jungle forest covering an area of 100 hectares or more
Schedule 6b	Forestry: An EIA must be carried out when forest land is logged or converted into other land use within the catchment area of reservoirs used for municipal water supply, irrigation, or hydro power generation, or in areas adjacent to state, or national parks and national marine parks
Schedule 6c	Forestry: Logging covering an area of 500 hectares or more requires that an EIA is conducted

The Environmental Quality Orders deal with specific projects, and do not take an overall view of the complex role of particular site in the overall ecosystem. While, the orders can be used to regulate individual projects (such as logging or mining concessions), they cannot be used to prevent fragmentation of a habitat.

Outside the permanent reserve forest or NSPSF, however, people should know that there is a total ban on all forms of opening burning except for religious and cremation purposes as stipulated under Section 29A of the Environmental Quality Act, 1974. Any public liable on conviction to be charged under such law which carries a RM500,000 (Ringgit Malaysia: Five Hundred Thousand) fine or maximum prison term of five years or both. Therefore, farmers and planters should refrain from open burning especially during prolong dry spell.

b) The National Land Code

The National land Code of 1965 divides land areas into four categories in accordance with the intended main use of the area. The main uses are agriculture, commercial, residential, and industry.

The National Land Code is Federal Legislation. However, it is legally and administratively under the jurisdiction of the State Governments. Hence, State Governments can acquire alienated land for development purposes.

c) The Town and Country Planning Act

The Town and Country Planning Act of 1976 were amended in 1996, and it recognizes conservation as an essential element of land use planning. The Act gives certain powers at both state and local level to protect specific areas. The Act instructs the establishment of a State Planning Committee to oversee the general policy related to planning of all land areas within the local authority in the state. It also calls for local planning authorities to regulate and control planning in their area and to prepare development and structure plans.

d) Local Government Act

Local authorities are mandated under Part VII and XII of the Local Government Act of 1976 to establish and manage public places, including parks. The mandates may provide for the creation of small protected areas of natural habitat or for intensively managed parks.

4.3 Proposed management actions for implementing strategies of buffer zone management adjacent to the NSPSF

The proposed management actions for implementing strategies of the buffer zone management adjacent to the NSPSF are summarised in **Appendix 1**. The prioritizations have been indicates that all these actions with priority 1 (One) needed to be undertaken immediate and/or short term phase and actions with priority 2 (Two) can be ongoing progressed to long-term phase. Most of the actions prescribed would require policy changes, integrated participation from all level, legal and administrative actions. This has to be done in collaboration with other stakeholders with the support of the state government.

a) Sustainability

A relevant issue to buffer zone management is sustainability. Buffer zone management is seen as a long-term intervention aimed at bringing about a transition to sustainability.

Four dimensions of sustainability can be distinguished:

Ecological - sustainability, which concerns using natural resources in a way which does not reduce their future use potential, or impair the long-term viability of the species.

Social - sustainability, which concerns the ability of contracting communities to sustain their obligations as set out in collaborative agreements. Social acceptability is an important criterion in this aspect.

Institutional - sustainability, which concerns the managing authority's ability to meet conservation obligations, etc.

Financial and economic - sustainability: a state in which resources are managed so as to maintain productive opportunities for the future and whereby natural capital stock is non declining through time. The latter concept is interesting as it bridges the gap between ecology and economics by demanding minimum conditions of ecosystem stability and resilience through time as a prerequisite for sustainability.

Sustainability is promoted by institutionalisation of activities and programmes, and capacity building at the government, private sector and community level. In order to create support and general awareness among the local communities, these people have to be involved in the process of buffer zone development and management. The population has to indicate what they expect and what they were or will be using the buffer zone for. Without their consent and understanding of the importance of a buffer zone, the approach will not be sustainable.

b) Management Agencies

Throughout the planning process it has been stressed that for integrated management to succeed, lead agencies need to be identified at the different land administrative levels that exist in the State of Selangor, specifically in Hulu Selangor District, Sabak Bernam District and Kuala Selangor District. The following the management agencies are proposed for consideration:

The **Selangor State Economic Planning Unit (UPEN)** representing the Selangor State Government management in the NSPSF

Selangor State Forestry Department and the **District Forest Office** in Pantai Klang & Hulu Selangor ensuring forest reserves management within and adjacent to the NSPSF.

Selangor State Wildlife and National Parks Department ensuring the wildlife and forest resources management within and adjacent to the Sungai Dusun Wildlife Reserve.

The **District Office of Hulu Selangor, Sabak Bernam and Kuala Selangor**. Chairing the district level management committee acting as the monitoring forum to monitor impacts as well as buffer zone management effectiveness

The **Selangor State Town and Country Planning Department** ensuring the protection Environmentally Sensitive Areas and monitoring environmental sustainably sound

development through the enforcement of the local plan of the 3 districts. This has to be done in collaboration with 3 Districts Councils.

The 10 agencies listed form the key players in implementing the buffer zone management plan for NSPSF. This recommendation is not intended to give the impression that all other institutional stakeholders are not important. Their roles are importance to implement the buffer zone management plan for NSPSF. The decision making process should not be limited to technical feedback from the respective government agencies alone but made open to others stakeholders (e.g. such as NGOs and local communities and the public at large). To ensure that the management effort includes all stakeholders, It is recommended that the three Districts that surround NSPSF each establish a formal peatland management committee should be established in each District and that the committee has to meet four times per year to oversee management of buffer zones in the district and review based on the Buffer Zone Management Plan.

4.4 Implementation of the Buffer Zone Management Plan

Buffer zone management plan is a separate but important plan for the implementation of IMP as a whole. Various activities at the buffer zone must be monitored regularly to ensure its' activities does not impact the NSPSF. Inter-agency coordination should be strengthened and all stakeholders at buffer zone shall be advised on the available BMP for their activities. Technical advice shall be given to the stakeholders when needed i.e. how to maintain high water level for the farm/ estate. Proposed development restrictions in the NSPSF buffer zone are shown in Table C-6.

Information on buffer zone management plan and cooperative fire management plan should be incorporated into the Kuala Selangor & Sabak Bernam District Local Plan 2025 and the Selangor State Structure plan 2035 being developed under the Town and country Planning Act, 1976. However, it is also recommended that the buffer zone is also gazetted under section 62 of the National Land Code 1965. This action will further strengthen the protection of the NSPSF.

Table C-6: Proposed development restrictions in the NSPSF Buffer Zone

Buffer zone type/ Current development status	ESA Class 2 (0-500m) from FR No development or agriculture	ESA Class 3 (500-1000m) from FR Controlled development
No current development (Stateland)	No development or agriculture permitted. Sustainable timber harvesting and eco-tourism may be permitted subject to local constraints Remaining forested land to be gazetted as FR	Controlled development Agriculture, plantations may be permitted (after study) provided that it does not negatively impact the water levels/quality and fire risk in class 2 buffer zone. Mining only permitted after study and clay bund construction No housing/building permitted
No current development (Private land)	Sustainable timber harvesting or forest replanting and eco-tourism may be permitted subject to local constraints. No Mining	Controlled development Agriculture or plantations may be permitted provided that it does not impact the water levels and fire risk in class 2 Buffer Zone. Mining or housing only permitted if approved by district government and meets certain guidelines including clay bund to

		isolate from drainage impact on Class 2 buffer.
Existing Legal development (approved prior to ESA requirement (2005)	Legal structures (e.g. houses) in private land may remain but to follow guidelines to minimize impact and fire risk. Mining to be phased out (depending on current agreements)	Existing/new mining only permitted to continue if prior study with conditions including clay bund to isolate from drainage impact on Class 2 buffer.
(Private land)	Existing agriculture and plantation to be permitted to continue but adopt BMP to manage water tables so as to avoid any drainage of NSPSF/ minimise fire risk and minimise pollution (agrochemicals)	

5.0 Conclusions and recommendations

In general, this report highlights the importance and strategies to implement the buffer zone management at the adjacent area of NSPSF. This buffer zones management plan has to be adopted as a guide or/and regulation, without this adoption for any activity in the buffer zone will be resulted in cooperation problems between the SSFD and land owners. This problem of legal setting is not only in Selangor, but also for many other states and countries, where the Forest Reserves is under national, legal protection or Forestry law and the buffer zone is private property or belongs to the community where multiple stakeholders with different interests have to be coordinated. Thus, national legislation is a precondition to regulate buffer zone responsibility and significantly contributes to buffer zone and NSPSF effectiveness.

Following are some recommendations based on discussions with workshop participants on things that should be done' in Buffer Zone Management

5.1 Restrict further conversion of forested peatlands to agriculture

The conversion of peatlands into agricultural or plantation schemes will results in loss of the peat swamp forest, total drainage of peat water and subsidence of peat soil. When this happens, this will have serious effects on the hydrology of peatland and increase the risk of peatlands fires. Development with inadequate understanding of peat swamp and peat soil characteristics poses a threat to the integrity of a peatlands and its associated uses. In addition, inadequate environmental management consideration on the use of agro-chemicals, over-drainage and subsidence, use of fires for land preparation will bring negative impacts in the long term. The State should stop further conversion of peat swamp forests and provide protection status to remaining peatlands forests on state land such as gazetting them as forest reserves.

5.2 Establish safeguards to ensure that development is undertaken in line with approved Land use and development plans

The state government should put in place mechanisms to ensure that incompatible developments are not approved in areas designated as environmentally sensitive areas. EIAS should be required for all projects in such areas irrespective of the normal requirements.

5.3 Include consultation with relevant stakeholders in the decision making process

The decision making process should not be limited to technical feedback from the respective government agencies alone but made open to others stakeholders (e.g. such as NGOs and local communities and the public at large). It is recommended that the three Districts that surround NSPSF establish a formal peatlands management committee in each District and meet four times per year to oversee management of buffer zones in the district and review based on the Buffer Zone Management Plan (prepared under the IMP 2014-2023), fire prevention and monitoring on the district level implementation and other related matters.

5.4 The concept of buffer zone for peatlands should be included in the Selangor State Action Plan for Peatlands (SAPP)

Selangor has substantial acreage of good peat swamp forests, which subsequently contributes on climate change mitigation at local, national and global levels. Conserving the State peatlands is crucial not only to ensure sustainable use of the rich resources and protection of the endangered species, but also to maintain environmental stability. Peat swamp forests act as a huge carbon sink to prevent global warming. These wetland forests also play a critical role in regulating water over vast areas such as preventing flood, revitalizing the soil and providing water during droughts. Continuous state land degradation and deforestation activities will reverse the role of peat swamp forest from being a carbon sink into a carbon source. Therefore degraded peat swamp forest areas should be rehabilitated and protected as “functional wetlands”. Therefore, this SAPP is an important document as guides, and if necessary, regular improvement on action plans should be conducted constantly to be in line with current development or information on the state peatland. With this SAPP, Selangor State Government will be managed remain forested peatlands on this state sustainably by balancing sound economic development and maintaining environment functions. Forest Research Institute Malaysia (FRIM) and Forestry Department Peninsular Malaysia (FDPM) through ASEAN Peatlands Forests Project (APFP) preparing the Selangor State Action Plan for Peatlands (SAPP) in line with the National Action Plan (NAP) for Peatlands developed by Ministry Natural Resources and Environment, Malaysia (NRE) under the ASEAN Peatland Management Strategy in 2011.

5.5 The buffer zone as mandate by NPP and SSSP must be included in the respective local plan for Hulu Selangor, Kuala Selangor and Sabak Bernam

This buffer zone management plan for NSPSF highlights the importance goals and strategies to implement at the buffer zone area adjacent to NSPSF. This buffer zone management plan has to be adopted as a guide or/and regulation. Without this adoption, any activity in the buffer zone will result in problems between the SSFD and land owners.

Finally, it can be summarized that the idea of establishing buffer zones adjacent to NSPSF in general, is the right way forward to enhance NSPSF effectiveness and to achieve national and global reduction of biodiversity and carbon loss. Ensuring the halt of biodiversity loss can only be achieved when integrating the initiator, such as human being. Establishment of buffer zones where this integration and cooperation is a necessity must be given more attention in the future and the political preconditions for effective management such as the legal backing must be facilitated.

6.0 References

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Report on Stakeholder Consultation Workshop for Buffer Zone & Forest Reserve Management at Selangor State Level on 29 November 2013

Report on Stakeholder Consultation Meeting for Buffer Zone Management adjacent to NSPSF in three districts (Sabak Bernam on 19 March 2014, Hulu Selangor on 26th March 2014 & Kuala Selangor on 27th March 2014).

7.0 Appendix 1

Proposed management actions for implementing strategies of buffer zone management adjacent to the NSPSF (2014-2023)

Kuala Selangor District

Zone	Land Status	Threat	Socio-economy	Protection mechanism / mitigation measures for buffer zones	Forest reserves (application of ESA, Law & others regulations)	Responsible Agencies	Time Frame (Years)	Priority	Note
KS 1 KS 2 KS 3 KS 4	Private land ownership and State land	a. Uncontrolled drainage system, peat swamp forest drying/ fire; due to smallholder b. Elevated clay bund along the main canal & Tengi river impact forest tree mortality c. Unauthorized intrusion or/ and encroachment d. Illegal livestock farm e. illegal foreign migrants increases (PATI)	Paddy, oil palm & short term crops production Non-Forest Timber Product (NFTP)	• Buffer zones / Green Corridor along the 500m should be marked as an ESA level 2 at the border of West, South and East NSPSF.	• Establish physical demarcation of forest reserve and buffer zone • Prevent further land encroachment in the Forest Reserve and buffer zone	UPEN, SSFD, DOE, KSDLO, DID, DTCP, IADA, MGD, GLCs & Smallholders	2014 – 2018	1	This has to be done in collaboration with other stakeholders with the support of the state government.
				• Ensure effective security measures in place to prevent any outside persons entering the developed / owned land by plantation company or smallholder	• Mobiles local communities to act as on – site guardians of the peat swamp forest and Tengi River		2014 – 2018	1	
				• Conduct long term monitoring for water pollution and & maintenance of water table	• Encourage sustainable use of forest resources through offering licenses to NTFR collectors		2014 – 2023	2	The strategic approach need to be devised on a case by case basis. Integrated effort that requires implement/establish, monitoring & from the stakeholder and state government.
				• Integrated enforcement should be created and broadened between the local authorities and paddy, oil & short term crops cultivators to prevent further illegal encroachment	• Educate local communities (SHGSU) on sustainable utilization on peat swamp forest resources, co-manage NTFP consumption		2014 - 2023	2	
				• Impose penalties against misconduct management or breach regulation; penalties such as social service for rehabilitation of degraded peat swamp forest	• Identify & subsequently manage of eco-tourism and recreation in FC 73		2014 - 2023	2	
				• Regular awareness rising programmes with relevant agencies, stakeholders and local communities & other commercial sectors on the important of the buffer zone management	• Conserve the area of degraded by fire. Encourage the participation of local communities, land owners and local authorities to work together with the Selangor State Forestry Department to undertake rehabilitation, habitat enrichment & maintenance of planted		2014 - 2023	2	
				• Blocking and restricting any drains and channels that are found along the outer boundary of NSPSF and Tengi Riverbank			2014 - 2023	2	
KS 1		a. Illegal		• The illegal livestock farm should		KSDLO,			

KS 3		livestock farm		be moved to more appropriate locations that do not impact forest reserves	area in buffer zone and forest reserve.	Department of Veterinary , SSFD & GLCs	2014 - 2018	1	
KS 2, KS 3, KS 4	Private land State land Raja Musa Forest Reserve	a. Uncontrolled drainage system, peat swamp forest drying/ fire; due to smallholder b. Unauthorized intrusion or/ and encroachment	Oil palm cultivation by plantation oil palm and short term crops cultivated by small holders Non-Forest Timber Product (NFTP)	<ul style="list-style-type: none"> • Build a fire break or clay dyke/ embankment between land that is being developed and forest reserve area to allow ground water level is maintained at high level and elevated conditions until forest ground forest. it has to be implement through mutual understanding and discussion with relevant parties • Conduct long term monitoring for peat subsidence • Monitor on zero burning policy in liaison with DOE • At present, there are many illegal foreign migrant (PATI) which helps local people in the land preparing for agriculture activities. These foreign migrants who stated the fire to ease their works on site. Local authorities must arrest them so that works are impact the forest reserve, including distinct, state & country in the form of fire and haze cab be controlled and stopped completely 			2014 - 2018	1	
							2014 - 2023	2	
					DOE		2014- 2023	2	
							2014 - 2018	1	

Note: The prioritizations have been indicates that all these actions with priority 1(One) needed to be undertaken immediate and/or short term phase and actions with priority 2 (Two) can be ongoing progressed to long-term phase

Sabak Bernam District

Zone	Land Status	Threat	Socio-economy	Protection mechanism / mitigation measures for buffer zones	Forest reserves (application of ESA, Law & others regulations)	Responsible Agencies	Time Frame (Years)	Priority	Note
SB 1 SB 2 SB 3	Private land ownership and State land	a. Uncontrolled drainage system, peat swamp forest drying / fire; due to smallholder b. Elevated clay bund along the main canal & Tengli river impact forest tree mortality c. Unauthorized intrusion or/and encroachment d. Illegal livestock farm	Paddy, oil palm & short term crops production Non-Forest Timber Product (NFTP)	Buffer Zone: <ul style="list-style-type: none"> Buffer zones / Green Corridor along the 500m should be marked as an ESA level 2 at the border of West and North- West NSPSF. 	<ul style="list-style-type: none"> Establish physical demarcation of forest reserve and buffer zone Prevent further land encroachment in the Forest Reserve and buffer zones Mobilise local communities to act as on-site guardians of the peat swamp forest and Tengli River Encourage sustainable use of forest resources through offering licenses to NTFR collectors Educate local community (SHGSU) on sustainable utilization on peat swamp forest resources, co-manage NTFP consumption Establish continuous monitoring of NTFP utilization Conserve the area of degraded by fire. Encourage the participation of local communities, land owners and local authorities to work together with the Selangor State Forestry Department to undertake rehabilitation, habitat enrichment & maintenance of planted area in buffer zone and forest reserve 	UPEN, SSFD, DOE, SBDLO, SBDC, DOA, DID, DTCP, MGD, MMD, IADA, GLCs & Small Holders	2014- 2018	1	This has to be done in collaboration with other stakeholders with the support of the state government.
				<ul style="list-style-type: none"> Ensure effective security measures in place to prevent any outside persons entering the developed/ owned land by plantation company or smallholder 			2014-2023	2	
				<ul style="list-style-type: none"> Conduct long term monitoring for water pollution and & maintenance of water table 			2014-2023	2	
				<ul style="list-style-type: none"> Integrated enforcement should be created and broadened between the local authorities and paddy, oil palm & short term crops cultivators to prevent further illegal encroachment 			2014-2023	2	
				<ul style="list-style-type: none"> Blocking and restricting any drains and channels that are found along the outer boundary of West NSPSF and Main Canal 			2014-2023	2	
				<ul style="list-style-type: none"> Impose penalties against misconduct management or breach regulation; penalties such as social service for rehabilitation of degraded peat swamp forest 			2014- 2023	2	
				<ul style="list-style-type: none"> Regular awareness-raising programmes with relevant agencies, stakeholders and local communities & other commercial sectors on the important of the buffer zone management 			2014- 2023	2	

				<ul style="list-style-type: none"> Monitor on control burning policy in liaison with DOE 	<ul style="list-style-type: none"> Law enforcement to inspect and ensure projects in forest reserve has maintenance system to reduce impacts to the ecosystem. Regular monitoring has to be done with project owner. 	DOE / IADA /GLCs	2014- 2023	1	
				<ul style="list-style-type: none"> The illegal livestock farm should be moved to a more appropriate that do not impact forest reserves 		SBDLO, Department of Veterinary & SSFD	2014- 2018	1	
SB 3				<ul style="list-style-type: none"> The State government & local authorities should stop further planning conversion of peat swamp forests and provide protection status to remaining peatland forests on state land such as gazetting them as forest reserves. 	<ul style="list-style-type: none"> Raise water levels in all areas with fire and Prevent further drainage of the adjacent peatland areas to facilitate and encourage natural regeneration 	UPEN, SSFD, SBDLO, SBDC, DTCP, DWNP, GEC & other technical government agencies	2014-2016	1	This area is the area of natural forest, and is a good habitat for wildlife and prevents flooding.
SB 1 SB 2				<ul style="list-style-type: none"> The clay bund has been constructed along the main canal and Tenggi river needed a comprehensive management plan including maintenance and others action to prevent from forest mortality due to high water level in the forest reserve including installation of water gate 		SSFD/ IADA	2014-2018	1	

Note: The prioritizations have been indicates that all these actions with priority 1(One) needed to be undertaken immediate and/or short term phase and actions with priority 2 (Two) can be ongoing progressed to long-term phase

Hulu Selangor District

Zone	Land Status	Threat	Socio-economy	Protection mechanism / mitigation measures for buffer zones	Forest reserves (application of ESA, Law & others regulations)	Responsible Agencies	Time Frame (Years)	Priority	Note
HS 1 HS 2	Private land State land	a. Uncontrolled drainage system, peat swamp forest drying / fire; b. Unauthorized intrusion or/and encroachment c. illegal foreign migrants increases (PATI)	Oil palm cultivation by plantation Oil palm and short term crops cultivated by small holders	Buffer Zone: • Buffer zones / Green Corridor along the 500m should be marked as an ESA level 2 at the border of West, North-East NSPSF.	<ul style="list-style-type: none"> Establish physical demarcation of forest reserve and buffer zone Prevent further land encroachment in the Forest Reserve and buffer zones Mobilise local communities to act as on-site guardians of the peat swamp forest Encourage sustainable use of forest resources through offering licenses to NTFR collectors Educate local community on sustainable utilization on peat swamp forest resources & co-manage NTFP consumption Establish continuous monitoring of NTFP utilisation Conserve the area of degraded by fire. Encourage the participation of local communities, land owners and local authorities to work together with the Selangor State Forestry Department to undertake rehabilitation, habitat enrichment & 	UPEN, SSFD, DOE, HSDLO, HSDC, DTCP, DID, DOA, GLCs & Felda Plantation & Small Holders	2014- 2018	1	This has to be done in collaboration with other stakeholders with the support of the state government.
				• Ensure effective security measures in place to prevent any outside persons entering the developed / owned land by plantation company or smallholder			2014- 2023	2	The strategic approach need to be devised on a case by case basis
				• Conduct long term monitoring for water pollution and & maintenance of water table			2014-2023	2	Integrated effort that requires to implement/ establish, monitoring & commitment from the stakeholders and state government
				• Integrated enforcement should be created and broadened among the local authorities between plantation company and smallholders to prevent further illegal encroachment			2014-2023	2	
				• Impose penalties against misconduct management or breach regulation; penalties such as social service for rehabilitation of degraded peat swamp forest			2014-2023	2	
				• Regular awareness-raising programmes with relevant agencies, stakeholders and local communities & other commercial sectors on the important of the buffer zone management			2014- 2023	2	
				• Monitor on zero burning policy in liaison with DOE			2014- 2023	2	

				<ul style="list-style-type: none"> At present, there are many illegal foreign migrant (PATI) which helps local people in the land preparing for agriculture activities. These foreign migrants who started the fire to ease their works on site. Local authorities must arrest them so that works are impact the forest reserve, including district, state & country in the form of fire and haze can be controlled and stopped completely. 	<ul style="list-style-type: none"> maintenance of planted area in buffer zone and forest reserve Raise water levels in all areas with fire and Prevent further drainage of the adjacent peatland areas to facilitate and encourage natural regeneration 		2014- 2018	1	
				<ul style="list-style-type: none"> Build a fire break or clay dyke /embankment between land that is being developed and forest reserves area to allow ground water level is maintained at high level and elevated conditions until forest ground surface. It has to be implement through mutual understanding and discussion with relevant parties 			2014 - 2018	1	
HS 1				<ul style="list-style-type: none"> Blocking and restricting any drains and channels that are found along the outer boundary of North-East NSPSF 		SSFD, DOE, HSDLO, HSDC, DID, GLCs & Felda Plantation & Small Holders	2014- 2018	1	
HS 2				<ul style="list-style-type: none"> Central Forest Spine (CFS) 2 and the network 2 should be marked at the border of North-East NSPSF The illegal livestock farm should be moved to a more appropriate that do not impact forest reserves 		UPEN, SSFD, DOE, HSDLO, HSDC	2014- 2023	2	
						HSDLO, DID, Department of Veterinary and other relevant agencies	2014- 2018	1	

Note: The prioritizations have been indicates that all these actions with priority 1(One) needed to be undertaken immediate and/or short term phase and actions with priority 2 (Two) can be ongoing progressed to long-term phase



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