Environmental Impact Assessment (EIA)

Guidelines for Oil Palm Plantation

Jabatan Perlindungan Alam Sekitar
Tingkat 1 - 3, Wisma Budaya, Jalan Tunku Abdul Rahman,
Beg Berkunci No.2078, 88999, Kota Kinabalu, Sabah, Malaysia.
No. Tel : +60 88 251290 / 251291 / 267572 / 268572
No. Faks: +60 88 238120 / 238390 E-mel:jpas@sabah.gov.my

Published by:

Environment Protection Department (EPD)
Tingkat 1-3, Wisma Budaya
Jalan Tunku Abdul Rahman
Beg Berkunci No. 2078
88999 KOTA KINABALU, SABAH
Tel. No.: +60 (088) – 251 290/ 251 291/ 267 572/ 268 572
Fax No.: +60 (088) – 238 120/ 238 390
Email: jpas@sabah.gov.my

First Published 2012

ISBN: 978-983-41174-5-0

Foreword

The Environmental Impact Assessment (EIA) has been widely used as a critical tool in managing and clarifying the complex interrelationships between development and the environment. It provides assessment of the environmental consequences of development actions in a systematic, holistic and multidisciplinary way.

In Sabah, the Environment Protection Department is imposing two environmental impact assessment categories namely the EIA or the Proposal for Mitigation Measures (PMM) in managing any development listed as prescribed activities under the Environment Protection (Prescribed Activities) (Amendment) Order 2013.

The purpose of these Guidelines is to provide practical guidance to environmental consultants, developers, planning authorities and any other stakeholders on procedural aspects as well as the processes involved in the preparation of the EIA/ PMM report. It intents to provide a structured framework for the scope of environmental considerations required during the planning, implementation and maintenance stages of any prescribed development activity. Identification of potential environmental issues at the initial stage of development is essential for the selection of realistic mitigation measures. Significance of this approach will ensure that any development activity will be carried out with minimal adverse residual environmental impacts.

It is the Department's hopes that these Guidelines will result in greater consistency and understanding on the basic of environmental requirements, selection of alternatives, identification of environmental issues, preparation of mitigating measures as well as environmental compliance and monitoring to ensure sustainable and profitable activities are achieved.

The Department gratefully appreciate the valuable assistance from government agencies, organizations and individuals in their comments, feedback and inputs on these Guidelines. We welcome comments and suggestions for the continuous improvement of these Guidelines in future.

Yabi Yangkat

Director

Environment Protection Department

Contents

1 Introduction

1.1 Definitions

The aim of this EIA guideline is to provide a framework for the preparation of an Environmental Impact Assessment (EIA) and Proposal for Mitigation Measures (PMM) report for oil palm plantation development in the State of Sabah, Malaysia. This EIA guideline should serve as an operating manual for the Project Proponents as well as a guide for environmental consultants. This guideline may also be applied to replanting activities for oil palms or conversion of other types of cultivation and crops into oil palm plantation.

The expression "Environmental Assessment" will in this document refer to either EIA or PMM as appropriate. The term "TOR" is likewise used generically to refer to either Terms of Reference (TOR) for EIA and Scoping Note for PMM as appropriate.

Within Sabah, establishment or replanting of oil palm plantation covering an area of 100 hectares or more, or conversion of wetland forest with area of 20 hectares or more into oil palm plantation, are categorised as a "prescribed activity" under the First and Second Schedule of the Environment Protection (Prescribed Activities) (Environmental Impact Assessment) Order 2005. This requirement therefore subjects the Project Proponent to appoint an environmental consultant registered with the Environment Protection Department (EPD), to conduct an Environmental Assessment report for submission to, and approval by EPD Sabah prior to project commencement.

Oil palm plantation development is defined as the development of contiguous land areas for the purpose of cultivating oil palm and includes activities such as land clearing, biomass management and disposal, earthworks, planting and re-planting activities, infrastructure development, transportation and workers' settlements. Throughout this EIA guideline, these activities will be uniformly known as oil palm plantation development.

This EIA guideline focuses on the planning and control of oil palm plantation development and management of impacts on adjacent areas. The main objective of this guideline is to provide environmental consultants, developers, contractors and government agencies involved in oil palm plantation development with:

i. Information on how to avoid and minimise environmental impact, which is preferable to the more costly option of undertaking remedial action;

ii. Information on the likely impact of oil palm plantation development on the environment and how this is to be assessed; and

iii. Suggested best practice environmental measures to meet the performance objectives.

This EIA guideline is not prescriptive or detailed. Each Environmental Assessment will require the environmental consultant to tailor their assessment to particular site conditions and make their own assessment of measures appropriate to the site.

The content of this EIA guideline may be amended from time to time in order to keep abreast with the latest developments and improvements in techniques and new understanding of the environmental impacts and risk. Such changes may be issued by EPD in a complete revision of this document, or in separate additional guidance notes which address specific issues.

This EIA guideline has been produced in consultation with relevant technical departments, stakeholder representatives, and other interested organisations. Printed copies of this and other EIA guidelines are available from EPD.

1.2 Assessment Procedures – A Quick Reference

The environmental assessment procedure may be divided into seven steps as described in Table 1-1. Of these steps, only steps 3 and 4 are dealt with in this guideline as these include issues particular to oil palm plantation development. The remaining steps are standard procedures, common to all Environmental Assessment reports. These steps are described in detail in the Handbook on Environmental Impact Assessment in Sabah (November 2005) issued by EPD.

Table 1-1: Assessment Procedures

The Seven Steps	Summary of Main Required Activities
Step 1: **Project Screening**	**Project Proponent:** • Check Section 2.2 to see if the project is required to undertake an EIA or PMM • Consult with EPD as to whether the project should undertake an EIA or PMM • Consult with EPD whether planning documents are sufficient
Step 2: **Selection of Environmental Consultants**	**Project Proponent:** • Select EPD registered consultants to undertake preparation of TOR and the EIA; or Scoping Note and the PMM
Step 3: **Project Scoping and Preparation of Terms of Reference/ Scoping Note**	**Environmental Consultant:** • Undertake scoping activities • Assess initial project description and assist the Project Proponent to make amendments • Perform initial site visit • Prepare a draft TOR or Scoping Note • Undertake the public hearing activities required for Special EIA • Participate in review meetings • Finalise the TOR for EIA or Scoping Note for PMM and obtain final approval from EPD
Step 4: **Undertaking the EIA/ PMM Study**	**Environmental Consultant:** • Assess the project details

The Seven Steps	Summary of Main Required Activities
	• Assess the existing environments • Assess the environmental impacts • Devise and propose mitigation measures • Devise and propose monitoring programmes
Step 5: **Preparation of the EIA/ PMM Report**	**Environmental Consultant:** • Adhere to the EPD requirements based on the approved TOR/ Scoping Note in the preparation of the EIA/ PMM report • Prepare the EIA/ PMM report in line with the EPD chapter by chapter recommendations • Discuss with the Project Proponent on the findings and content of the EIA/ PMM report
Step 6: **Submission of the EIA/ PMM Report**	**Environmental Consultant:** • Submit the EIA/ PMM report to EPD • Undertake the public hearing activities required for Special EIA • Participate in review meetings • Submit additional information if required and finalise the EIA/ PMM report
Step 7: **Preparation of the Agreement of Environmental Conditions/ Mitigation Declaration**	**Project Proponent:** • Review the draft Agreement of Environmental Conditions (AEC)/ Mitigation Declaration (MD) prepared by EPD • Signing of the Letter of Undertaking on AEC/ MD • Implement mitigation measures and monitoring programmes • Submission of periodic environmental compliance report as required in the AEC/ MD

2 Sabah Context

2.1 Geographical Overview

As of 2010, the area of land in Sabah planted with oil palm far exceeded that of other states in Malaysia (refer to Table 2-1). The districts planted with the largest area of oil palm is Sandakan (727,917 ha) and Kinabatangan (345,035 ha) (refer to Table 2-2).

Table 2-1: Distribution of Oil Palm Planted Areas by State in Malaysia

State	Mature	Immature	Total
Johor	635,933.71	81,464.80	717,398.51
Kedah	73,967.92	4,571.61	78,539.53
Kelantan	100,393.69	32,320.84	132,714.53
Melaka	48,888.30	2,461.39	51,349.69
N. Sembilan	149,405.26	14,956.31	164,361.57
Pahang	600,398.15	88,468.00	688,866.15
Pulau Pinang	13,311.92	282.72	13,594.64
Perak	345,181.73	37,345.22	382,526.95
Perlis	234.50	0.00	234.50
Selangor	118,511.79	10,487.89	128,999.68
Terengganu	138,246.17	27,839.74	166,085.91
Sabah	1,261,154.20	148,521.59	1,409,675.79
Sarawak	716,586.18	202,832.54	919,418.72
MALAYSIA	**4,202,213.52**	**651,552.65**	**4,853,766.17**

Source: MPOB, 2010

Table 2-2: Distribution of Oil Palm Planted Areas by Division and District in Sabah

Division	District	Area	Area Percentage (%)	
		ha	Divisional	Sabah
Tawau	Tawau	230,206.51	39	16.33
	Semporna	34,199.95	6	2.43
	Lahad Datu	279,002.60	47	19.79
	Kunak	47,890.01	8	3.40
	Total	591,299.07	100	41.95
Sandakan	Sandakan	169,937.79	23	12.06
	Kinabatangan	345,035.23	47	24.48
	Labuk/ Sugut	212,944.38	29	15.11
	Total	727,917.40	100	51.65
Kudat	Kudat	7,026.29	35	0.50
	Pitas	4,182.80	21	0.30
	Kota Marudu	8,908.66	44	0.63
	Total	20,117.75	100	1.43
West Coast	Kota Belud	826.84	12	0.06
	Ranau	4,059.78	58	0.29
	Tuaran	470.93	7	0.03
	Kota Kinabalu	24.63	0	0.00
	Penampang	29.32	0	0.00
	Papar	1,571.34	23	0.11
	Total	6,982.84	100	0.49
Interior	Beaufort	24,450.77	39	1.73
	Sipitang	1,014.03	2	0.07
	Kuala Penyu	1,431.30	2	0.10
	Tenom	5,462.26	9	0.39
	Keningau	30,116.00	48	2.14
	Tambunan	99.20	0	0.01
	Pensiangan	785.17	1	0.06
	Total	63,358.73	100	4.5
Sabah		1,409,675.79		

Source: MPOB, 2010

With 1.4 million hectares planted, Sabah has become the biggest oil palm state in the country, accounting for 31 per cent of the country's palm oil output. In year 2010, the palm oil industry contributed RM 13.56 billion to the State's revenue from 5.136 million tonnes of palm oil produced *(Daily Express, 31st July 2011)*.

Although the conversion of land for palm oil activities is an important component of Sabah's socio-economic development, the impacts associated with the conversion can be severe and irreversible and therefore require an appropriate amount of consideration and planning.

2.2 Legal Requirements

Under the Environment Protection (Prescribed Activities) (Environmental Impact Assessment) Order 2005, the submission of PMM and EIA are mandatory requirements for oil palm plantation development in Sabah under the First and Second Schedules of the Order respectively. Specifically, the prescribed activities are:

First Schedule: List of Prescribed Activities Requiring Proposal for Mitigation Measures (PMM) Report

Item 1: Agriculture

Para (i) *Development of agricultural estates or plantations covering an area of 100 hectares or more but less than 500 hectares*

Para (ii) *Development of agricultural estates or plantations involving change in type of crops covering an area of 100 hectares or more but less than 500 hectares*

Para (iii) *Conversion of wetland forests into agricultural estates or plantations covering an area of 20 hectares or more but less than 50 hectares*

Second Schedule: List of Prescribed Activities Requiring Environmental Impact Assessment (EIA) Report

Item 1: Agriculture

Para (i) *Development of agricultural estates or plantations covering an area of 500 hectares or more*

Para (ii) *Development of agricultural estates or plantations involving change in type of crops covering an area of 500 hectares or more*

Para (iii) *Conversion of wetland forests into agricultural estates or plantations covering an area of 50 hectares or more*

Para (iv) *Agricultural programmes involving the settlement of 100 families or more*

There are also other prescribed activities that have an indirect connection to oil palm plantation activities. These include (but are not limited to):

First Schedule: List of Prescribed Activities Requiring Proposal for Mitigation Measures (PMM) Report

Item 2: Forestry

Para (i) *Felling or extraction of timber covering an area of 100 hectares or more but less than 500 hectares*

Para (ii) *Development of forest plantation or reforestation covering an area of 100 hectares or more but less than 500 hectares*

Second Schedule: List of Prescribed Activities Requiring Environmental Impact Assessment (EIA) Report

Item 2: Forestry

Para (i) *Felling or extraction of timber covering an area of 500 hectares or more*

Para (ii) *Development of forest plantation or reforestation covering an area of 500 hectares or more*

Item 9: Quarries

Para (i) *Quarrying of aggregates, limestone, silica, quartzite, sandstone, sand, marble or stones for commercial or construction purposes within 3 kilometres of:*

(a) *Any existing settlement, residential, commercial or industrial area, major roads, or any buildings for public purposes; or*

(b) *Any area for which a license, permit or approval has been granted for development of settlement, residential, commercial or industrial area, major roads, or any buildings for public purposes*

Under Section 12A of the Environment Protection Enactment 2002, amended in 2012, failure to comply to the requirement for an Environmental Assessment may result in a fine not exceeding fifty thousand ringgit (RM50,000) or imprisonment for a term not exceeding two years, or both a fine and imprisonment, under the First Schedule. Under the Second Schedule, failure to comply may result in a fine not exceeding one hundred thousand ringgit (RM100,000) or imprisonment for a term not exceeding five years, or both a fine and imprisonment.

An Environmental Assessment is an important technique for ensuring that the likely impacts of oil palm plantation development on the environment are fully understood and taken into account, before the commencement of such developments. The main objectives of an Environmental Assessment for oil palm plantation development are:

- To assess and recommend the most appropriate oil palm plantation development options based on existing site conditions, so as to minimise impacts on the environment;
- To identify, predict and wherever possible quantify the significance of any adverse impacts on the environments and communities that are likely to be affected by oil palm plantation development;
- To formulate and incorporate appropriate and cost effective mitigation and abatement measures into overall planning for oil palm plantation development; and
- To determine a suitable and effective programme for ensuring environmental compliance and monitoring of residual impacts.

Other legal requirements related applicable to oil palm plantation development, which should be referred to by the environmental consultant during preparation of the Environmental Assessment report are:

Legal Requirements	Relevance
Environmental Quality Act, 1974	– Restriction and prohibition of pollution (air emissions, noise pollution, inland waters, soil, waste, hazardous and scheduled substances) – Prohibition of open burning – Management of scheduled waste
Environmental Quality (Sewage) Regulations 2009	– Provision and proper operation of sewage treatment system – Sewage discharge quality
Environmental Quality (Scheduled Wastes) Regulations 2005	– Management and disposal of scheduled waste including storage and labelling
Wildlife Conservation Enactment 1987	– Protection of plants and animals – Protection of land and property against damage by animals – Animal rescue operations – Requirement to notify Wildlife Department
Town and Country Planning Ordinance (Sabah Cap. 141)	– Preparation and approval of schemes for designated landuse of an area (zoning)
Land Ordinance (Sabah Cap. 68)	– Land matters
Water Resource Enactment, 1998	– Water conservation areas – Flood plain management areas – River reserves
Cultural Heritage (Conservation) Enactment 1997	– Preservation and conservation of cultural heritage sites
Forest Enactment, 1968	– Requirement for forest management plan and forest harvesting plan
Pesticide Act, 1974	– Use of approved pesticides – Storage and handling of pesticides
Sabah Biodiversity Enactment, 2000	– License to access biological resources

In addition to the legal requirements, there are several guidelines related to the environment which should be considered by all oil palm plantation development applicants. These include (but are not limited to):

- Guidelines on the Prevention and Control of Soil Erosion and Siltation in Malaysia (Department of Environment, 1996);
- Guidelines on Erosion Control for Development Projects in the Coastal Zone (Department of Irrigation and Drainage, 1997);
- Guidelines for Erosion and Sediment Control in Malaysia (Department of Irrigation and Drainage, 2nd Edition 2011); and
- EIA Guidelines for Forest Harvesting (Logging) and Forest Plantation Establishment (EPD, 2012).

These guidelines should be followed as appropriate (depending on the project concept and site specific issues) by the environmental consultant during preparation of the Environmental Assessment report for submission to EPD.

The guidelines and legislation above are correct as of November 2012. It is the duty of the environmental consultant at all times to update the list and to apply the latest regulations as issued by relevant government agencies.

2.3 Application and Approving Procedures

Any person who intends to undertake oil palm plantation development in the State of Sabah is required to submit an Environmental Assessment report to the Director of EPD, Sabah for approval. The contact details for EPD are:

DIRECTOR
ENVIRONMENT PROTECTION DEPARTMENT
Tingkat 1 – 3, Wisma Budaya
Jalan Tunku Abdul Rahman
Beg Berkunci 2078
88999 Kota Kinabalu, Sabah, Malaysia

Telephone Number:	+60 (088) – 251 290/ 251 291/ 267 572/ 268 572
Facsimile Number:	+60 (088) – 238 120/ 238 390
Email Address:	jpas@sabah.gov.my
Website Address:	http://www.sabah.gov.my/jpas

Oil palm plantation development in the State of Sabah is carried out mainly for production of high quality fresh fruit bunches (FFB) for the purpose of producing crude palm oil (CPO), palm kernel oil (PKO) and other products that generate income for the developer, the state of Sabah and Malaysia as a whole. The Second Sabah Agricultural Policy (SSAP) for 1999–2010 concluded that:

An aggressive, commercially-oriented, market led and globally competitive agricultural sector is desired. The focus will be on optimising the utilisation of resources, strengthening between the oil palm sector and manufacturing sector vis-a-vis greater private sector role to achieve the SSAP targets.

In spite of the above, the responsible development of oil palm cultivation, which takes into account not only the needs of investors and developers but also compliment in a broader sense the State's environmental and socio-economic interests, is still relevant. Environmentally friendly methods of oil palm cultivation are clearly emphasized in the current Sabah Agricultural Policy.

The typical procedure for developing an oil palm plantation begins with the application for land (refer to Figure 2-1). However, not all applications go through the same procedure. Nevertheless, for all applications, the land in question must have a valid land title issued by the Director of Lands and Surveys and is subject to EIA or PMM as stipulated in the Environment Protection Enactment 2002.

The procedure is summarised as follows:

- Application shall be made in writing to the Assistant Collector of Land Revenue (ACLR).

- The ACLR shall refer the application to the Land Utilisation Committee (LUC) for technical comments. Permanent members of the LUC are the Director or Deputy Director of Lands and Survey Department (Chairperson), District Surveyor, Department of Agriculture, Forestry Department, Department of Irrigation and Drainage, Fisheries Department and community leaders. Community leaders and surveyors will ensure that the land is available and unencumbered. The Department of Agriculture will provide technical comments in terms of land suitability with emphasis on soil-crop suitability evaluation and will also consider the proposed Agriculture Development Plan and make recommendations to the Assistant Collector of Land Revenue. The recommendations do not bear any regulatory weight but if applied by the Enforcement Section of the

Lands and Surveys Department under the regulations stipulated in the Land Code, the recommendations may be used to prosecute any breach of the requirements under the Code.

- The application is then forwarded to the Director of Lands and Surveys Department who will then forward it to the Secretary of Natural Resources for approval by the Chief Minister.

- An approved application is returned to the Director of Lands and Surveys Department who will direct the Assistant Collector of Land Revenue to make an offer to the applicant and a Draft Land Title is subsequently issued.

- The applicant shall approach the District Surveyor to establish the Registered Survey Paper through the service of a Registered Surveyor who will then produce a Draft Survey Plan (DSP).

- The DSP will be reviewed and checked by the District Surveyor before the Plan and survey data are submitted to the Lands and Surveys Department for official registration.

- Upon completion of the tasks required by Lands and Surveys Department, the Land Registrar will issue the lease to the applicant and the Final Title is produced.

- Having obtained the Land Title, the applicant will then carry out an EIA or PMM (if it is a prescribed activity) for submission to the EPD. The EIA or PMM will assist in determining the final planted area of the plantation and the location of the boundary, which amongst other things will be included in the Agreement of Environmental Conditions (AEC) to be entered between the Project Proponent and the EPD.

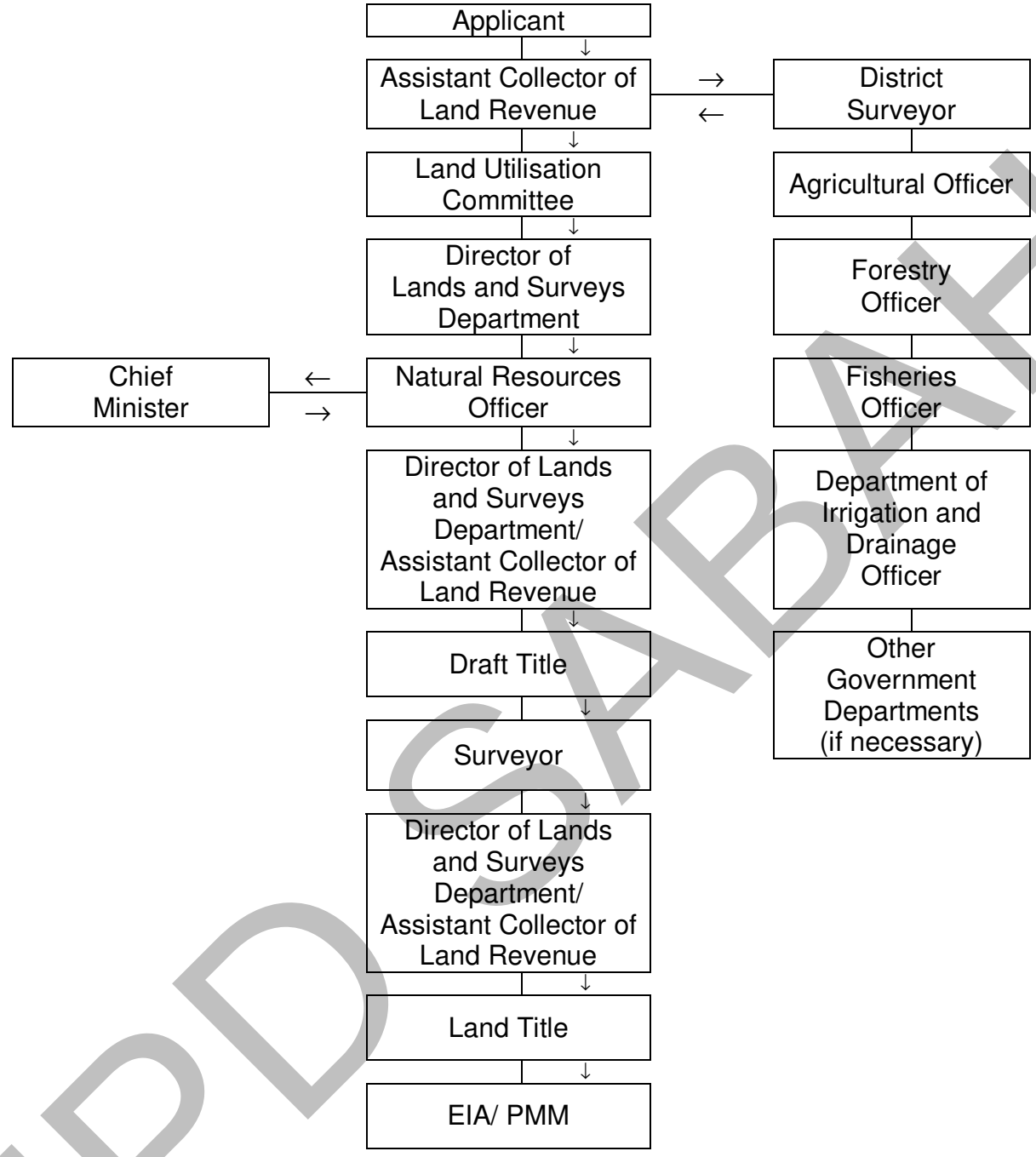


Figure 2-1: Application procedures for oil palm plantation development

2.4 Key Stakeholders

As part of the environmental assessment procedure, EPD will seek technical comments from relevant departments with responsibilities for specific aspects relating to oil palm plantation development in Sabah. The main responsibilities of these departments in relation to the environmental assessment are listed below. However the department may also comment on any other aspect of the assessment, if deemed relevant.

Department		Responsibility
Lands and Surveys Department	-	Land titles/ ownership
District Office	-	Local settlement issues, i.e. water use and public complaints
Sabah Wildlife Department	-	Habitat and wildlife issues
Department of Irrigation and Drainage	-	Hydrology and drainage issues
	-	Water resource issues
Department of Fisheries	-	Estuarine fisheries
Public Works Department	-	Use of public roads
Department of Agriculture	-	Review/ comment on the plantation development plan and land/ soil suitability
Department of Environment	-	General environmental concerns (air, effluent, water, scheduled waste)
Department of Health	-	Local water supplies

The lists of departments are not exhaustive and may vary depending on the oil palm plantation development concept and sensitivity of the location.

EPD is responsible for overseeing the environmental assessment procedure in relation to the prescribed activities and at the same time, requires comments/ concerns/ advice from the key stakeholders for decision making.

3 Typical Project Activities

3.1 Project Plan

An environmental impact assessment is an assessment of an intent, i.e. the assessment of the potential impacts occurring from well described planned activities.

It is therefore important that all activities, which have potential environmental impacts, are planned properly and described in sufficient detail prior to the environmental assessment. After the initial project information, the Environmental Assessment report therefore concerns the project description or plan.

The Project Proponent must provide the environmental consultant with a detailed description of all activities; both the main oil palm plantation activities and the supporting activities.

3.2 Project Stages

Typical activities associated with oil palm plantation development are undertaken in six main stages, namely:

Stage	Activities
Pre-Development	• Land acquisition and access - Acquire land - Relocation of existing occupants (if any) • Investigation - Feasibility studies - Detailed site survey of boundary and plantation blocks - Preparation of Environmental Assessment report - Detailed design for plantation development plan and Erosion and Sediment Control Plan (ESCP)
Nursery Establishment	• Access road establishment • Base camp establishment • Site clearing – under brushing and clear felling • Biomass management and disposal • Earthworks, drainage and irrigation • Planting and maintenance of seedlings - Preparation of high quality seedlings for planting

Stage	Activities
	- Normally one hectare of nursery will cater for a planting area of 100 ha.
Site Preparation	• Access road establishment • Base camp establishment • Utilities provision • Site clearing – under brushing and clear felling • Biomass management and disposal • Earthworks, particularly for terracing, drainage and infrastructure • Cover crop establishment
Field Establishment	• Field lining and holing • Final culling of seedlings • Transplant suitable seedlings from nursery to planting field
Maintenance and Harvesting	• Fertiliser application • Use of controlled agro-chemicals • General field upkeep • Harvesting (normally within 2.5 to 3 years after field planting) • Transportation of FFB to palm oil mills
Replanting/ Abandonment	After completion of the productive life span (20 to 25 years), a decision will be made to either replant or abandon the oil palm plantation. • Replanting - Nursery establishment - Removal of old palm trees - Biomass management and disposal - Field lining and holing - Transplanting of mature seedling - Maintenance and field upkeep - Harvesting and transportation of FFB • Abandonment - Evacuation of plantation staff and workers - Removal of equipment and structures - Site restoration/ rehabilitation

4 Scoping

This chapter deals with the scoping stage which defines the work scope for preparation of the Environmental Assessment report (refer to Table 4-1).

Table 4-1: Assessment Procedures - Scoping

The Seven Steps	Summary of Main Required Activities
Step 3: Project Scoping and Preparation of Terms of Reference/ Scoping Note	Environmental Consultant: • *Undertake scoping activities* • *Assess initial project description and assist the Project Proponent to make amendments* • *Perform initial site visit* • *Prepare a draft TOR or Scoping Note* • *Undertake the public hearing activities required for Special EIA* • *Participate in review meetings* • *Finalise the TOR for EIA or Scoping Note for PMM and obtain final approval from EPD*

Scoping is the identification of potential environmental impacts and the predicted extent of the impacts. This exercise is an important early stage of the environmental assessment process to ensure that the assessment is carried out properly and appropriately, i.e. that the report is sufficiently comprehensive, while at the same time preventing the assessment from becoming unnecessarily protracted or expensive due to inappropriate focus on issues of only minor concern.

In general, the scoping process is outlined in the EPD's Handbook on Environmental Impact Assessment in Sabah. This section briefly outlines the main steps in scoping, but primarily focuses on providing specific guidance on:

- Identification and preliminary assessment of potential impacts with respect to certain approaches to oil palm plantation development and with respect to specific project locations; and
- Selection of appropriate assessment methodologies, based on project sensitivities.

In order to carry out the above, a comprehensive description of the project in terms of location, activities and processes needs to be developed. This is described in the following section.

4.1 Project Information

The first step in scoping is to obtain as much relevant information about the project as possible, to ascertain the scale of the project and its component activities which may result in impacts to the environment.

4.1.1 Description

A description of the project location, activities and potential qualitative and quantitative impacts should be developed at this stage, in order to identify the stages, activities or characteristics of the proposed project that are likely to give rise to environmental impacts.

4.1.2 Project Location

A preliminary assessment of the baseline conditions shall be made to identify key sensitive receptors. Consideration should be given to the existing topography and drainage features, soil and vegetation conditions, wildlife, water quality and sensitive habitats and land uses.

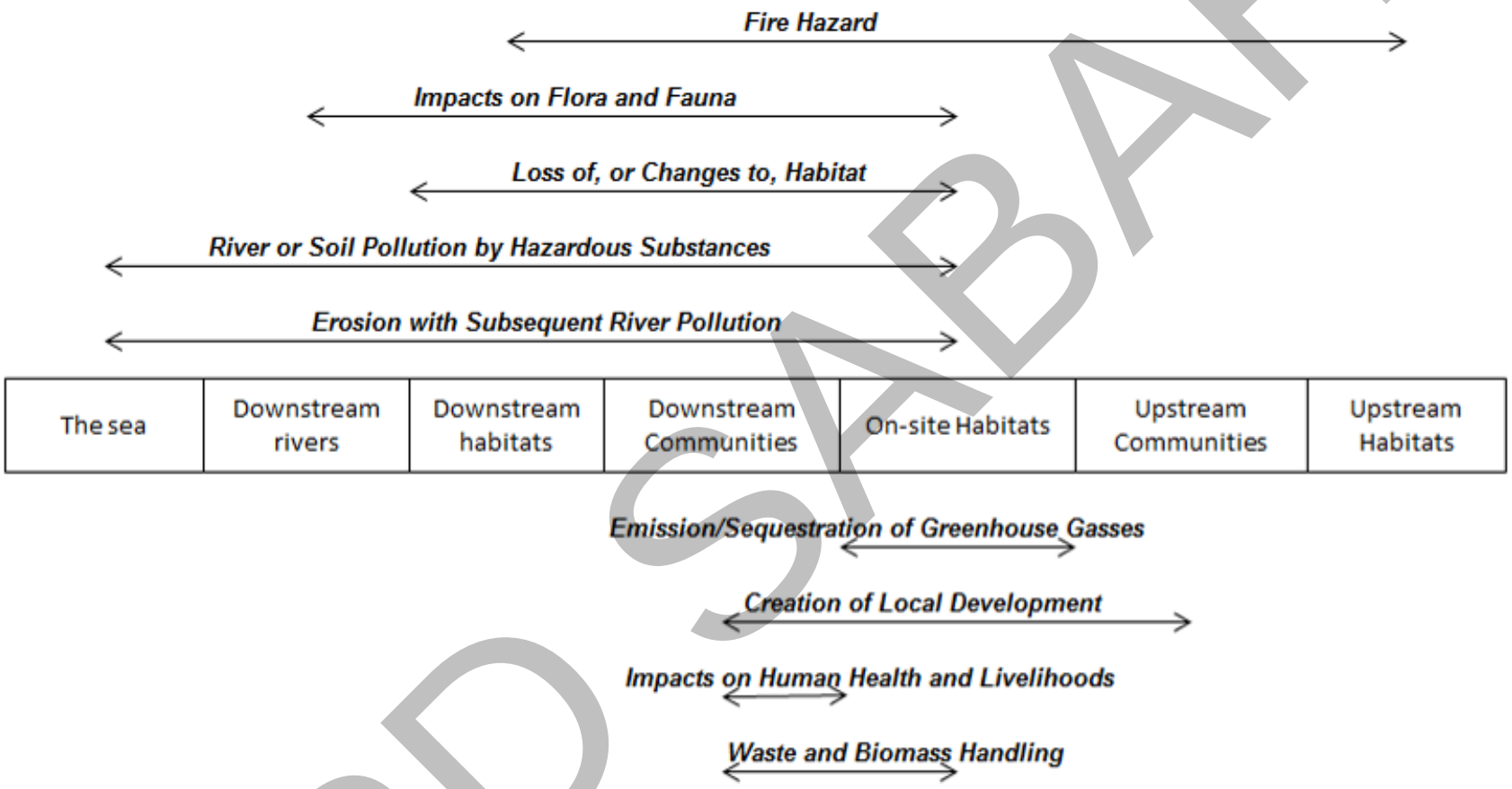
A site visit and preliminary consultations with relevant regulatory authorities must be undertaken during the scoping exercise.

4.1.3 Identification and Prioritisation of Impacts

Based on the previous steps, a list of all potential environmental impacts should be made with a preliminary estimate of their relative significance. The key impacts are those with the highest potential significance, considering both spatial scale, significance to stakeholders, potential impact severity and mitigation potential. EPD's Handbook on Environmental Impact Assessment in Sabah is a useful resource for this assessment. A prioritised list of impacts shall thereby be established and clearly described.

For each key impact identified, the anticipated zone of impact should be estimated by the expert judgment of the relevant specialists, based on conditions at the site. The zone of impacts may differ depending on the environmental component; the zone of impact for noise pollution for example may be much smaller than the potential river water quality zone of impact, owing to properties of both the polluting and the dispersing agent and the conditions at the site.

Some potential impacts and their zone of impact for oil palm plantation development are shown in Figure 4-1.



Source: Adapted from DOE Malaysia EIA Guidelines for Land Reclamation Projects, 2008

Figure 4-1: Main issues and extent of impacts for oil palm plantation development

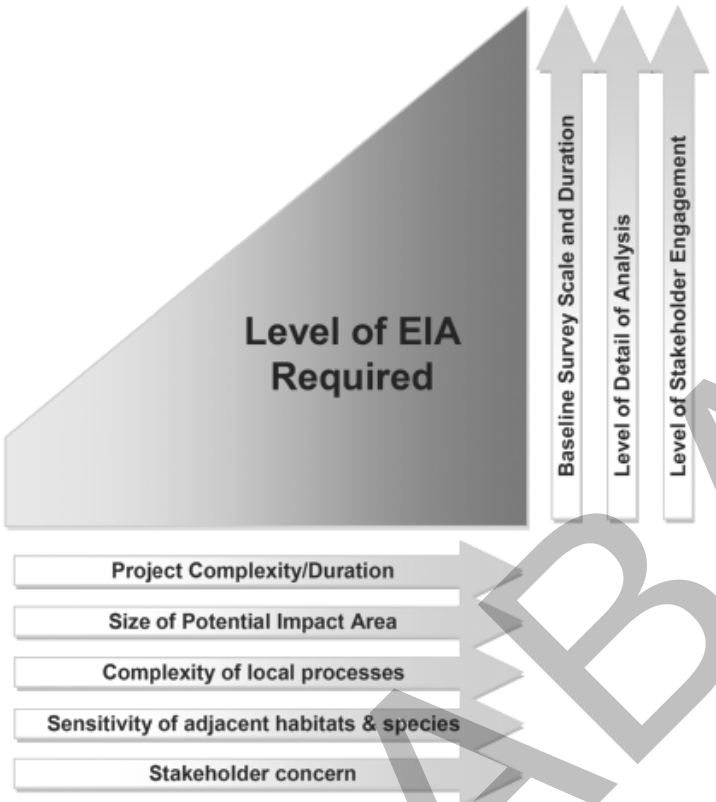
4.2 Types of Impacts

Whereas oil palm plantation development can provide significant planning and development opportunities as well as benefits to the public if properly planned and executed, there are also numerous potential adverse impacts that have to be taken into account. The potential impacts are site and project specific, depending, among other factors, on topography and drainage patterns, but mostly on the oil palm plantation development practices chosen.

Whilst the environmental assessment evaluates both positive and negative impacts, the positive impacts are generally site specific, related to the project objectives, whilst the negative impacts can be considered as generic impacts on the physical, ecological, or socio-economic environments. A non-exhaustive list of main potential impacts related to oil palm plantation development is provided in Section 5.3; these are also listed in Figure 4-1.

4.3 Terms of Reference

The TOR for the Environmental Assessment shall directly reflect the scoping exercise whereby the environmental consultant should address the identified impacts as fully as practicable. The level of analysis from baseline studies and the sophistication of prediction and evaluation methodologies, shall be tailored to the level of significance of the impacts and hence level of precision required for the evaluation, as illustrated in Figure 4-2. Less attention should be given to those issues which have lesser significance. In practical terms, this means that the level of uncertainty may be higher for these issues.



Source: PIANC, 2010

Figure 4-2: Key factors in determining the level of environmental assessment required

4.3.1 Data Collection Requirements

Collecting existing data is always the first step in the collection of baseline information. It must however be reviewed for its relevance to the proposed site, its accuracy, and used as a basis for determining what primary field investigations may be required to 'fill the gaps'.

Primary field surveys are almost always required for most aspects of the environment, such as: existing vegetation and habitats, wildlife, water quality, topography, socioeconomic and other factors. Field surveys are needed either because published information in Sabah often does not exist at a suitable scale, or is not generally applicable to the project being assessed.

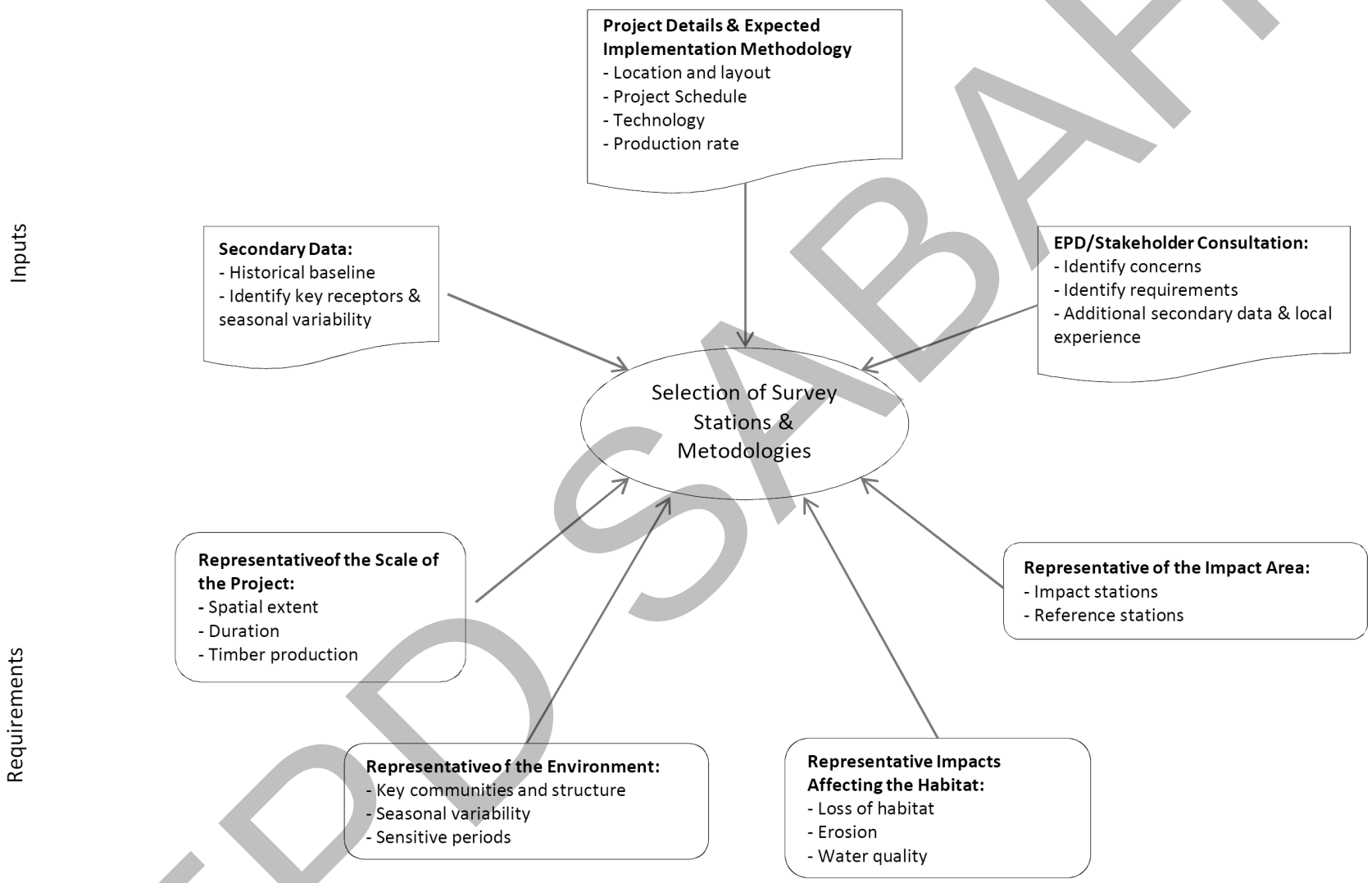
Where primary field surveys are required, careful consideration must be given to the design of the field survey and sampling programme (refer to Figure 4-3). The data collection must focus on the key issues needed to be examined for the Environmental Assessment (identified during the scoping process), and should be collected at the appropriate time(s) of the year. In Sabah, this

may include consideration of rainy and dry seasons, and on the coast, the monsoon and inter-monsoon periods.

It is important to address the temporal scale of the project when designing the baseline survey programme. A long-term oil palm development programme (e.g. five or more years) would require a baseline survey that captures natural seasonal variations within that period; while for a short project (e.g. 6 - 9 months field establishment phase), capturing a snapshot of the existing conditions can be sufficient.

In addition, the survey programme shall take into account the anticipated zone of impact of the issue in question to ensure that all potential sensitive receptors are included.

It should also be highlighted that a more detailed baseline, capturing seasonal variations, provides more security for the Project Proponent, in the event that natural variations are incorrectly perceived by stakeholders or regulators as project-derived impacts.



Source: Adapted from PIANC, 2010

Figure 4-3: Examples of criteria for selection of baseline survey stations and methodologies

5 Impact Prediction and Evaluation

This chapter deals with the assessment of the impacts that are likely to occur in the existing environment when the project activities are implemented (refer to Table 5-1).

Table 5-1: Assessment Procedures – Description of Impact Assessment

The Seven Steps	Summary of Main Required Activities
Step 4: Undertaking the EIA/ PMM study	Environmental Consultant: • *Assess the project details* - *Plan assessment* • *Assess the existing environments* - *Physical environment* - *Biological environment* - *Human environment* • *Assess the environmental impacts* - *Ecological impacts due to land development* - *Soil erosion and water pollution due to land clearing* - *Disposal of biomass and air pollution* - *Land ownership and water supply issues* - *Peat subsidence* - *Potential for subterranean fire* - *Emission of greenhouse gases* - *Social impacts* • *Devise and propose mitigation measures* • *Devise and propose monitoring programmes*

This section outlines procedures for identifying the environmental impacts associated with oil palm plantation development as well as proposed methodologies for assessing the scale and extent of the environmental impact.

The magnitude of the impacts depends on the combination of existing conditions and the selected plantation technologies and methodologies, while the zone of impact depends on existing environmental conditions such as topography, soil, vegetation, wildlife presence or nearby settlements. Adverse environmental impacts affect production capacity as well as habitats and livelihoods outside the project area and hence, the Project Proponent is

responsible to minimise such impacts by adopting mitigation measures. As a general principle, mitigation measures should preferentially focus on addressing the impacts in order to eliminate/ minimise the residual impacts.

The assessment must consider site characteristics, the proposed project activities as well as the cumulative effects with other existing or proposed projects within close vicinity. The environmental consultant's approach to assessing these interrelated factors should be clearly described based on the TOR as approved by EPD.

5.1 Description of Plans and Site

Step 4 of the overall environmental assessment process generally consists of four (4) main parts:

i. Description of planned activities and existing environment conditions;

ii. Assessment of environmental impacts;

iii. Devising mitigation measures; and

iv. Formulation of monitoring programme.

This chapter deals with the description of plans and the existing conditions within the site and the zone of impact (refer to Table 5-2).

The assessment of the existing environment and thus also the activities and associated mitigation will to a large extent be based on an analysis of topographic maps combined with knowledge of the field conditions. These maps are based on aerial photo interpretation of dense canopy cover and can only be indicative of terrain contours and smaller features such as creeks and streams. The actual delineation of areas and mitigation measures must be based on the verifiable conditions in the field i.e. be based on field surveys.

Table 5-2: Assessment Procedures - Description of Plans and Existing Environments

The Seven Steps	Summary of Main Required Activities

Step 4:
Undertaking the EIA/ PMM study
	Environmental Consultant:
	• *Assess the project details*
	  - *Plan assessment*
	• *Assess the existing environments*
	  • *Physical environment*
	  - *Air*
	  - *Soils and geology*
	  - *Water*
	  • *Biological environment*
	  - *Flora and fauna*
	  • *Human environment*
	  - *Public administration*
	  - *Demography*
	  - *Livelihoods and economic activities*
	• *Assess the environmental impacts*
	• *Devise and propose mitigation measures*
	• *Devise and propose monitoring programmes*

The impact assessment is, as mentioned, based on a combined knowledge of the intent and the existing environment.

An assessment must therefore be made of the existing environment, its components and its sensitivity to impacts from the oil palm plantation development. In order to provide a basis for comparison during later monitoring, it is important to have a set of baseline data, describing clearly the pre-project conditions. The description provided must be clear and direct to the point being discussed.

5.1.1 Project Screening

Screening is recommended to be applied by environmental consultants to determine the aspects that should be covered in an Environmental Assessment report. The process of screening should be simple and rapid, but effective enough to eliminate major potential environmental impacts that have residual significance, such as destruction of environmentally sensitive areas or priority habitat.

Screening allows for focus on real environmental issues at an early stage of the assessment process and allows for environmentally sensitive planning and the early resolution of some issues. This will minimise the possibility of residual impacts. Project screening is conducted by assessing the project details in relation to the existing environment as described in Section 5.1.2 and Section 5.1.3.

5.1.2 Assess the Project Details

The environmental consultant must, based on the information received from the Project Proponent, describe the activities that are likely to pose a risk of negative impacts on the environment or which are seen as an opportunity for environmental improvement. The description shall include technologies and methodologies chosen by the Project Proponent after consultation with the environmental consultant. If there are areas where the project description from the Project Proponent lacks detail, it must be clearly stated by the environmental consultant and he must then later make appropriate proposals for technology selection and mitigation. The environmental consultant can recommend changes in the project plan to better suit the site should initial assessment indicate so. It should be highlighted in the Environmental Assessment report as “Project Options”.

5.1.3 Assess the Existing Environment

It is necessary to provide sufficient information to give a brief but clear illustration of the existing environmental components. These components include, to the extent applicable (but are not necessarily limited to) the following:

- **Physical Environment**: topography, slope features, soil features and suitability, geology (rock features, stability), hydrology (drainage and seasonal flow pattern, flood plains, swamps), climate (temperature, wind regime, rainfall), surface water quality (particularly for Total Suspended Solids, Dissolved Oxygen, pH, Temperature, Phosphorus, Nitrogen, Coliform Count and harmful pesticides), air quality and noise level.

- **Biological Environment**: wildlife, forest cover, rare, protected or endangered species (terrestrial and aquatic flora and fauna, elephant and rhinoceros home range) and area (mangroves, national parks, wildlife sanctuaries/ corridors, salt licks, peat swamp, freshwater swamp), fisheries, aquatic biology, wilderness or protected areas, key conservation value habitats or species.

- **Human Environment**: population and communities (including numbers, locations, compositions, employment and others), land use, location of important economic resources/ upstream and downstream activities (including plantations, river sand extraction, fish rearing, *Tagal* areas), infrastructural facilities (including water supply, electricity, sewerage, flood control), institutions (such as schools, clinics and places of worship), water catchment areas, transportation (roads, navigation and others), archaeological, historical and cultural values and aesthetic values.

The baseline study for the Environmental Assessment should concentrate on identifying those environmental components that may be significantly impacted by the proposed project. These may be identified through ground observation, literature review and stakeholder consultation. The description can be presented in the form of mapping, listing or reports in the Environmental Assessment report

5.1.4 Study Area and Zone of Impact

Generally, a study area for preparation of an Environmental Assessment report covers 3 km radius from the project site boundaries. However, the study area should focus on what the environmental consultant deems to be the zone of impact. A clear delineation of the study area based on actual ground survey conducted is important to define the area within which impacts should be considered.

There may be different zones of impact for physical (such as water quality, terrain features and hydrology), biological (such as wildlife species, habitat and diversity) and human (such as social issues affecting communities, cultural and aesthetic aspect and land use) environment. The environmental consultant should overlap these impact zones and decide which zone is particularly sensitive and where impacts are likely to be of some significance. Such zones may reach far downstream from the sites, particularly if there are sensitive areas downstream, or locality concerns. The zone of impact can be determined after understanding the concept of the proposed development and conducting ground observations to identify these sensitive areas.

The extent of the study area/ zone of impact must be mapped out, clearly defined and justified in the TOR document and agreed upon with EPD. This will particularly include human settlements that are to be included in the assessment surveys for the preparation of the Environmental Assessment report.

5.2 Impact Assessment

The Environmental Assessment for oil palm plantation development will assist in the following:

- Planning of site preparation works and plantation establishment;
- Identification of environmental impacts and the risk of negative impacts;
- Exclusion or protection of sensitive or vulnerable areas; and
- Protecting environmental components in the immediate site area, in adjacent areas and in the broader environment.

Integrating environment protection at the project planning stage will ensure that measures to avoid and minimise pollution can be built into the project design and work schedule. The Environmental Assessment should not only consider the environmental impact on a site, but whether or not significant off-site effects are likely. An initial assessment of the site should be conducted to identify sensitive environmental areas or land-uses that require protection. These may include:

- Sensitive or endangered flora and fauna;
- Aquatic plants and animals, if a natural waterway is affected; and
- Historical/ cultural areas that are considered as sensitive.

The first activity to be performed as part of the Environmental Assessment process is to identify environmental issues which are important and which will need to be studied in detail, and to identify and eliminate issues which are of little or no importance and therefore can be excluded from the Environmental Assessment study.

5.2.1 EIA Matrix

Impact assessment is not an exact science. The assessment of impacts therefore requires a deep knowledge and understanding of the local environment and of oil palm plantation development. Therefore, different assessments are likely to come to similar but still somewhat different, conclusions.

The environmental consultants should combine their personal experience with recent international and local research results, monitoring reports from

neighbouring areas of oil palm plantation development, from new survey data and in some cases from the results of modelling.

Literature on the impacts of oil palm plantation development already exists and in the first instance this should be consulted. A review of known impacts documented for similar environments is likely to provide a good foundation for the basis of the impact assessment.

Results obtained from computerised mathematical models need to be verified against field data. It should be recognised that for the results to be representative, the data requirements are high and limited by the quality of the input data. To enable verification by EPD, actual procedures must be made available. Before using computer models, prior consultation and approval with EPD is advisable.

It cannot be stressed enough that the environmental consultants must take a realistic and site specific view of the project. They shall neither promote nor counter the proposed activities but realistically present, what in their professional opinion is realistic to expect as a result of the plans. In order to have an impact on the planning, the environmental consultant should focus on a limited number of significant key issues supported by literature review and project specific information. In addition to an assessment of the probability (risk) of the impact to occur, each issue shall be described in with a view of:

- The magnitude of the projected impact.
- The permanence of the projected impact.
- The reversibility of the projected impact.
- Cumulative impacts over time of the projected impact.

This means that these four points must be represented as sub-headings for each description of each impact.

The summary of results shall be presented in an EIA Matrix, an example of which is shown in Table 5-3. To guide the reader of the Environmental Assessment report, this summary table is best placed before the descriptions of each environmental impact.

Table 5-3: EIA Matrix (Example)

Impacts	Magnitude	Permanence	Reversibility	Cumulative
Key Environmental Impacts				
Soil Erosion, Water Pollution and Hydrological Impact	2	2	3	3
Biomass Waste Management	2	2	2	2
Ecological Impact	2	2	2	2
Other Environmental Impacts				
Social Impact	2	2	2	1
Abandonment	1	2	2	2

Legend	**Number**		
Criteria	**1**	**2**	**3**
Magnitude *Measure of the importance of the condition in relation to spatial boundaries*	Change/ effect within project site only	Change/ effect to local conditions and/ or to areas immediately outside	Regional/ national/ international change/ effect
Permanence *To define whether the condition is temporary or permanent*	No change/ not applicable	Temporary	Permanent
Reversibility *Measure of the control over the effect of the applied condition*	No change/ not applicable	Reversible	Irreversible
Cumulative *Measure of whether the effect will be a single effect or a cumulative effect over time or a synergistic effect with other conditions*	No change/ not applicable	Non-cumulative/ single	Cumulative

When scoring the level of impact, the environmental consultant should give justification on how the scoring has been done and what has caused very high or very low assessment scores. This can be done by repeating the table row at the end of each impact description. An example is given in Table 5-4.

Table 5-4: Activity Level EIA Matrix (Example for Soil Erosion)

Criteria	Score	Justification
Magnitude of Change/ Effect	2	Impact extends to settlements located approximately 1 km downstream of site boundary at the nearby river which utilised the water for domestic purposes.
Permanence of Impact	2	Temporary – duration approximately 6-12 months (during site establishment stage only).
Reversibility of Condition	2	Reversible with the establishment of ground cover crops.
Cumulative Impact	3	Cumulative impact as erosion will likely to continue over time until new equilibrium is reached.

5.2.2 Use of Geographical Information System (GIS)

The representation of spatial data by means of a GIS provides an appropriate tool for representing and analysing spatial data sets, particularly for larger, more complex and sensitive projects. GIS therefore offer good opportunities to examine the environmental sensitivity of different environments.

It is a requirement to submit datasets directly to EPD. The GIS used by the environmental consultant should be able to export datasets in a format readable by the EPD's system. The environmental consultant should therefore consult the EPD before the analytic work begins in order to ensure such compatibility.

EPD may from time to time issue a list of map formats including standardised map symbols or spatial data requirement, which must be used in maps submitted as part of an Environmental Assessment.

5.2.3 Optimisation of Project Plan

The environmental consultant will at several points during the assessment, find that the plan description provided by the Project Proponent is suboptimal seen from an environmental point of view. There may be environmental management issues, which are not included in the plan description, there may be certain parts of the project scope, timing or lay-out, which are not seen as acceptable, or there may be suboptimal choices of technologies or methodologies. The environmental consultant will, when such flaws in the plan description become obvious, advise the Project Proponent on recommendable plan changes so the final plan, which is being assessed by

the environmental consultant, is optimised for environmental management, i.e. negative environmental impacts are being minimised through proper choice of scope, technologies and methodologies.

It is unavoidable that the project activities will cause some residual impacts even when all activities are carried out in the best possible manner. The assessment by the environmental consultant will then concentrate on assessing the magnitude and effect of these residual impacts. There will be no more that the Project Proponent can do to minimise them. There will, however, be some mitigation in the form of compensation that can be implemented. Off-set planting or replacement of habitat conservation, cash compensation or substitutes for lost livelihoods or environmental services are among the options for mitigating unavoidable and thus residual, impacts.

Project optimisation options must be thoughtfully considered and reported in the Environmental Assessment report so that the maximum benefits of the project are clearly understood. These benefits should be considered against any residual impacts that may be identified in the Environmental Assessment.

5.3 Environmental Impacts

The key environmental impacts associated with oil palm plantation development concern:

- Ecological impacts such as de-forestation and fragmentation, loss of wildlife habitat or wildlife corridors, and human animal conflict
- Soil erosion and associated water pollution due to land clearing and development
- Generation and disposal of biomass from land clearing
- Local water supply issues from encroachment into catchment for water supply
- Socio-economics impacts on surrounding communities' livelihoods
- Increase in waste generation (sewage, domestic and scheduled waste) due to influx of plantation workers
- Development on river floodplain leading to loss of riparian habitat and function
- Reduced availability of water resources

- Water pollution due to usage of agro-chemicals
- Land and water pollution from hazardous materials
- Impacts due to draining of peat swamp
  - Land subsidence
  - Acid sulphate soils exposure
  - Increased saline intrusion
  - Increased coastal flooding

5.3.1 Ecological Impacts

The establishment of plantations will result in the permanent loss of nearly all flora and fauna species in the developed area. If adjacent undisturbed forest exists and it is assumed that it is in ecological equilibrium, opportunities for the absorption of displaced neighbouring populations will be limited, if they exist at all. It can be assumed that displaced individuals will compete with the resident individuals in the intact forest, resulting in their displacement or the eventual loss of the residents.

Site selection and site preparation activities are the two main aspects that result in ecological impacts of oil palm plantation development. Location within areas classified as ecologically sensitive and site clearing for access road, nursery and plantation will directly damage the habitats for a broad range of terrestrial and aquatic flora and fauna species.

Assessment Methodology:

An assessment of the flora and fauna impacts to be addressed in the Environmental Assessment depends on a number of factors, some of which would have been determined in the initial assessment of the project (see Section 5.1.3):

- Assessment of the existing land use in the project site i.e. whether it is an existing oil palm plantation, pristine forest, secondary forest and others;
- Assessment of the geographical location and size of the project area;
- Assessment of the status and land development trends in the area and within the State;

- Discussion with existing regulatory bodies governing the project;
- Assessment of the main project activities; and
- Assessment of the project site and the presence of key conservation value elements.

Based on the above, the environmental consultant can determine whether a detailed flora and fauna study is required or not. A related proposal of mitigation measures and monitoring programmes might suffice in some instances. For example, a small to medium scale project in an area already developed; there would generally be no need or little purpose to study the flora and fauna impacts.

The reasons to include, or not include, a more detailed assessment of impact on flora and fauna need to be clearly outlined and presented and supported with relevant land-use maps.

The overall objective of an assessment of flora and fauna would be to identify areas that may need special attention and treatment or protection because of an identified significance. Appropriate assessment methodologies need to be identified depending upon the scale and significance of the project.

5.3.2 Soil Erosion

The removal of the protective vegetation cover during land clearing and the subsequent disturbance to the soil surface will inevitably increase soil erosion rates. The causes of increased soil erosion rates are tabulated below in Table 5-5, along with the typical effects.

Table 5-5: Soil Erosion Impacts for Oil Palm Plantation Development

Key Impacts	Possible Cause	Typical Effects
Soil Erosion	Site clearing and earthwork for: - Construction of access road - Establishment of base camp - Establishment of nursery - Terracing, drainage and infrastructure	Reduction in arable soil from plantation area. Elevated Total Suspended Solids content and turbidity in waterways downstream. Reduction in channel capacity of waterways due to sedimentation leading to potential localised flooding and impeded navigation.

Eroded soil as a result of oil palm plantation development will be carried into drains and hence to the waterways, eventually being deposited in the

downstream floodplain areas. Surface runoff laden with eroded soil particles will increase the total suspended solids and turbidity of the receiving water bodies, which in turn will affect the aquatic life therein. High concentrations of sediment reduce stream clarity, inhibit respiration and feeding of stream biota, diminish light needed for plant photosynthesis, and promote infections. Deposited sediment in stream bottoms can suffocate benthic organisms. Waterborne sediment can carry increased levels of phosphorous and nitrogen into the waterways, resulting in algal growth and feeding waterweeds (e.g. water hyacinth).

Socially and economically, high sediment concentrations can add considerably to the cost of water treatment for human use and also significantly decrease the storage capacity of reservoirs. As more and more eroded soil being deposited in the waterways bed, downstream channel capacity will be reduced, leading to flooding and restricted river transport, as the channel becomes difficult to navigate. Soil loss to the streams or rivers is expected to reduce as time progresses when the oil palm trees mature and ground vegetation establishes and covers the site.

Factors influencing soil erosion

The dominant factor controlling soil erosion in the humid tropics is *rainfall volume and intensity*, while other factors are:

- The erodibility of the soil;
- The slope of the land;
- The nature of the vegetation cover;
- The location of project and its activities;
- The area of land exposed to erosion; and
- The period of exposure.

Assessment Methodology:

The proposed method for assessing soil erosion impacts is:

- *Erosion hazard assessment* incorporating biophysical data i.e. slope and stream drainage network, and when requested, vegetation cover, rainfall distribution and/ or intensity and soil classification; and

- *Assessment of intended management procedures* i.e. area to be exposed, length of time exposed and schedule of oil palm plantation development.

The impact analysis should focus on identifying potential areas of erosion hazard. A theoretical approach would be to analyse thematic data layers based on the factors that control erosion, i.e. slope, rainfall, vegetation cover and intended sites and schedules of disturbance i.e. location of roads and terraces. Additional layers should include all permanent streams and catchment boundaries. Subsequent overlay analysis of these factors will help identify site suitability at a reconnaissance scale of mapping, based on erosion hazard.

Given the limited availability of rainfall intensity and soil data in Sabah, suitable data is seldom available and will not normally be required given the associated difficulties of making good decisions based on such data. However, for specific projects it may be required that such data is produced when it is thought that such an assessment can better assist decision-making.

Geographical Information System (GIS) is well suited for overlay analysis. Manual methods may, however, also be employed.

The assessment of erosion hazard is a specialised form of land resource evaluation, the objective of which is to identify areas of land that will be threatened by or are prone to excessive soil loss. The assessment aims at dividing a land area into regions of similar erosion hazard as a basis for planning project activities and soil conservation work.

Although the rate and amount of soil erosion under undisturbed conditions is controlled by a number of known factors, the impact of the disturbance often overrides these. This therefore requires the identification of the existing or planned disturbance i.e. road network, terraces, road and drainage networks and other land clearings indicated in the plantation development plan.

As a minimum requirement, an assessment should include the flowing steps and data layers:

Process 1: Elevation and Slope

- *Topography and Slope:* Topographical data should be abstracted from the available 1:50,000 national map sheets. If larger scale 1:25,000 data are available, this may be used or at least reported that it is available. Elevation data is required to derive slope (refer to Figure 5-1 and Figure 5-2). A minimum data requirement is that slope is captured from topographic data from the 1:50,000 scale maps using the minimum

contour interval spacing available, which on most map sheets is 100 feet. Once data on elevation has been captured, it is usually easier to utilise computerised methods to determine slope and several commercial software packages are available to do this. Details of the software and the basic principles of the derivation should be presented with the slope map. Digitally derived slope maps captured from 1:50,000 topographic maps provide a general assessment of the distribution of steep land, however, it should be recognised that important local topographic variation may be missed, and therefore the local erosion risk may be underestimated.

This process can be enhanced and refined if more recent technologies such as LiDAR (Light Detection and Ranging) data or aerial photography is available, or can be arranged. This will allow the generation of a more accurate DEM (Digital Elevation Model), good representation of topography and identification of slope categories.

- *Slope Classification:* Slopes of 25 degrees and above to be clearly marked on a map. As described above, factors other than slope do affect rates of erosion; however, a slope classification map (refer to Figure 5-2) will provide important indicative information as to high risk areas. It is also recognised that in some cases when other data is not available, slope may be the only indicator of erosion hazard available.

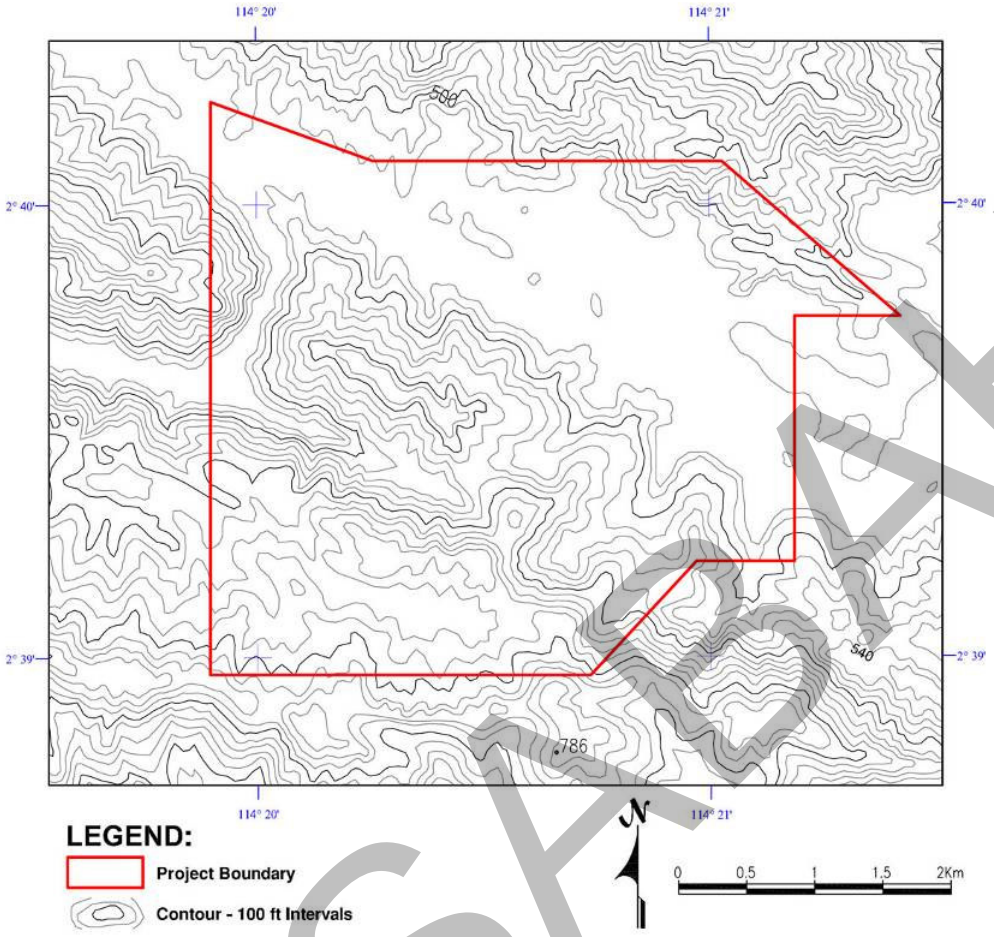


Figure 5-1: Elevation and geographical location of project abstracted from 1:50,000 map sheet

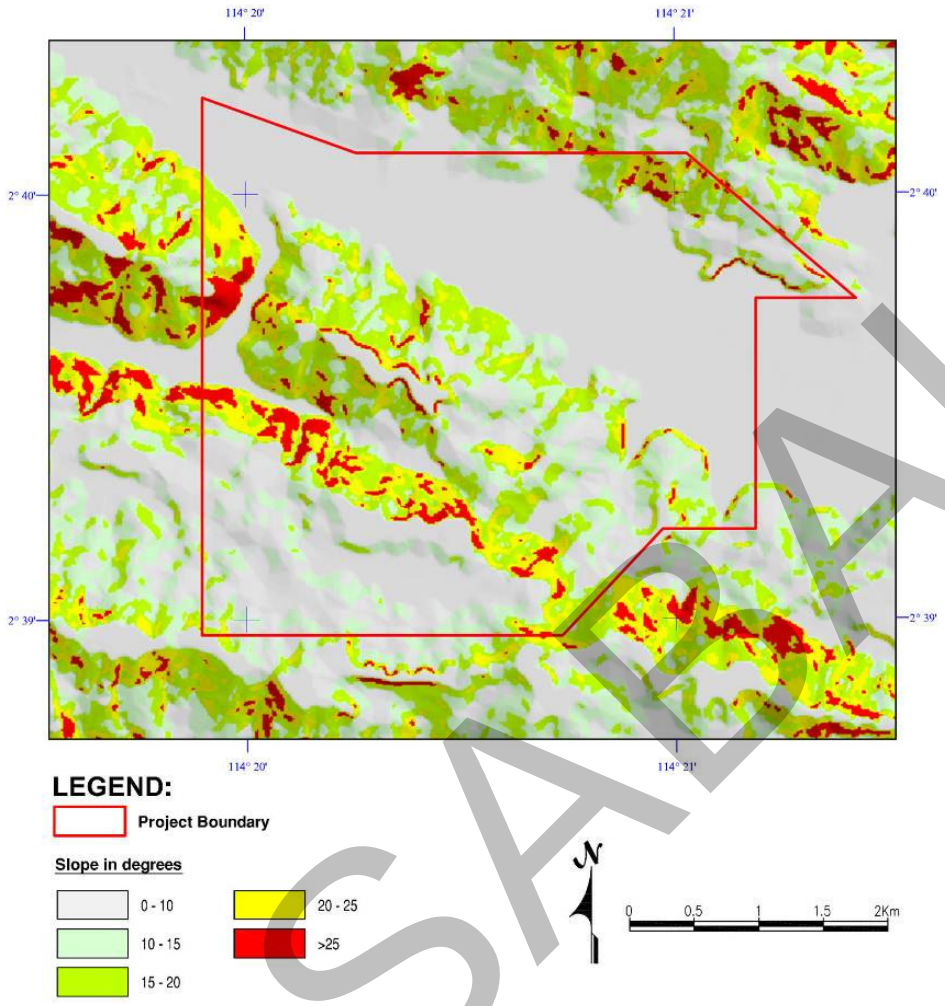


Figure 5-2: Slope gradient as derived from elevation (Figure 5-1)

Process 2: Additional Information

Additional information and data layers that may be used if specifically requested include:

- *Vegetation*: Available data on vegetation cover, habitat and/ or current landuse should be presented at the same 1:50,000 scale. If current information is not available, this data may be mapped for larger oil palm plantation developments, by for example, satellite imagery or aerial photographs, or by site visits for smaller projects. It should be recognised that it is the removal of vegetation that increases the hazard, therefore the intended or existing road network may also provide an important data layer for erosion hazard assessment.

- *Rainfall:* Data on average annual rainfall over the project location, presented at the same 1:50,000 scale, may in some instances provide information for planning and assessment. If more appropriate rain data is

available i.e. data available from agricultural stations, research stations and DID, this data should also be incorporated. In general soil erosion rates will increase with increased rainfall intensities.

- *Soil:* Erodibility defines the resistance of soil to both detachment and transport. Although a soil's resistance to erosion depends in part on topographic position, slope steepness and the amount of disturbance, erodibility varies with soil texture, aggregate stability, shear strength, infiltration capacity and organic and chemical content. Given the inherent difficulties associated with determining any one of these factors - a thematic layer might be constructed using available soils data, also preferably at a scale of 1:50,000 or the largest scale available (see for example 'The Soils and Crop Suitability Report of the Sungai Bole Area, Lahad Datu - map scale 1:25,000). It may be that if a site is identified as potentially having a high erosion risk, more data or an additional survey might be requested. If requested, the survey adopted should use an internationally accepted procedure e.g. Food and Agriculture Organisation (FAO) of the United Nations guidelines for soil description (FAO, 1970) or should follow the recommendations of the Department of Agriculture, Sabah. The soils of Sabah have been described down to the Family (1974). A soil family is a unit of classification defined specifically by the type of parent material, which in Sabah has been quite broadly classified. The soil parent material would for example be described as sedimentary, intrusive igneous or crystalline basement rock. For the existing soils map of Sabah, soil associations have been mapped at a scale of 1:250,000. A soil association is not a classification unit but has been adapted to enable mapping based on landform classes, dominant soil units and characteristic vegetation, this mapping level is broad and may be used for the initial assessment.

  In general, large particles are more resistant to transport because of the greater force required to entrain them. Fine particles are also resistant to detachment because of their cohesiveness. The least resistant particles are silts and fine sands. When necessary, a geologic data layer should be provided. If soil data is used for erosion risk modelling or is presented as part of the assessment, the significance of the data must be justified. For example, one soil type may be more erodible because it has a higher percentage of sands and silts.

Process 3: Schedule and Phasing of Operations

- The schedule and phasing of oil palm plantation development should be clearly stated and when possible represented in a spatial format. See

Figure 5-3. Information on the time lag between clearance and conversion to oil palm plantation is required. The conversion should preferably take place in phases or immediately after the land clearance and clear-cutting operations. If replanting is delayed, the adverse physical environmental impacts will increase, resulting in long term consequences, particularly in relation to soil erosion and water pollution.

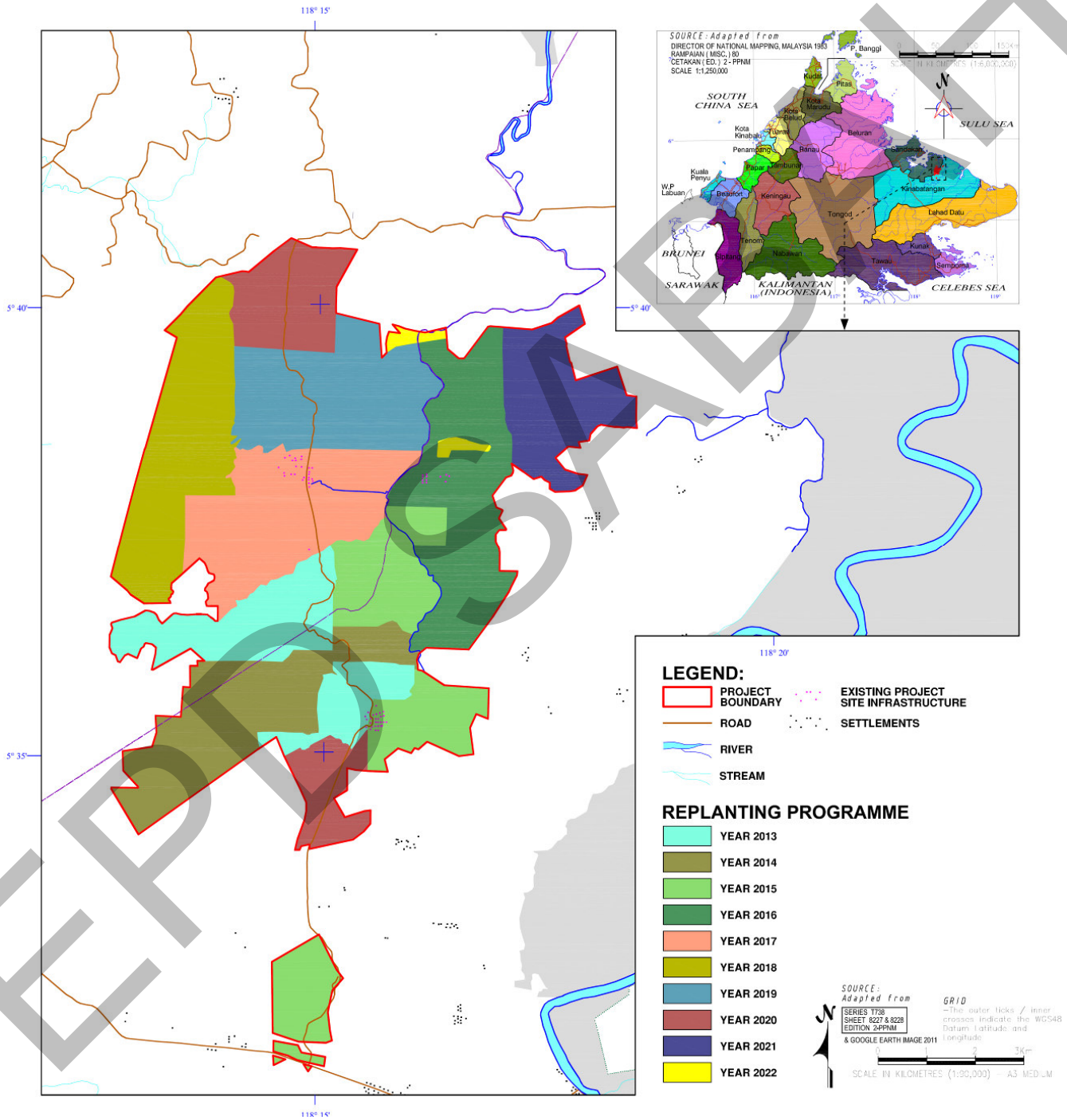


Figure 5-3: Project locality map along with plantation phasing

Process 3: Hazard Assessment Map

- The overall assessment of erosion hazard could either be based on slope alone or incorporate the above data layers. The resulting hazard map should identify regions that are at risk should they be disturbed, i.e. a range or collection of steep regions with high erosion risk or isolated areas of high erosion risk i.e. single hill slopes (refer to Figure 5-4). Each locality should be given an identification number or code for reference. Due to the difficulties associated with locating and identifying specific steep areas in the field, the data will later require the integration of other data e.g. human impacts, to focus the assessment on specific high-risk areas.

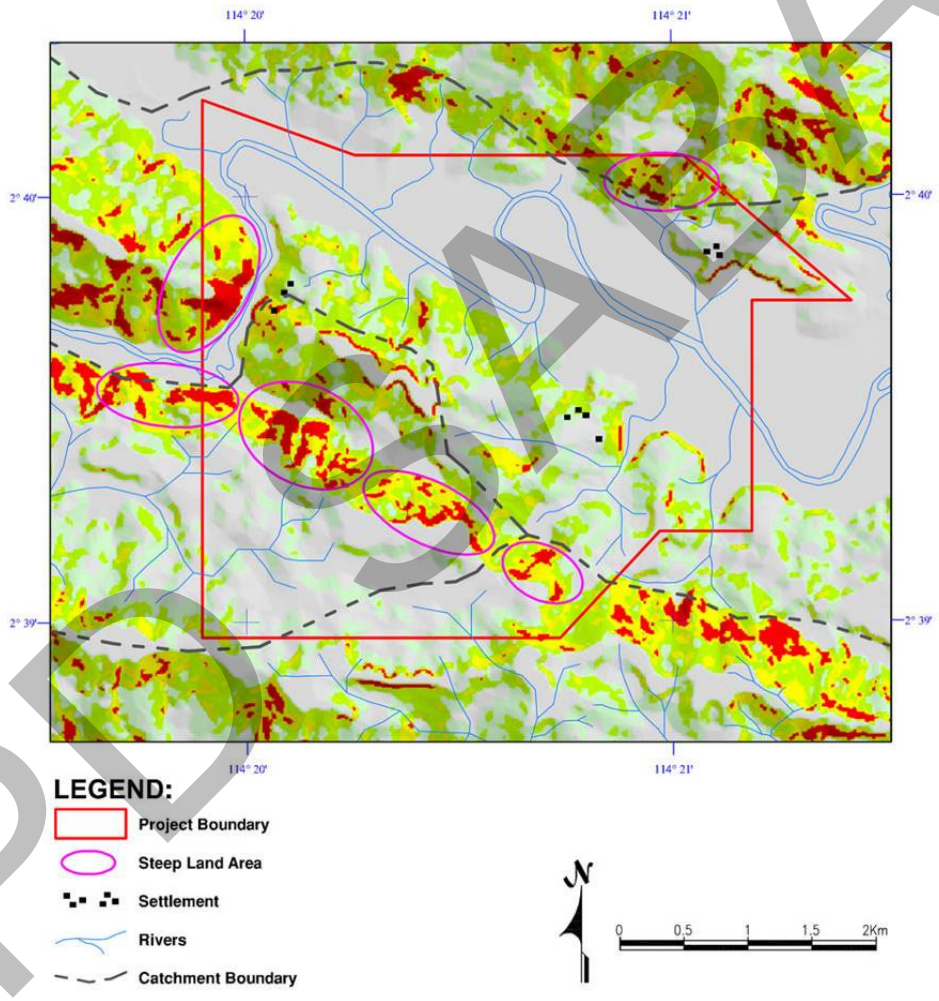


Figure 5-4: Erosion risk as derived from data on slope

5.3.3 Biomass Disposal

Site preparation and field maintenance result in the generation of large quantities of biomass. Site clearing comprises activities such as under brushing and clear felling that generates biomass in the form of re-useable/

marketable timber and vegetative wastes. Field maintenance will results in the generation of manually removed weeds as well as vegetative wastes from pruning.

During site preparation, remnant biomass can be piled in windrows, simultaneously with terrace construction. Biomass, piled in windrows along the outer lip of terraces, and on slopes between terraces, also serves to protect these vulnerable areas from soil erosion during the early stages of plantation development. Biomass piled in this manner will decompose rapidly, especially once the cover-crop is established and covers the biomass.

Improper biomass disposal such as pushing biomass into streams and rivers will block/ pollute rivers and thereby impact downstream settlements.

Assessment via site survey will be used to ascertain the estimated amount of biomass to be disposed. The determining factors would be the size of the area and the extent of vegetation cover and the species therein. The findings of the biomass estimation shall be used to assess the possible reduction in the amount of biomass to be disposed of by sorting/ recovery of useable biomass (segregate useable timber from vegetative wastes). After undergoing sorting and recovery of useable biomass, the residual biomass from clearing activities, which is mainly vegetative wastes, must be disposed of by adopting the zero burning techniques.

5.3.4 Socio-Economics Impacts

Oil palm plantation development can result in a number of interrelated socio-economic impacts; adverse or otherwise. These impacts touch on community structure, amenities, human settlements and infrastructure as discussed below. However, this list is not exhaustive and may vary based on site conditions and location of which the environmental consultant should make an assessment based on their knowledge and judgment.

- *Deterioration of drinking water quality:* Increased sediment loads and improper waste handling may degrade the quality of drinking water obtained from gravity feed systems (see Plate 5-1) or water intake points, and thereby increase health hazard issues. In remote areas, especially areas where piped potable water supply is not available, there is a possibility that the oil palm plantation encroaches into the catchment for local water supply (normally in the form of a weir and gravity feed distribution line refer to Plate 5-1). The quality of the water supply may be affected and the local population may face difficulty in obtaining potable water for their daily use.

- *Landscape degradation and loss of existing and potential eco-tourism opportunities.* Excessive damage to the natural vegetation cover may degrade the landscape and impact aesthetic values. Sediment polluted rivers may lead to the degradation or loss of water recreation sites.

- *Land ownership issues,* for example land ownership conflicts and disagreements, increased landlessness, loss or degradation of sacred areas i.e. areas that have cultural or religious value for the local residents

- *Dust and noise problems* relating to road construction, operation and haulage.

- *Water resource issues,* i.e. reduced availability of water if it is the Project Proponents intention to abstract water for the purpose of irrigation or to meet the domestic needs of the workforce.

- *Social/ community impacts* due to influx of itinerant workers.

- *Potential for development opportunities* associated with project. Better access to markets, infrastructure facilities, employment in projects.

- *Development needs that may be provided as part of the project* - health facilities, education, recreation, transportation, communication, power supply, improved water supply.

The objective of the assessment is to identify what impact the proposed oil palm plantation development may have on the social aspects of the environment. The social aspects that may need special attention, and appropriate assessment methodologies need to be identified depending upon the scale and significance of the project. Examples of the aspects include:

i. The ways people cope with life through their economy, social systems, and cultural values.

ii. The ways people use the natural environment, for subsistence, recreation, spiritual activities, cultural activities, and so forth.

iii. The ways people use the built environment, for shelter, making livelihoods, industry, worship, recreation, gathering together and others.

iv. The ways communities are organised, and held together by their social and cultural institutions and beliefs.

v. Ways of life that communities value as expressions of their identity.

vi. Art, music, dance, language, arts, crafts, and other expressive aspects of culture.

vii. A group's values and beliefs about appropriate ways to live, family and extra-family relationships, status relationships, means of expression, and other expressions of community.

The assessment would involve characterising the existing state of such aspects of the environment, forecasting how they may change if a given action or alternative is implemented and developing means of mitigating changes that are likely to be adverse from the point of view of an affected population. In most cases, there is a series of more or less standard steps through which the analysis must proceed in order to achieve good results.

- *Process 1. Initial assessment of potential adverse impacts.* An initial assessment based on available data, information, interviews and maps should be undertaken. See Figure 5-6.

- *Process 2: Develop an effective public involvement plan, so that all affected interests will be involved.* The level of public participation needed varies with the nature of the action under review. On a complicated project, a social assessment may be useful at the outset to establish the general character of the community, define the potentially affected groups, and determine enough about them to know how to involve them. In a simpler case, merely consulting with local leaders and experts may be sufficient to obtain the critical data on which to build a public involvement plan.

- *Process 3. Survey of potential affected settlements and define baseline.* Based on the initial assessment, a semi-structured questionnaire should be developed. The questionnaire should include; (i) a number of close-ended questions, for example; 'What is the population size of the village?' 'Do you use the forest for income-generation purposes?' and, (ii) a number of open-ended questions, including for example; 'What do you think are the main environmental concerns associated with the project? How do you think the project will affect your family?'

  Brief social survey notes describing the oil palm plantation development and outlining the social consultation method (list of questionnaire) must be prepared by the environmental consultant and documented in the Environmental Assessment report. The number of respondents to be consulted within the zone of impact must be determined and justified by the environmental consultant with **locations of those interviewed**

marked in a map. Emphasis should be given on consultation with the village head/ local representative. Refer to Figure 5-5.

- *Process 4: Define assessment scope.* The assessment must be scoped to make sure it is focused on the right things, and that the right methods are employed. Factors to consider in establishing the scope include:
  - Probability that an event will occur
  - Number of people potentially affected
  - Duration of potential impacts
  - Values of benefits and costs to affected groups
  - Potential for reversibility or mitigation
  - Likelihood of subsequent impacts
  - Relevance to decisions
  - Uncertainties over probable effects
- *Process 5. Project probable impacts.* Based on the results of Step 1 and 2, an assessment of specific impacts shall be carried out. For example:
  - Social disruption;
  - Deterioration of potable water supply;
  - Land ownership issues;
  - Landscape degradation and loss of existing and potential eco-tourism opportunities;
  - Dust and noise problems; and
  - Water resource issues.
- *Process 6: Develop a mitigation plan.* Work with the Project Proponent and affected groups to establish ways to mitigate social effects, and put this plan forward in the Environmental Assessment report. Establish monitoring programs to make sure that mitigation actually occurs.

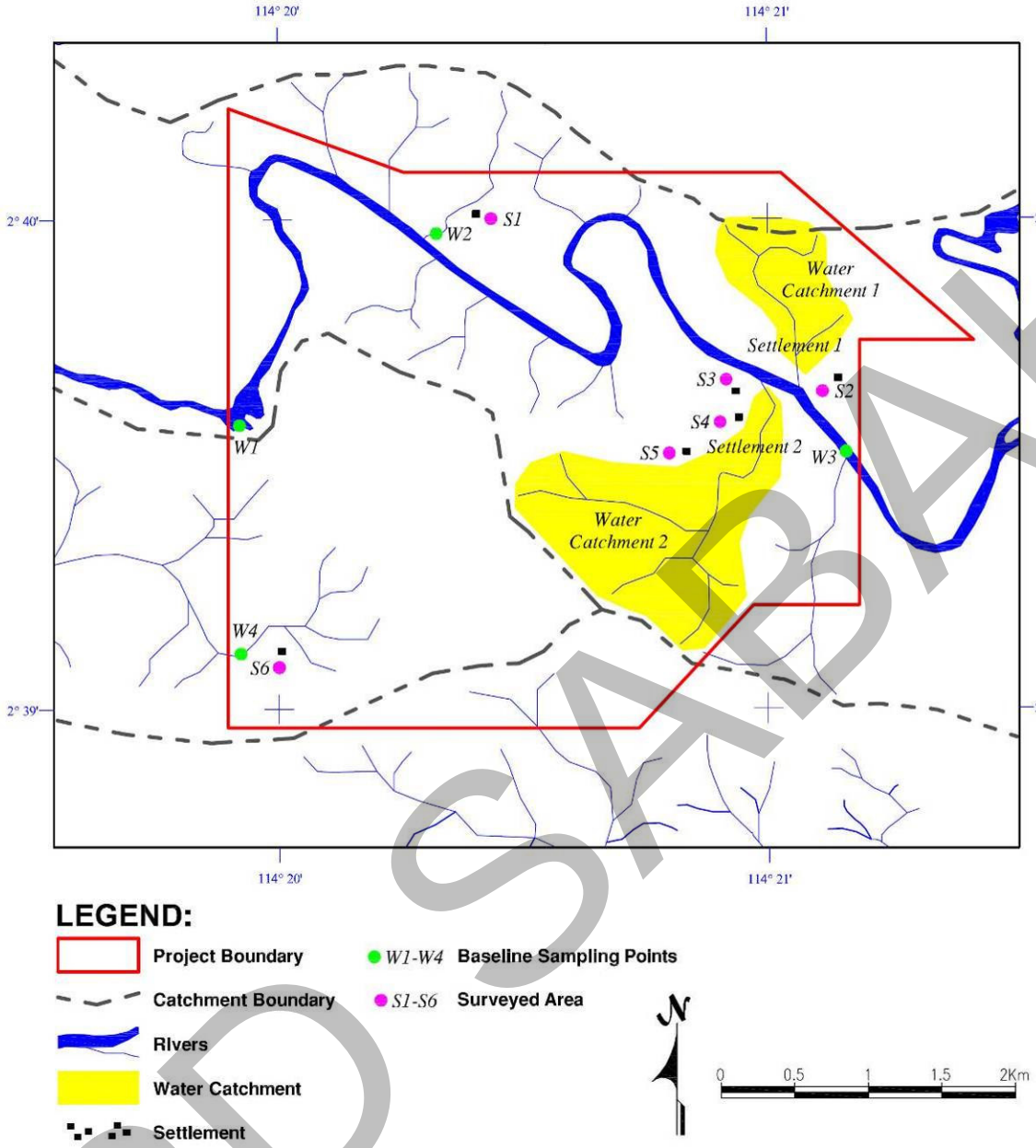


Figure 5-5: Locality map with environmental sampling points and community survey points

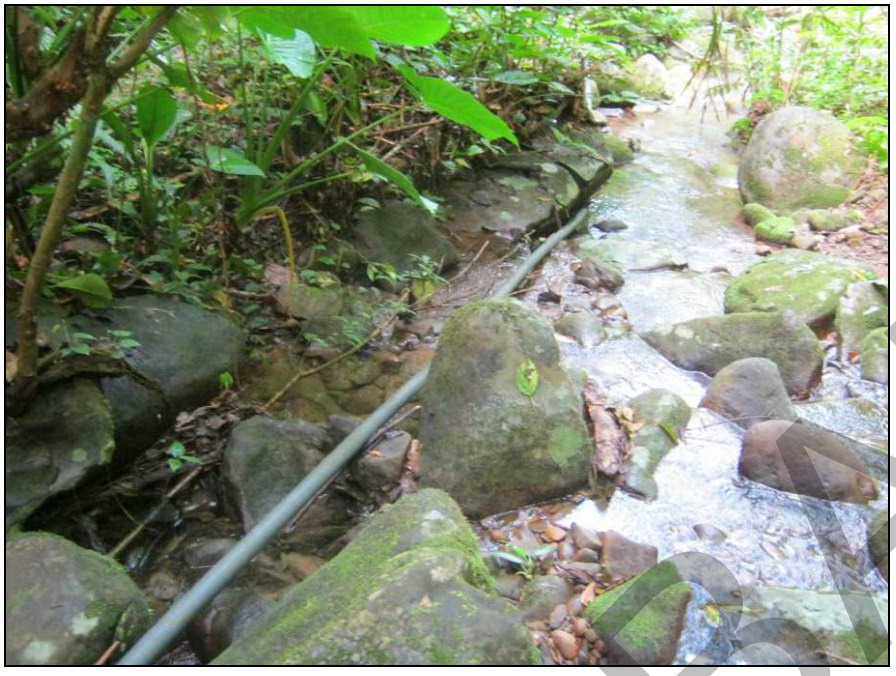


Plate 5-1: Typical gravity water pipeline

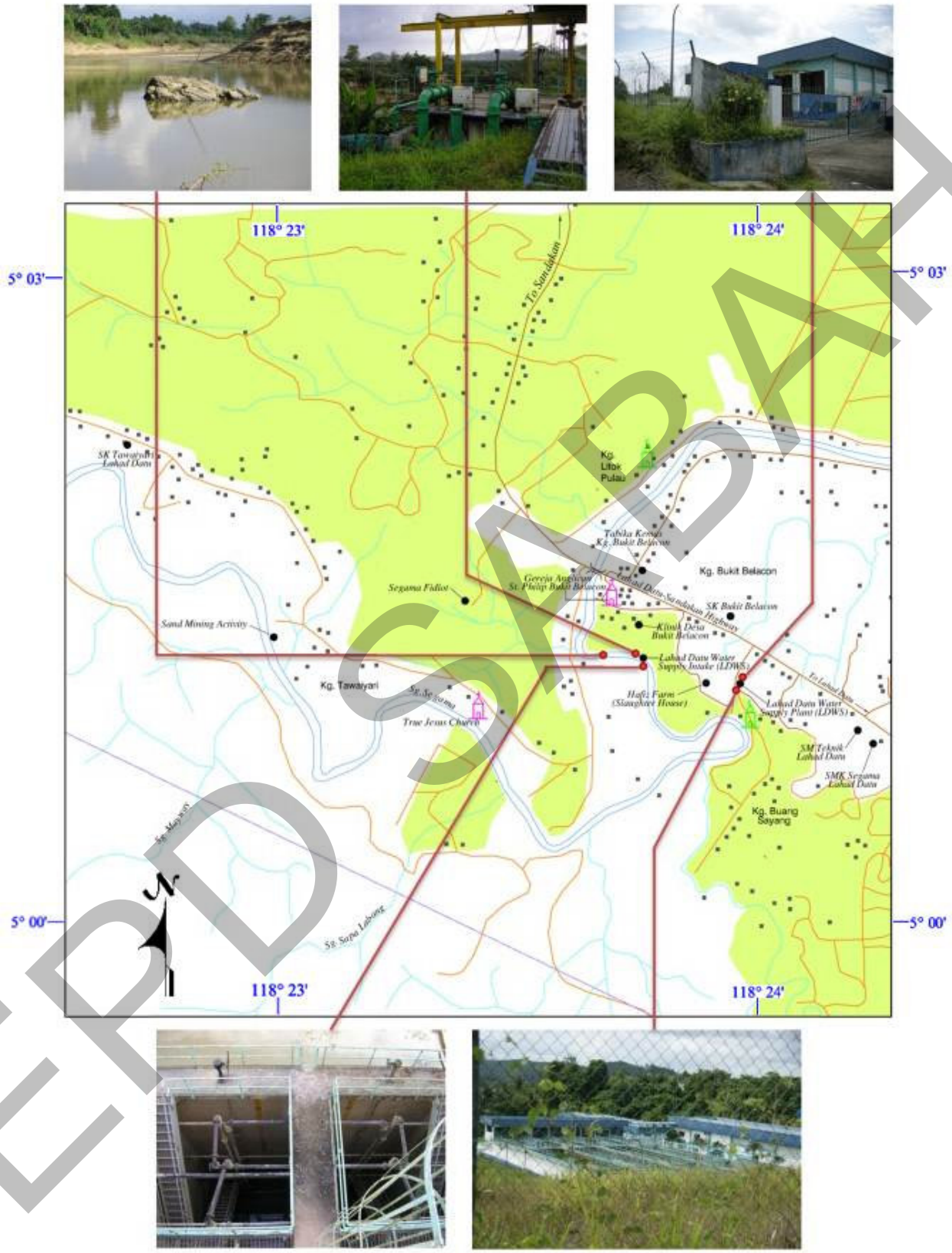


Figure 5-6: Photographic data used to supplement the assessment

5.3.5 Land Development on Flood Plains

A floodplain is a particular type of valley floor, formed through lateral and vertical accumulation of alluvial sediments and inundated in perhaps two years out of three – unless protected by a flood defence scheme. In built up areas, lateral channel migration is usually precluded by buildings and infrastructure located close to the channel. Floodplains ought to be preserved but demand for land may supersede this. Hence, the environmental assessment is vital to ascertain whether or not floodplains can be developed for oil palm plantation.

The presence and extent of any natural corridor along the course of the river (riparian corridor) has long been known to provide important ecological habitat, but more recently it has been recognized that riparian vegetation has other significant effects. First, a buffer strip creates space within which river form and process can be allowed to adjust freely, reducing the need for engineering stabilization and heavy maintenance. Second, it reduces near-bank flow velocities. Experience has shown that bank instability often occurs when the buffering effect of riparian vegetation is lost because cultivation extends right up to the bank edge. Third, it intercepts and reduces surface runoff, reducing the potential for erosion by drainage over and through the bank. Fourth, riparian vegetation and the presence of a natural vegetation corridor around the channel are important scenic elements that add significant aesthetic value to any landscape.

Assessment Methodology:

An assessment of the river channel form may provide some useful information for planning. The extent of a flood plain can best be determined from geomorphological data i.e. site visits combined with aerial photograph interpretation. It is relatively simple to identify old river channels and flow paths from aerial photographs. A site survey would also help to visually determine signs of recent and historical floods e.g. vegetation damage, vegetation trash lines and vegetation communities.

In some instances information on the flood history of the area may be obtained from the Department of Irrigation and Drainage (DID) as well as by interviewing local peoples.

Demarcation of flood plain

An estimate of the extent of the flood plain should be demarcated for the proposed plantation and the flood risk areas for specified return periods should be marked e.g. 1 to 5, 10, 50 year floods. The flood plain area should

be mapped on the topographic or river catchment base map. Refer to Plate 5-2.

Plate 5-2: Flood plain areas

5.3.6 Drainage of Land (Wetlands)

Wetland environments are heavily influenced by the pattern of water movement. Once water is drained out of peat soils, the structure of the soil is irreversibly changed. In dry conditions, peat soils become a fire hazard.

Drainage projects in wetland areas can affect a wider area than originally intended. Although drainage is usually intended to remove surface water and lower the water level of the water table to support agriculture or assist in flood mitigation, these modifications may impose physical, chemical and biological impacts on the overall wetland environment, well beyond the project boundary.

When waterlogged sulphidic soils become exposed by drainage, oxidation of the iron sulphide produces sulphuric acid, which further reacts with other natural compounds. When these find their way into streams, they have the potential to be lethal to many wetland life forms.

Subsidence is another problem associated with drainage of peat soils, which have a structure not dis-similar to that of a sponge. When the peat soils dry out, the internal voids that constitute their water holding capacity are easily compacted under mild loads. Thus, any drainage or working of these soils results in consolidation and subsidence of the surface. In low-lying areas, this can lead to increased frequency of flooding, increased salinity due to the inflow of sea water (if in coastal environments) and the destabilisation of buildings and structures. Changes in the balance of saltwater and freshwater in the river systems will affect the productivity of a site.

Assessment Methodology:

If it is proposed to drain a project location or part thereof, then it is a requirement that an agricultural or drainage engineer is consulted to assess and report on the following:

- Identify specific areas within the project area where, if drainage and disturbance took place, adjacent habitats would be threatened.
- Identify potential threats to the project area due to drainage and land use change in adjacent lands.
- Identify sites (soils) that if drained would result in acid sulphate conditions.

5.3.7 Water Pollution due to Use of Agro-Chemicals

Deterioration in water quality within plantations may occur due to infiltration of chemicals following the application of fertilisers and usage of agro-chemicals such as pesticides and herbicides. Excessive levels of chemicals can seriously affect aquatic life and freshwater supply.

The application of artificial fertilisers can lead to a marked increase in the nutrient concentrations of water draining from the fertilised areas. The main elements compounded in fertilisers are nitrogen (N), potassium (K), phosphorus (P) and magnesium (Mg). Fertilisers find their way into the natural watercourses via a few processes:

- They are eroded away together with the surface soil and washed into the watercourses.
- Leaching conveys soluble compounds into the groundwater.
- Runoff carries both soluble and insoluble compounds into surface watercourses.

Nitrogen and phosphorus will have a significant impact on water quality. Nitrogen is mainly supplied bound in the forms of ammonium and/ or nitrate compounds, and urea. Both ammonium compounds and urea are eventually converted into nitrate in the soil under well-drained conditions. Nitrate, being soluble in water, will easily enter the river system if precautions are not taken. Excess nitrate promotes undesirable growth of aquatic micro flora in watercourses (eutrophication). Eutrophication in turn depletes dissolved oxygen, imparts undesirable tastes and odours in the water and clogs water supply intakes. High nitrate concentrations in drinking water can result in methemoglobinemia, a potentially fatal disease in infants.

Phosphorus in the form of phosphate has the same eutrophication effect in surface water as nitrate, causing excessive wanton growth of algae, stopping sunlight from reaching aquatic life in deeper water. However, phosphate is less mobile than nitrate. Therefore, leaching loss of phosphate is small. Loss is mainly through runoff and soil erosion.

5.3.8 Pests

There are two types of pests, namely vertebrates and invertebrates. Vertebrate pests normally consist of rats, porcupines, squirrels, monkeys, pigs, elephants and birds, whereas invertebrate pests are nematodes, ants/ termites, slugs/ snails, grasshoppers, wasps/ bees, beetles (leaf miner, weevils, cockchafers), oil palm bunch pests, sucking insects and leaf-eating caterpillars. Invertebrate pest infestations may occur when large amounts of biomass are left on site to degrade naturally i.e. zero burning method. Under such conditions not only will the growth and production of palm trees be severely affected, intervention by using extra amounts of pesticides will be necessary, which in turn may be a cause of water pollution. The presence of large quantities of biomass will also provide shelter for certain pests such as rodents, which will forage on available palm fruits and thus create the necessity to provide some form of control i.e. chemical or biological. Again, chemical control may become a source of water pollution.

5.3.9 Land and Water Pollution from Hazardous Materials

The use and storage of hazardous materials such as used lubricants and agrochemicals may be a potential pollution source to surface water quality and land. Appropriate storage locations and disposal procedures, specific to the material being stored, should be designed and located to prevent possible spillage and inadvertent pollution.

Assessment Methodology:

A site assessment should identify the proposed storage location and the areas downstream that will be affected if spillage or leakage were to take place. It should also include assessment of the potential amount of lubricants to be used and agrochemicals, including storage requirements and location, should also be made.

5.3.10 Land and Water Pollution from Workforce Housing

Environmental impacts that can be associated with the development of workforce housing include the generation and subsequent indiscriminate disposal of wastes and sewage which could lead to the spread of disease and other disease vectors, creating a potential health hazard to the residents and other settlements downstream. Domestic wastewater may also cause contamination of surface water rendering the water unsafe to use.

Assessment Methodology:

An assessment of the potential impact shall include the proposed capacity of the camp i.e. number of families and residents to be accommodated, the proposed location of the camp and the areas downstream that will be affected due to surface water pollution.

An assessment of pollution loading from effluent discharge should be undertaken but it should be based on the current condition of the receiving waterbody. Environmental consultants shall make value judgment first on the need prior to commencement of pollution loading assessment.

5.3.11 Peat Subsidence

Certain stretches of peat swamp forest (PSF) in Sabah may be utilised for oil palm cultivation. Due to its waterlogged nature, PSF is drained in order to make it suitable. Draining of PSF will lead to irreversible drying of surface peat and excessive subsidence. There is limited peat swamp forest area left in Sabah, therefore judging by its uniqueness and its function, any development must be planned carefully.

Assessment Methodology:

An assessment of the drainage and its sustainability (drainability study) has to be carried out by environmental consultants for oil palm plantation development in peat areas, to assess whether the drainage is sustainable or otherwise. The subsidence rate of peat will have to be determined by soil experts. Given the optimal water table for oil palm, and given the thickness of

the peat layer, the subsidence rate can be used to assess the sustainability of the peat soil.

For peat soils, the prime requisite for agricultural development is their long-term drainability on a sustainable basis. A peat soil area can only be economically drained if the mineral subsoil level is above the mean water level (MWL) in the nearby stream, river or sea, into which the drained water will be discharged. This is because of the unique properties of the peat, which will decompose and subside once drainage is improved. If the mineral subsoil level is below the MWL, continued drainage will eventually cause the ground surface to subside to a level that approaches the river level, thus making further drainage by gravity impossible.

In view of this, it is imperative that peat depth and level surveys are undertaken before the agricultural suitability of a peat soil area can be reasonably determined:

- Soil augering will be done with a special extension peat auger at an interval of 100-150 m right down to the underlying mineral substratum. Attention will particularly be paid to peat depth, nature of the mineral substratum, depth of groundwater table, presence or absence of sulphidic materials.

- Along the same transects where peat depth has been determined, a ground and water level survey will also be undertaken. Spot heights will be measured at an interval of 25 m. A temporary benchmark will be established at the starting point of each transect along the riverbank. The elevation of the benchmark will be related to the “high water” and “low water” levels of the river.

- In the field, other relevant information like land use, vegetation, drainage conditions, and micro-relief will also be recorded.

- The highest and lowest daily river level (usually the river where main drains flow to) will be monitored. The water level will be measured during the period of survey at the transect lines. The high water level will be identified through flood marks on the tree trunks or other indicators.

- The ground level shall be related to the Lands and Surveys Department datum if it is found within reasonable distance to the transect concerned. Otherwise, the transect level shall be based only on an arbitrary datum.

Once the above is complete, an assessment on the drainability of the study area and an appraisal of the potential of the proposed site for oil palm

plantation development will be carried out. Subsequently, the optimal water management system can be determined to ensure the timely removal of excess water.

5.3.12 Emission/ Sequestration of Greenhouse Gas

As oil palm plantation development generally involves the clearing of large existing forest cover, it alters the carbon balance through decomposition of forest products and waste and altering the forest's capacity for carbon sequestration.

Assessment Methodology:

In view of this development, air quality is assessed based on the amount of CO_2 released into the atmosphere and the methods for calculation and reference rates of carbon contents, decomposition rates and others are regularly published by the Intergovernmental Panel on Climate Change, national and international research centres and NGOs. The methods currently (2012) applied include:

- Estimation of carbon standing stock – both above ground and below – based on reference figures for similar vegetation. Roughly, dry biomass is composed of 50% carbon, so if the volume or weight of dry biomass is known from detailed surveys or from using reference material, the amount of carbon held in the biomass can be estimated.

- Estimation of emission rates for the forestry products is based on estimated life cycles of the products (paper, energy wood, timber) and waste left in the forest. If the proportion of the biomass which is utilised for various products is known, and if the environmental consultant estimates that e.g. paper has a life cycle of 2 years, timber 20 years, then the annual emission of carbon can be calculated. This must then be converted to tons CO_2 by dividing by 12 (the atomic weight of carbon) and multiplying by 44 (the molecular weight of carbon dioxide).

- Estimation of sequestration rates for the new vegetation to be created by the oil palm plantation development. Again this is estimated based on the area and nationally acknowledged reference rates of sequestration for that particular management regime.

- Methods for integrating and modelling, including the combined impact of all of the above.

5.3.13 Impacts from Nursery Establishment

The establishment of a nursery involves the clearing of land to plant the seedlings. Typically, the site area depends on the total size of the oil palm plantation. However, impacts from the nursery would be similar to plantation establishment i.e. land clearing, potential ecological impacts, agro-chemical usage impacts.

5.4 Additional Impacts

The list of potential impacts above is non-exhaustive as the environmental consultant must extend or shorten the list of issues depending on local conditions. The discovery of particular key conservation value areas or particular sensitive habitats will require the inclusion of new issues while other issues may not be applicable for that particular project.

6 Mitigation Measures

This chapter covers identification of the major mitigation measures for the environmental impacts identified (refer to Table 6-1).

Table 6-1: Assessment Procedures - Description of Mitigation Measures

The Seven Steps	Summary of Main Required Activities
Step 4: Undertaking the EIA/ PMM study	Environmental Consultant: • *Assess the project details* • *Assess the existing environments* • *Assess the environmental impacts* • *Devise and propose mitigation measures* - *Provision for habitat and wildlife protection/ conservation* - *Provision for soil erosion control measures* - *Management of waste generated* - *Reducing adverse impact on settlements* - *Zoning of flood prone areas* - *Limiting carbon emission from land clearing* • *Devise and propose monitoring programmes*

The previous section included a description of methods for assessing planned activities and their impact on the environment. It also points out that there may be impacts from necessary and unavoidable activities, which were not included in the project plan and description. Mitigation measures therefore address three different scenarios:

- Proposals for improved technologies or methodologies for planned activities in order to minimise their negative environmental impact, e.g. use of reduced impact machinery, provision of river reserves, or exclusion of fragile and high risk areas.

- Proposals for management activities, which are not included in the Project Proponent's original plan of activities but which are necessary in order to control environmental degradation, e.g. waste management, drainage, soil erosion control practises, wildlife management.

- Proposals to compensate for unavoidable, residual impacts, e.g. off-set planting, community development programmes or a specific contribution towards local conservations or offsets.

The environmental consultant should assess the adequacy of the measures to alleviate or mitigate negative environmental impacts planned by the Project Proponent. Where the Project Proponent's measures can be strengthened or where they are seen as insufficient, the environmental consultant should propose mitigation in the form of proposals for alternative technologies, methodologies or scope of work. Addressing the key physical impacts prior to design finalisation is essential to the sustainability of the overall design concept. For residual impacts, the environmental consultant should, where appropriate, propose mitigation measures to compensate for the effects of the impacts.

The environmental consultant should for each foreseen impact and for each proposal for changes to scope, technology or methodology assess the risk level and magnitude of all expected residual impacts and state these clearly in the Environmental Assessment report.

In addition, there are requirements, which are imposed for administrative reasons. These include employment of an environmental officer, provision of maps and other information, which may be necessary for environmental monitoring.

It is, however, important that the Project Proponent and the environmental consultant together use the latest knowledge and development in the respective fields, in order to devise a project and site specific plan for environmentally sound management and associated mitigation. The pointers included in this guideline should not be seen as a complete, ready-made, direct solutions, but rather as principles of mitigation.

At the same time, it must be stressed that any combination of site, technology and methodology will warrant a unique set of mitigation measures.

6.1 Key Mitigation Measures

6.1.1 Ecological

The mitigation measures that can be considered for ecological impacts include (but are not limited to):

- **Matching of Project Boundary with Water Catchment Boundary**

Project boundary demarcation and alignment frequently does not follow the local topography and water catchment boundaries. This condition will make it difficult in terms of controlling environmental impacts since pollution sources may be external to the project location.

Boundary demarcation can facilitate control of potential environmental impacts such as fragmentation, severance and the like. This can be achieved when topography is given due consideration when assigning the plantation boundary. Thereafter, the identification of environmental impacts and their related control/ mitigation measures can focus on the Project Proponent's operations residing in a given catchment. This will also facilitate enforcement as well as clearly defining the spatial responsibility of the Project Proponent.

Assessment and proposals for mitigation measures for demarcation of water catchment as boundaries have to be made. The following can be used as a guide:

Step 1: Mapping. From the assessment exercise, overlay the proposed plantation boundary onto the topography map

Step 2: Adjust boundary. If necessary adjust the project boundary to follow the catchment boundaries. Initiate administrative procedures to adjust the boundary of the proposed project location. Ideally, this should be done during land alienation or land use planning at the very early stage.

- **Buffer Zones for Protected Areas**

The impacts of oil palm plantation development on the biodiversity of nearby protected areas can be minimised by provision of clearly demarcated buffer zones between the plantation site and the protected area. The width of the buffer must be determined based on the values to be protected and the level of threat from the plantation. The mitigation measures must include permissible land use practices within the buffer zone. This will depend on type of protected area, vegetation and topography of the buffer or occurrence of wildlife.

6.1.2 Soil Erosion

The mitigation measures that can be considered for the management of soil erosion include (but are not limited to):

- **Zoning of High Soil Erosion Areas**

Exclusion of high risk soil erosion areas (refer to Plate 6-1) or very steep slopes from plantation development will substantially reduce soil erosion rates and thus maintain water quality. Excluded or reserved areas will furthermore provide natural, bio-diverse habitat for flora and fauna within the plantation area.

While zoning of high risk areas and areas of steep slopes such as slopes exceeding 25 degrees, may be made based on existing 1:50,000 topographic maps, it will be the conditions in the field that in the end count. The topographic maps are only indicative concerning topographic contours and there can be several metres of inaccuracies. High risk areas may be subdivided based on gradient, soil, vegetation or other features.

Areas including significant regions of high risk should be excised from the project plan. If the steep areas are few and isolated, then a decision may be taken to progress with the development. Intensive conversion should be restricted to low risk more gentle terrain, generally in the lower parts of catchments.

Within the high risk or increased risk areas, the environmental consultant must establish whether these areas shall be totally excluded from plantation development or whether there shall be imposed restrictions on technologies, methodologies or plantation density.

The risk areas shall be clearly mapped as shown in Figure 6-1 and described in the Environmental Assessment report. Once work is being planned in the area, the high risk areas must be identified on the ground, surveyed (Class II survey or GPS) and visibly demarcated (refer to Plate 6-2). Geographical coordinates may be extracted from maps or obtained by other means such as by GPS and listed in the Environmental Assessment report or in the associated working plans.

Plate 6-1: Slopes which are high risk erosion areas

Plate 6-2: Signboard showing steep areas

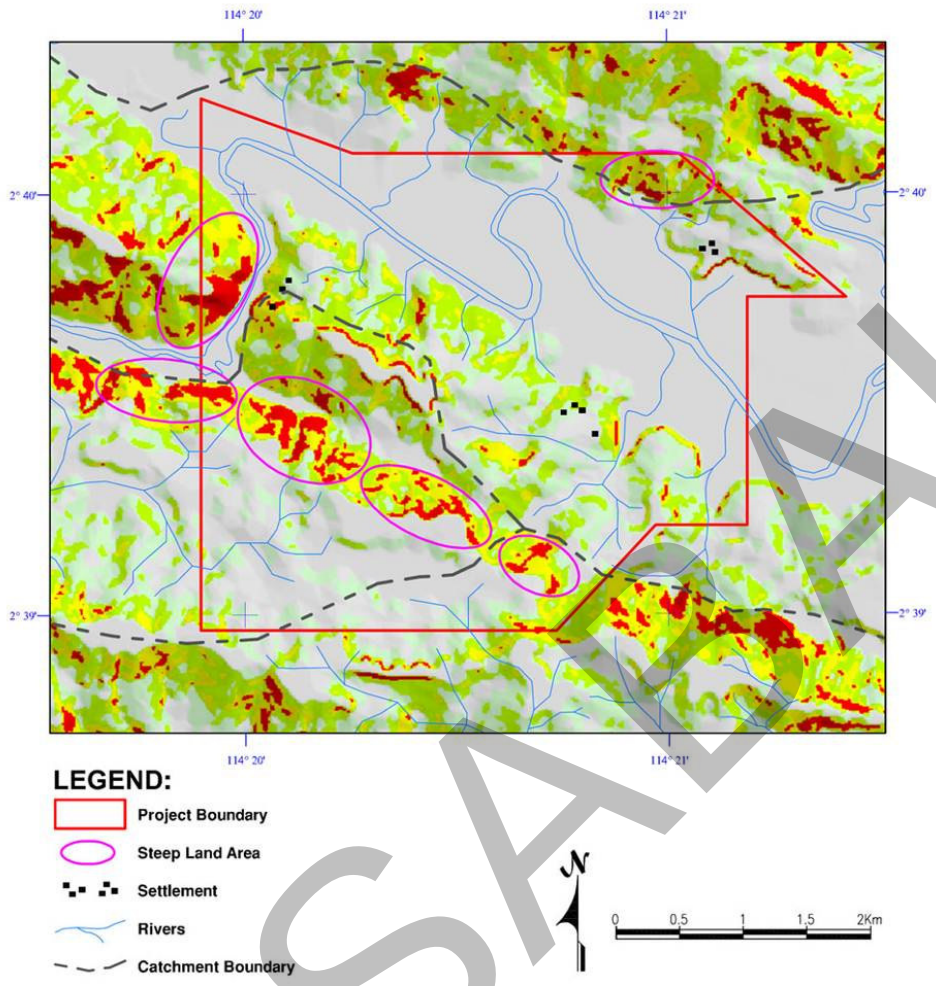


Figure 6-1: Mapping of high risk erosion/ steep areas

Replanting on slopes of more than 25 degree has to be assessed on a case by case basis. Most of the established plantations practice terracing to mitigate for slope instability and soil erosion. Hence, if replanting on steep areas cannot be avoided, then soil conservation measures such as terracing and cover cropping should be considered.

- **Zoning of River Reserves**

The impact of plantation development on ecology, soil erosion and water pollution can be minimised by the provision of river reserves for waterways affected by or related to the plantation (refer to Plates 6-3 and 6-4).

The purpose of maintaining river reserves is to minimize the amount of sediments entering the river system, to minimize erosion of riverbanks and to minimize destruction of riparian habitat. Densely vegetated river reserves may serve as natural filters for surface runoff from the plantation

areas. The reserves also play a major role in protecting the banks of the waterways from channel erosion. River reserves within the plantation area will in addition provide evacuation corridors and sanctuaries for the wildlife. These excluded areas will in the long run, and if they are wide enough, provide habitats for most of the original natural forest species that occupied the site prior to the plantation development thus preventing their local extinction. In addition, the reserves maintain an aesthetic value. The implementation of river reserves will also help protect the hydrological environment.

The river reserves and other corridors will also provide a breeding ground for predators useful for controlling pests such as rats in the plantations.

The border of the river reserves may be determined by a simple Class III survey (compass and tape) measuring along the surface of the terrain. Detailed correction for slope during measurement is not necessary.

The environmental consultant must make precise recommendations for the appropriate width of river reserves. This will be dependent on the river conditions, topography, vegetation, wildlife populations and connectivity to other corridors. Some general guidelines have been issued by the Sabah Forestry Department and Department of Irrigation and Drainage. These guidelines by other departments are in general supported by EPD as minimum requirements. The law requires a 20 m reserve on both banks of rivers exceeding 3 metres width.

- Sabah Forestry Department requires 2 x 30 m reserves for rivers exceeding 5 metres width and 2 x 5 metres for rivers less than 5 metres width in forest reserves.

- For ***alienated land and state land*** operations, the Department of Irrigation and Drainage requires:

More than 40 m:	minimum 50 m river reserve
Between 20-40 m:	minimum 40 m river reserve
Between 3-20 m:	minimum 20 m river reserve
Less than 3 m river:	minimum 5 m river reserve

The identification of river reserves must be done based on conditions in the field rather than on maps only. The identified reserves must be included on operational maps to be submitted to EPD.

Plate 6-3: Signboard showing river reserve

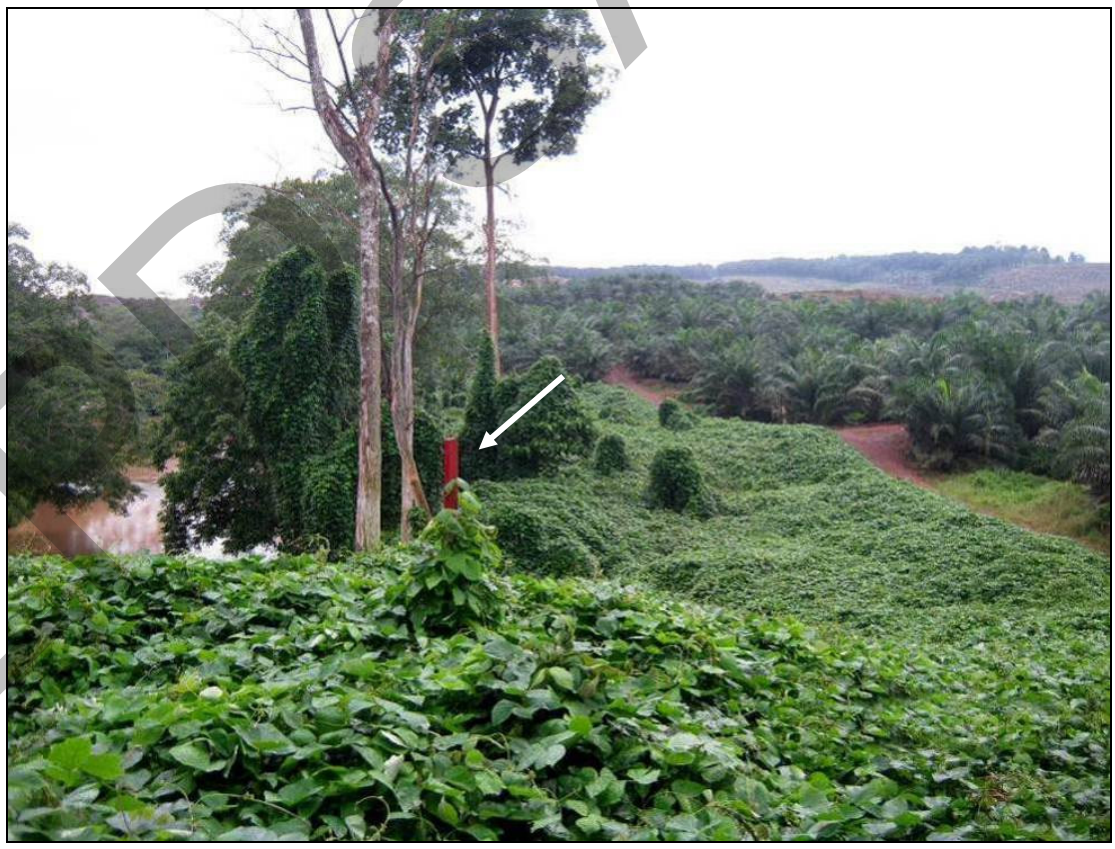


Plate 6-4: Demarcation of river reserve with red paint

- **Soil Erosion Management**

  Soil conservation practices will minimise or eliminate the impact of soil erosion within the plantation, which in turn will prevent related impacts such as deterioration of water quality and aquatic habitat and sedimentation of rivers due to high suspended solid content in stream and river water.

  A major step is recognising the potential soil erosion risk sites and the subsequent zoning of areas. Areas comprising significant regions of high soil erosion risk – steep areas - shall be excised from the project. Provision of river reserves also contributes to reduced soil erosion.

  Thereafter, the key mitigation measure is to minimise ground disturbance during clearing and site development operations. Mitigation measures should focus on reducing the land area disturbed and reducing the time of soil exposure after disturbance.

  Assessment and proposals for mitigation measures for reducing soil erosion have to be made. The following can be used as a guide:

  - **Reducing time of soil exposure after disturbance.** The forest conversion schedule should minimise the time between harvesting, conversion and planting, thus minimising the period of exposure and increased erosion risk. Large exposed areas may be re-vegetated with fast growing ground cover species such as *Mucuna bractiada*, *Centrosema pubescens*, *Calopogonium caeruleum*, *Calopogonium muconoides*, *Pueraria phaseoloides* and *Pueraria javanica* or indigenous species of the same attributes (refer to Plate 6-5). Ground cover not only protects against soil erosion but if leguminous plants are used, they also enrich the soil through their nitrogen fixing abilities. Exposed areas where planting of cover crops is not favourable (e.g. road sides) may be compacted as soil in large particles are more resistant to transport by erosive agents because of the greater force required to mobilise them. Compaction or other soil management practices may be implemented to reduce as much as possible detachment of soil particles. Practices intended for use should be clearly stated in the Environmental Assessment report.

  - **Use existing access roads and construction along contour lines.** Reducing the area of disturbed land may be achieved by minimising fresh clearing for access roads through improvement and use of existing timber tracks within the area. Access roads constructed

during nursery establishment and site preparation stages can be based on existing logging tracks in order to minimise or prevent fresh clearing of vegetation and disturbance to soil. Existing and new road should be clearly marked in the Environmental Assessment report.

- **Provision of surface runoff control measures.** Providing a drainage system for effective conveyance of surface runoff away from disturbed areas will minimise the extent of erosion (refer to Plate 6-6). For plantation nurseries, roadside drains and culvert berms may reduce soil erosion. River reserves can further retain direct discharge of eroded soil particles into the waterways. However, for areas that have been cleared for large blocks of oil palm plantation, a sedimentation pond that corresponds to at least 5 to 15% of the total cleared area may be constructed to retain the surface runoff and allow for the deposit of sediments from eroded soils, prior to discharge of surface water into the waterways. Any intended application of surface runoff control systems should be clearly indicated in the Environmental Assessment report.

- **Contour planting and terracing.** Contour planting and terracing may contribute to minimizing soil erosion as these measures enhance slope stability.

Plate 6-5: Cover crops for prevention of soil erosion

Plate 6-6: Drainage system for surface runoff control

A soil erosion management plan that details temporary measures should be incorporated during the plantation establishment stage and may

subsequently lead to permanent measures once plantation development is complete. The soil erosion management plan should have the following general information:

- Narrative and mapping on project location and site description;
- Narrative and mapping on proposed project development; and
- Narrative and mapping on erosion and sediment control including the calculation of soil loss, sediment yield and BMP design.

The soil erosion management plan must at least contain the following components:

- Report;
- Site plans;
- Engineering drawings; and
- Inspection and maintenance plan.

6.1.3 Biomass Management

Burning of debris and clearing waste during the development stage of an oil palm plantation is currently prohibited in Sabah. Zero burning will eliminate air pollution impacts (smoke), reduce forest fire risks, and result in better soil conditions and more productive growing sites.

Assessment of and proposals for mitigation measures for management of biomass generated have to be made. These include consideration on temporary stockpile location, amount and disposal method which may also include onsite natural decomposition (refer to Plate 6-7 and 6-8).

Plate 6-7: Vegetative wastes from site clearing left to decompose

Plate 6-8: Pruned fronds left on site to decompose

6.1.4 Socio-Economics Enhancement

The mitigation measures that can be considered for socio-economic impacts include (but are not limited to):

- **Form Joint-Venture with Local Community**

  When the native rights have been established, recognising those rights is the main measure to mitigate potential social impacts relating to land ownership issues. Recognition of rights may be further enhanced through formation of a joint-venture between the Project Proponent and interested landowners to develop their lands in tandem with the plantation development. This approach will reduce potential conflicts due to land matters and helps to provide an additional source of income for the affected people that may be translated into improved standard and quality of living.

  Formation of joint-ventures between the smallholders and Project Proponent may be implemented by:

  - *Identifying the plantation area that comprises native land*. The areas shall be properly surveyed and marked on the ground. The extent of the area shall then be determined and the coverage incorporated into the overall plantation plan.

  - *Exclusion of native land area from land title*. Based on the information from above, the Project Proponent may now appeal to the Lands and Surveys Department for exclusion of such areas from the land title and thus reduction in land premiums as well as other payments related to holding the land. On the landowners' side, this information will confirm their land tenure security and define their role in the joint-venture.

  - *Development arrangements*. Prior to execution of the joint-venture, the following aspects shall be clarified between the Project Proponent and the smallholders: distribution of development costs, distribution of profits and possible employment of smallholders as workers and/ or service providers on the plantation.

- **Securing Water Supply**

  Exclusion of water supply catchment areas from plantation development is one of the best approaches to eliminate or minimize the social impacts arising from plantation development. However, if exclusion cannot be implemented or water quality is eventually impacted, the Project Proponent shall be responsible for providing alternative water supply for the affected community.

Assessment and proposals for mitigation measures for local water supply have to be made. The following can be used as a guide:

Mitigation A. Exclusion of water catchment areas:

- Water supply areas shall be clearly identified on a map (refer to Figure 6-2) and GPS waypoints should be supplied. The boundaries of the local water supply catchment areas have to be agreed upon by the Project Proponent and the claimants. The Lands and Surveys Department should be involved in these negotiations. The area should be clearly demarcated in the field e.g. with rentice and/ or stakes as determined by the environmental consultant.

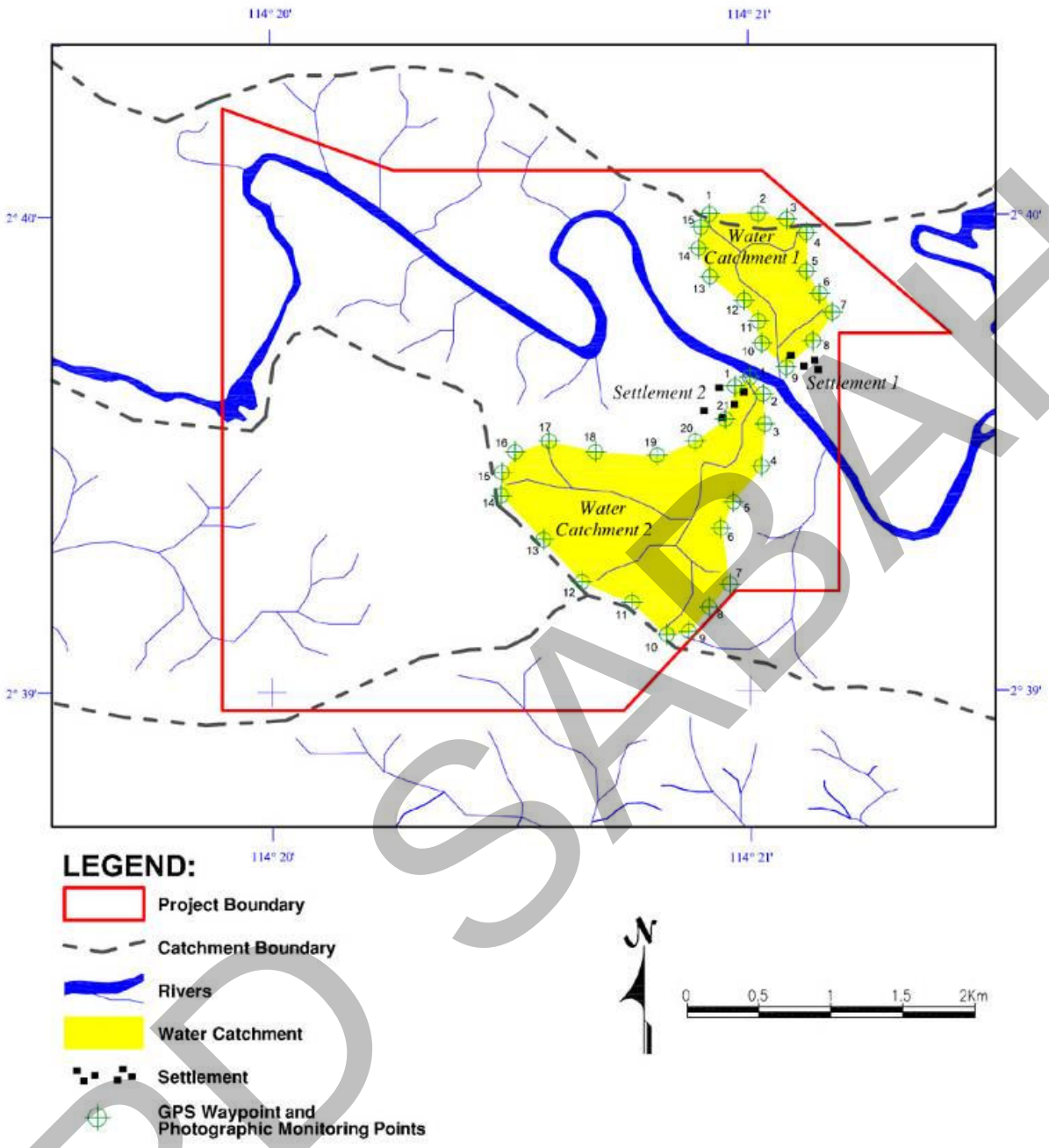


Figure 6-2: Identification of water supply catchments together with GPS waypoint locations

Mitigation B. Alternatives for local water supply

- If nearby government piped water mains are available, the Project Proponent may assist the affected local communities to be included in the water supply scheme by making the necessary arrangements with the relevant agencies. If there are no piped water mains nearby, but there is a reservoir accessible to the affected communities, the Project Proponent can assist in providing the necessary resources (e.g. funds, cost, labour and materials) for the

water supply to be extended to the affected community. However, before decisions are made to implement this alternative, the following shall be investigated:

- (a) *Catchment capacity* – The catchment capacity shall be determined in terms of water quantity and sustainability. Water quantity needs to be ascertained as the size of the catchment will determine the number of communities it can support.

- (b) *Water quality* – The quality of water from the reservoir for the supply scheme shall be determined to ensure that it is potable and fit for human consumption as well as other domestic uses. Water quality analysis can be carried out and the results shall be compared to the WHO (World Health Organisation) drinking water standards. Any variations from the potable water quality will result in the need for treatment prior to use. At this stage, the Project Proponent may initiate assistance and support from the relevant Government agencies including State Water Department for further implementation.

- If piped water mains and water reservoirs are not available, a remaining option would be to improve the rainwater collection capacity. This can be implemented by providing rainwater collection drums and tanks.

- Considering the difficulties in implementing alternative approaches, it is logistically more feasible to exclude existing water catchment areas from plantation development.

6.1.5 Flood Mitigation

The flood mitigation measures that can be considered include (but are not limited to):

- **Zoning of Flood Prone Areas**

In addition to zoning of river reserves, the floodplain assessment may identify areas that are frequently inundated. The consequences of planting in such zones should be brought to the Project Proponents attention. Frequently inundated areas should be excised and demarcated in the field as with other zoning exercises. Refer to Plate 6-9.

Plate 6-9: Inundation of oil palms in flood plains

- **Maintenance of Waterways**

  Waterways on site should be maintained and kept clear from any blockages in the form of vegetative wastes. Removal and disposal of blocking materials should be incorporated into the plantation work schedule to ensure smooth conveyance of surface water and to prevent flash floods on site. Refer to Plate 6-10 and Plate 6-11.

  Stream crossings (bridges and culverts) should be provided where natural waterways within the oil palm plantation are affected. This approach will prevent the occurrence of flash flooding as well as reducing erosion in the waterway. Use of available logs on site (during site preparation stage) to construct temporary crossings can further justify the need to sort and recover useable biomass generated by plantation land clearing operations.

Plate 6-10: Vegetative waste obstructing the waterway flow

Plate 6-11: Obstruction of stream flow due to near collapse temporary crossing

6.1.6 Handling and Usage of Agro-Chemicals

Excessive usage and untimely application of agro-chemicals not only results in higher operating cost but also pollution of surface water systems. Manure/ fertiliser application should be based on the palms' requirements (i.e. through foliar sampling and analysis). Use of pesticides, herbicides and others should be minimised, restricted to the oil palm stands only and limited to serious cases of infestation. Priority should be given to biological control and manual weeding.

In brief, for pest control as far as possible use of agrochemicals should be taken as the last resort and biological control should be given priority. If use of agrochemicals is inevitable, controlled usage should be implemented with emphasis on the amount and timing of application, and proper training programmes for those handling and applying these substances Refer to Plate 6-12.

Plate 6-12: Use of plastic during fertilizer application to minimise leaching by surface runoff

6.1.7 Pest Control

When carrying out zero burning method for biomass disposal, pests such as rats and termites may become a concern. The mitigation measures for control of pests include (but are not limited to):

- Providing breaks within the alignment of the biomass windrows to prevent any potential for extensive infestation.

- Controlled usage of pesticides, particularly when infestation is extensive.

6.1.8 Management of Hazardous Materials

In the operation of an oil palm plantation, there are two types of materials that are of environmental concerns, namely the agrochemicals (pesticides, herbicides and fertilisers) and oil/ grease wastes. Both materials can be a source of significant water pollution.

Oil and grease wastes and mishandling of used lubricants or other petrochemical products such as fuel and fuel enhancers may result in episodic pollution. The mitigation measures that can be considered to minimise pollution from these materials include (but are not limited to):

- **Agrochemicals** – Used containers to be returned to suppliers or collected for approved disposal – the disposal procedure should be described.
- **Used lubricants** – These should be collected for recycling (if suitable) and/ or disposed of as scheduled wastes.
- **Fuel dispensing** – This should be carried out at a bunded area to prevent spillage and to contain any spills (refer to Plate 6-13) and handled by trained and experienced personnel.
- **Containers for fuel and fuel enhancers** – These should be collected and disposed of using approved procedures.

Plate 6-13: Properly bunded skid tank on concrete flooring and roofed

6.1.9 Waste Management of Workforce Camp

Improper sanitation facilities may lead to disease outbreak (either air-borne, water-borne or vector-borne). Adequate sanitation facilities that can be provided include:

- Toilets with septic tanks that are maintained regularly to ensure their effectiveness (refer to Plate 6-16).
- Domestic waste disposal system that is capable of ensuring proper disposal, prevention of scavenging by rodents and other scavengers. This may include provision for waste pits. Waste segregation facilities should also be provided to encourage recycling practise (refer to Plate 6-14).

It is important that the Project Proponent allocates sufficient funds for providing adequate facilities for the plantation population (refer to Plate 6-15) and ensuring good housekeeping practice is implemented at all times.

Plate 6-14: Waste segregation facilities to encourage recycling

Plate 6-15: Good housekeeping practise within the workers' quarters area

Plate 6-16: Sanitary facility provided for onsite workers

6.1.10 Emission/ Sequestration of Greenhouse Gas

Greenhouse gasses are emitted from energy production and from removal of vegetation. The mitigation measures that can be considered for greenhouse gas emissions include (but are not limited to):

- **Limit New Areas Opening** – Clearing of land for the plantation development should be done in phases.
- **Electricity Supply** – Make preference for electricity to be procured from the grid rather than from independent diesel generators.
- **Renewable Energy** – Use of renewable energy sources such as solar or hydro power.
- **Strict Control** – Implementing strict control on equipment with combustion engines, from chainsaws to large earth and vegetation moving equipment.
- **Drainage** – Drainage of all areas of impounded water to avoid formation of methane.

6.1.11 Others

Assessment of and proposals for mitigation measures for other environmental impacts arising from oil palm plantation development should include:

- Consideration on proper drainage system for development on peat areas.

6.2 Residual Impact

It is unavoidable that there will be some adverse impacts from the oil palm plantation activities even if these are carried out with every intention of avoiding or minimising such impacts.

There will be soil erosion with subsequent siltation of waterways as a result of clearing, harvesting, quarters construction or road construction. Cleared areas will lead to loss of natural wildlife habitat and subsequently reduce the wildlife population in that particular area. Such impacts, the risk and the magnitude must be assessed as part of the assessment procedure.

6.2.1 Off-set of Residual Impacts

Residual impacts relating to the emission of greenhouse gasses or loss of biodiversity/ habitat may be countered by off-set activities elsewhere. Particular key conservation value habitats or carbon sinks may be protected or restored elsewhere. Such off-set activities may balance the impact in full or partially but should in all cases be considered.

6.2.2 Mitigation of Residual Impacts

Residual impacts are already minimised through the choice of technologies or methodologies. Mitigation is therefore only possible through compensation or substitution. Compensatory measures in terms of replacement of habitat loss, re-vegetation, alternative access to livelihoods and others are among the available options for mitigation of residual impacts.

7 Monitoring Programmes

This chapter covers the recommended monitoring programmes based on the mitigation measures highlighted for the identified environmental impacts (refer to Table 7-1).

Table 7-1: Assessment Procedures - Description of Monitoring Programme

The Seven Steps	Summary of Main Required Activities
Step 4: Undertaking the EIA/ PMM study	Environmental Consultant: • *Assess the project details* • *Assess the existing environments* • *Assess the environmental impacts* • *Devise and propose mitigation measures* • *Devise and propose monitoring programmes* - *Compliance monitoring* - *Impacts monitoring*

Environmental monitoring provides feedback on the actual environmental impacts of a project. Monitoring results will assist in the judgment of whether the environmental mitigation measures proposed are successful in reducing or eliminating negative environmental impacts. An environmental monitoring programme is also used to ensure compliance to the recommended mitigation measures and environmental standards stipulated by EPD, Sabah and other relevant agencies.

Generally, an environmental monitoring programme will involve collecting data for one or more of the following purposes (Everitt, 1992):

i. To establish a baseline, that is, gathering information on the basic site characteristics prior to development or to establish current conditions;

ii. To establish long term trends in natural undisturbed systems to establish natural baselines;

iii. To estimate inherent variation within the environment, which can be compared with the variation observed in another specific area;

iv. To make comparison between different situations (for example, pre-development and post development; upstream and downstream) to detect changes; and

v. To make comparisons against a standard or target level.

Without a monitoring system, there is no mechanism for ensuring that the specified mitigation measures are being implemented and for evaluating the success of the mitigation measures undertaken.

The environmental monitoring programme will generally comprise compliance and impacts monitoring. Compliance monitoring aims to ensure compliance to the recommended mitigation measures and environmental standards stipulated by EPD, Sabah and other relevant agencies whereas impacts monitoring provides feedback on the actual environmental impacts of a project in order to confirm that a project is meeting the agreed level of impact and that the predictions of impacts made during the environmental assessment have been accurate.

7.1 Compliance Monitoring

The environmental consultant should in the Environmental Assessment report, propose means and schedules for monitoring whether the technologies and methodologies applied in the project comply with the recommended measures and methods. This compliance monitoring plan will then, by the EPD, be used as a basis for an Agreement of Environmental Conditions (AEC) or Mitigation Declaration (MD), which is an agreement between EPD and the Project Proponent on how environmental management of the project should be optimised.

The environmental consultant must, for each of the mitigation measures proposed in relation to the environmental issues that have been identified, recommend how, when and where a monitoring can be implemented to verify that the recommendations have been followed.

EPD has also established a standardised monitoring system. The system is linked to a database within EPD. This database will store all future monitoring data from all monitoring of oil palm plantation activities.

The frequency of environmental monitoring and reporting is dependent on the stage of the project development and sensitivity of the area, i.e. erosion prone area, wildlife and social concern and is specified by the EPD through the AEC/ MD issued with the Environmental Assessment report approval.

There are requirements for submission of maps and photos to support compliance monitoring. Maps must follow standard cartographic requirements of showing geo-references, scale and north arrow, while photos must have dates and geo-reference.

7.1.1 Monitoring Techniques

Compliance monitoring will be undertaken primarily by means of the techniques listed below. This information should be submitted to EPD based on the agreed frequency of monitoring until the project is completed.

Photographs. Photographs to provide evidence of the implementation of the recommended mitigation measures. Photographs could, for example, be used to verify compliance with the following mitigation measures:

- Provision of hill/ steep land reserves.
- Provision of river reserves.
- Reducing the land area disturbed.
- Reducing the time of soil exposure after disturbance.
- Reducing dust and noise problems.
- Provision of buffer zones, corridors and protected area management.
- Proper waste handling and management facilities.
- Phased clearing and replanting.

When photographs are submitted for compliance monitoring, the exact location should be clearly marked on a map together with a GPS reading and a direction bearing. The date and time shall be noted.

Field checks. Periodic field checks at appropriate stages of the oil palm plantation development should be undertaken in order to ensure compliance with the following mitigation measures:

- Provision of hill/ steep land reserves.
- Provision of river reserves.
- Reducing the time of soil exposure after disturbance.
- Reducing dust and noise problems.
- Improved working practices/ management procedures.
- Maintaining potable water supply.

- Provision of buffer zones, corridors and protected area management.
- Proper waste handling and management facilities.
- Phased clearing and replanting.

Maps/ layout plans. Maps/ layout plans to indicate locations of key mitigation measures during implementation. These should, for example, be used to verify compliance with the following mitigation measures:

- Provision of hill/ steep land reserves.
- Provision of river reserves (see Figure 7-1).
- Provision for water catchment areas.
- Phased plantation development.
- Provision of buffer zones, corridors and protected area management.
- Provision for detailed site layout plan.

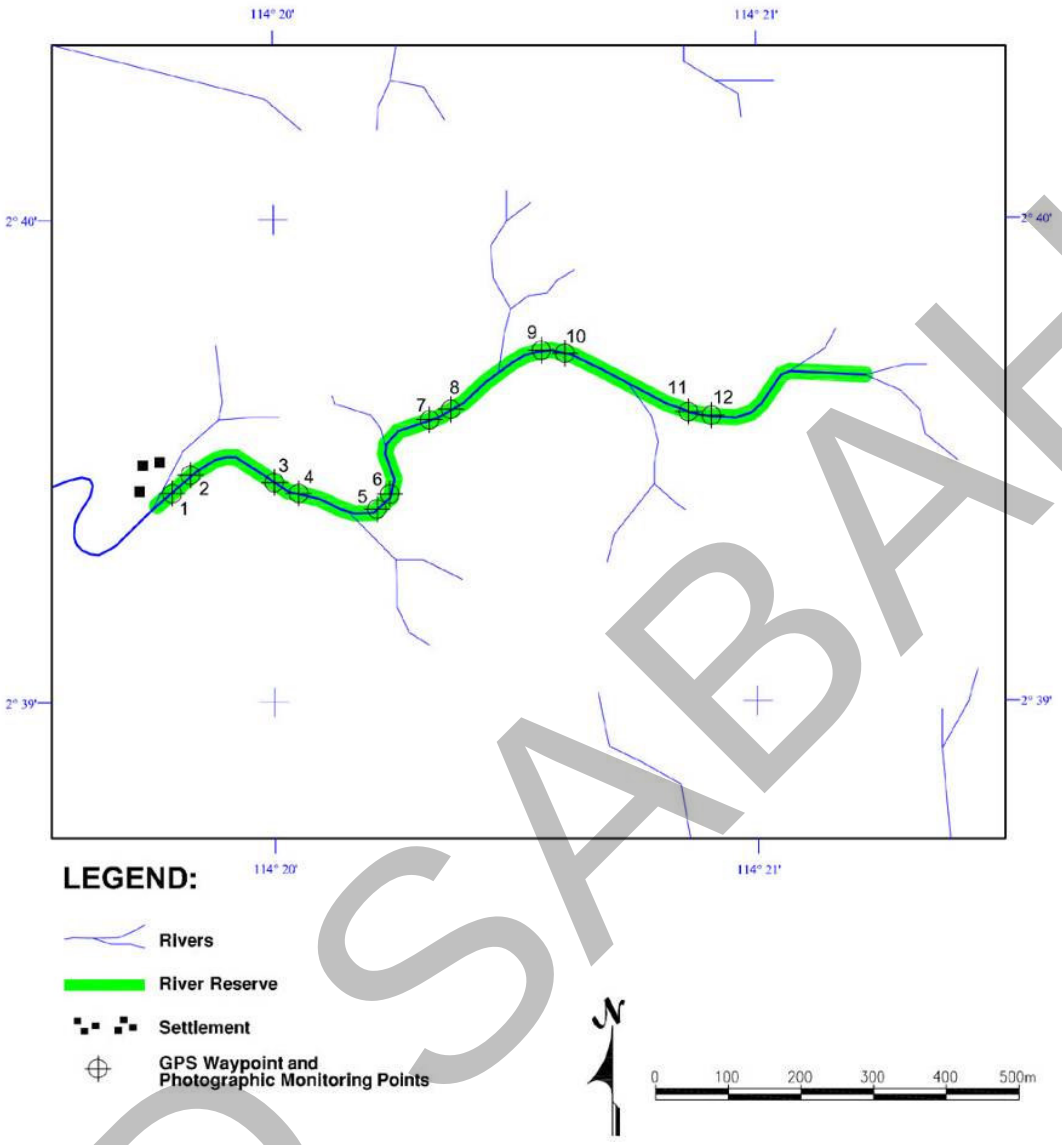


Figure 7-1: Map used to plan river reserve compliance monitoring activities

Impact statements concerning affected settlements. Periodic statements, in written or oral form, from affected settlements can be used to check compliance with the following mitigation measures:

- Provision of hill/ steep land reserves.
- Provision of river reserves.
- Maintaining potable water supply.
- Reducing dust and noise problems.

Satellite images. Larger projects or projects nearby sensitive sites, may utilize satellite imagery taken at various stages during the project life cycle to monitor compliance with the following mitigation measures:

- River reserves.
- Hill/ steep land reserves.
- Percentage area of exposed soil and vegetated zones.
- Provision of buffer zones, corridors and protected area management.

All requirements laid down in the AEC/ MD that are possible to check through the use of satellite images will be overlain on the image to check for compliance.

If satellite imagery is used, a compromise has to be made between cost and spatial resolution. An appropriate image type would be SPOT as it has a resolution of 10 metres for multi-spectral images and 2.5-5 metres for panchromatic. Most monitoring activities will benefit from the higher resolution. The land area covered by a full SPOT image is 60 km x 60 km.

Normally two satellite images will be required: One before initiation of the activity being monitored, and one (or two or more for large scale projects) after implementation of the activity. An example of a satellite image is shown in Figure 7-2.

Figure 7-2: Satellite image showing various stages of forest conversion

Scheduling and responsibilities. As the Environmental Assessment report covers the entire oil palm plantation activities, the need for images and other monitoring requirements should be planned accordingly. The monitoring programme should be formulated in advance by the environmental consultant in collaboration with the Project Proponent and their ground contractor(s) in accordance with the schedule of operations, and be approved by EPD through the AEC/ MD.

The Environmental Assessment report should clearly state the responsibilities and actions to be taken in relation to compliance monitoring, as follows:

- Allocate institutional and administrative responsibilities for planning, management implementation and monitoring of the environmental requirements; and
- Allocate responsibilities to execute mitigation measures, including the detailed design of the mitigation measures.

Non-compliance will normally be followed by the issuance of an order to comply and a simultaneous and immediate compounding of the non-compliance offence according to the Environment Protection Enactment 2002.

The Project Proponent and/ or environmental consultant should consult the EPD for advice if there are difficulties in implementing the approved mitigation measures and monitoring programmes.

In some cases EPD may request a “re-assessment” of specific aspects of the operation related to the mitigation measures found to be in “non-compliance”.

7.2 Impact Monitoring

Impact monitoring is concerned with the monitoring of the residual impacts or the effectiveness of the mitigation measures. The Environmental Assessment report will have provided baseline data showing the situation as it was before the oil palm plantation development took place. All subsequent impact monitoring will relate to this baseline data. It is therefore important that the environmental consultant plans sampling points and parameters for baseline sampling to coincide with points and parameters for impact monitoring.

7.2.1 Ecology

The effectiveness of mitigation measures for ecological impacts can be determined by monitoring the extent of ecological impacts on the species identified within the zoned areas. Adequate and effective buffer zones will clearly demarcate the plantation and the protected areas, whereas river reserves can provide sanctuary for mobile fauna as well as establish new habitats for displaced species.

Impacts on the species can be identified by determining the changes that take place within that particular species. Changes within a particular species can be ascertained by determining variations in terms of population size (increase, remain, decrease) and growth condition (good, retarded, normal). The baseline data will serve as the yardstick to ascertain the extent of changes taking places.

7.2.2 Soil Erosion

If the Environmental Assessment indicates that the oil palm plantation may result in significant soil erosion, periodic monitoring might be required for signs of soil erosion on site and water quality deterioration that could be attributed to the soil erosion.

Visual inspection of soil erosion indicators, e.g. gully, sheet erosion and others, within the plantation area can be used to assess soil erosion on site. Variations in the level for soil erosion indicators, particularly Total Suspended Solids and turbidity in waterways relevant to the plantation, will have to be

determined. Test results and assessment shall be reported and submitted to the EPD as per the AEC/ MD.

7.2.3 Water Quality

Soil erosion, use of agro-chemicals and other on-site activities will inevitably affect water quality of waterways within the oil palm plantation.

The impact monitoring of water quality can be carried out by determining the changes in water quality of waterways relevant to the oil palm plantation. This can be achieved by taking water samples at locations that are representative of the site's condition, which will be determined and agreed by EPD. Report on the variations to be submitted to the EPD as per the AEC/ MD.

Water quality changes for waterways relevant to the oil palm plantation can be ascertained by determining variations between the existing water quality and the baseline data. Parameters that should be determined are (but not limited to): total suspended solids, turbidity, dissolved oxygen, pH, biochemical oxygen demand (BOD), chemical oxygen demand (COD), oil and grease, agro-chemicals. Additional parameters may be recommended depending on site characteristics. Known aquatic life for the area such as fish may be used as biological indicators for water pollution.

7.2.4 Water Supply

Matters pertaining to water supply that have not been properly planned and implemented will result in possible conflicts between the Project Proponent and those affected. In extreme situations, hostility may ensue, particularly when the livelihoods of the local communities and households are negatively impacted.

The impact monitoring of water supply issues can be carried out by noting any feedback, comments or grievances from affected communities. This can be achieved by having dialogue sessions with these communities as and when necessary. Report on the findings from these sessions must be submitted to the EPD as per the AEC/ MD.

The Project Proponent, being the party that had initiated the change within the affected communities, should be responsive to this feedback by taking actions that could minimise or eliminate the negative or adverse impacts to all parties. Involvement or cooperation with the relevant Government agencies, especially the District Office, should be sought in order to resolve such issues before they escalate into conflicts.

7.2.5 Monitoring Frequencies

Frequencies of monitoring depend upon the timing and schedule of project activities. The monitoring frequency can be varied. If the environmental consultant finds there is a particular parameter, which should be monitored more frequently due to increased activity levels, an increased monitoring frequency should be proposed in the Environmental Assessment report. On the other hand, if little activity is on-going, and the operation is in compliance over an extended period, the Project Proponent may request a less intensive monitoring schedule. Changes in the monitoring frequency will be decided on a case-by-case basis by EPD.

References

In addition to the relevant laws, regulations and guidelines, the following list includes general and specific literature, which may be useful for the reader.

1. Canter, L.W. (1977). Environmental Impact Assessment. Mc Graw-Hill, U.S.A.

2. Business and Biodiversity Offsets Programme (BBOP) (2009). The Relationship between Biodiversity Offsets and Impact Assessment: A BBOP Resource Paper. BBOP, Washington, D.C.

3. Business and Biodiversity Offsets Programme (BBOP) (2012). Guidance Notes to the Standard on Biodiversity Offsets. BBOP, Washington, D.C.

4. Department of Agriculture, Sabah (1998). Sabah Agricultural Policy, Department of Agriculture, Sabah.

5. Department of Irrigation and Drainage, Malaysia (2010). Guideline for Erosion And Sediment Control in Malaysia.

6. Edwin D. Ongley (1996). Control of water pollution from agriculture – FAO Irrigation and Drainage Paper 55, http://www.fao.org/docrep/ W2598E/w2598e00.htm.

7. Environmental Conservation Department Sabah (ECD) (2000). Handbook for Environmental Impact Assessment (EIA) in Sabah. Kota Kinabalu.

8. Environment Protection Department, Sabah (2011). Impact Study on Palm Oil Mills, Oil Palm Plantations and Other Pollutants on the Quality of Specific Rivers in Sabah. First Edition. Ministry of Tourism, Culture and Environment, Sabah.

9. Department of Environment (1996). Guidelines for the Prevention & Control of Soil Erosion & Siltation in Malaysia. Kuala Lumpur.

10. Everitt, R.R (1992). Environmental Effects Monitoring Manual. Prepared for the Federal Environmental Assessment Review Office and Environment Canada, Environmental Assessment Division, Inland Waters Directorate. Ottawa, ON.

11. Kato, R., Y. Tadaki & H. Ogawa (1978). Plant biomass and growth increment studies in Pasoh Forest. Malayan Nature Journal, 30(2): 211 – 224.

12. Ministry of Land Development, Sarawak (1997). Handbook on New Concept of Development on Native Customary Rights (NCR) Land: Policies, Benefits, Issues & Responses.

13. Malaysia National Interpretation Working Group (undated). National Interpretation of RSPO Principles and Criteria For Sustainable Oil Palm Production.

14. Ministry of Rural and Land Development (2001). Water management Guidelines for Agricultural Development in Lowland Peat Swamps of Sarawak.

15. Morgan, R.P.C. (1986). Soil Erosion and Conservation. Longman Group UK Limited.

16. PIANC (2010). PIANC Report No 108: Dredging and Port Construction Around Coral Reefs. PIANC Secretariat General, Belgium.

17. Payne, J (1997). Potential Benefits of Retaining Forests in Malaysian Plantations. Paper presented in the "One-day Workshop on Forests Plantations", Kota Kinabalu, 09th October 1997.

18. Raghavan Srinivasan, J. Arnold, H. Wang & C. H. Walker (2000). Nonpoint Source Sediment and Organic Nutrient Loadings to Major River Bodies in the U.S., Blackland Research Centre, USA.

19. Roundtable on Sustainable Oil Palm (2007). RSPO Principles and Criteria for Sustainable Palm Oil Production including Indicators and Guidance.

20. Roundtable on Sustainable Oil Palm (October 2012). RSPO Manual on Best Management Practices (BMPs) for Management and Rehabilitation of Natural Vegetation Associated with Oil Palm Cultivation on Peat.

21. Soepadmo, E. (1987). Structure, above ground biomass and floristic composition of forest formations at Gunung Janing Barat, Ulu Endau, Johor, Malaysia. Malayan Nature Journal 41: 275 – 290.

22. Turner, P.D. & Gillbanks, R.A. (1974). Oil Palm Cultivation and Management. The Incorporated Society of Planters, Kuala Lumpur, Malaysia.

23. Wetlands International (March 2010). A Quick Scan of Peatlands in Malaysia. Wetlands International-Malaysia: Petaling Jaya, Malaysia. 50 pp.

24. WWF Malaysia (2009). High Conservation Value Forest (HCVF) Toolkit for Malaysia: A National Guide for Identifying, Managing and Monitoring High Conservation Value Forest. 1st Ed.

Appendix 1: Glossary of Terms

Acid Sulphate Soil – a soil containing pyrite, which upon oxidation will result in very low pH values.

Activity – basic element of a project or plan that has the potential to affect any aspect of the environment. Projects are composed of activities. Activities are often called actions.

Agriculture – any agricultural activities including breeding or raising of livestock.

Biomass – total weight, volume or energy equivalent of organisms in a given area.

Building – any building, erection or structure on any land and where the context so permits, includes the land on which the building is situated.

Central Board – the Central Town and Country Planning Board constituted under the provisions of Section 3 of the Town and Country Planning Ordinance.

Development – any land development that involves infrastructures and other structural construction activities together with related activities or changes the land's natural condition.

Effluent – any discharge either sewage or industrial effluent by an operation to the receiving environment.

Environment – physical factors of the surroundings of the human beings including land, water, atmosphere, climate, sound, odour, taste, the biological factors of animals and plants, and the social factor of aesthetics.

Environmental Impact – an estimate or judgement of the significance and value of environmental effects on physical, biological, social or economic environment.

Evapotranspiration - the quantity of water used for transpiration by vegetation and lost by evaporation from the soil.

Factor – basic element of analysis used in any method. In most methods, factors relate to some form of environmental impact.

Fragmentation – usually referring to habitat fragmentation where a disturbed habitat is reduced into smaller habitats

Green Lungs – a type of physical landscape on an area that is covered with vegetation or water for recreational features. Examples are parks, open space, swamps, hilly areas.

Irrigation – the supply, distribution and controlled applications of water to agricultural land to improve the cultivation of crops.

Landslide/ Landslip – rapid movement of earth materials separated from the underlying stationary part of the slope by a definite surface.

Matrix Method – identifies interaction between various project actions and environmental parameters and components.

Natural Resources – air, biological diversity of resources, oil, gas, forest and forest product, land, rocks, soils, animals, birds, plants, marine or aquatic life, and water of the State of Sabah.

Peat – an organic soil, which contains at least 65% organic matter (less than 35% mineral material) and is at least 0.5 m in depth and 1.0 ha in area.

Pollutants – any natural or artificial substances, whether in solid, semi-solid or liquid form, or in the form of gas or vapour, or in a mixture of at least two of these substances, or any objectionable odour or noise or heat emitted, discharged or deposited or is likely to be emitted, discharged or deposited from any source which can directly or indirectly cause pollution and includes any environmentally hazardous substances.

Pollution – any direct or indirect alteration of the physical, thermal, chemical, or biological properties of any part of the environment by discharging, emitting, or depositing wastes so as to affect any beneficial use adversely, to cause a condition which is hazardous or potentially hazardous to public health, safety or welfare, or to animals, birds, fish or aquatic life, or to plants.

Residual Impact – the potential environment impact remaining after mitigating measures have been adopted into a project plan.

Severance – partitioning, especially habitats

Topography – shape of the ground, formed by highlands, slopes, rivers, swamps, coasts and river network which have their own aesthetic values.

Wetland Forest – forests where land is either subject to inundation with saltwater or freshwater, or has a high water table and such forests include mangrove forests, brackish water forests, transitional forests, freshwater swamp forests and peat swamp forests.

Zone of Impact – an extent of area which will receive the greatest effect from an activity.

Appendix 2: List of Abbreviations

ACLR	Assistant Collector of Land Revenue
AEC	Agreement of Environmental Conditions
CO_2	Carbon Dioxide
CPO	Crude Palm Oil
DO	Dissolved Oxygen
EIA	Environmental Impact Assessment
EPD	Environment Protection Department
FFB	Fresh Fruit Bunches
GIS	Geographical Information System
GPS	Global Positioning System
HCV	High Conservation Value
LUC	Land Utilisation Committee
MD	Mitigation Declaration
MPOB	Malaysian Palm Oil Board
N	Nitrogen
NOx	Nitrogen Oxides
OPP	Oil Palm Plantation
P	Phosphorus
PKO	Palm Kernel Oil
PMM	Proposal for Mitigation Measures
PSF	Peat Swamp Forest
SOx	Sulphur Oxides
SSAP	Second Sabah Agricultural Policy
TSS	Total Suspended Solids
ZOI	Zone of Impact

Appendix 3: Contact Details

Contact details for other key government agencies related to oil palm plantation development are as following:

Department	Address	Contact Details	
Lands and Surveys Department	Wisma Tanah dan Ukur, Jalan Perwira, Beg Berkunci No. 2044, 88576 KOTA KINABALU	Tel No.:	088 - 527600/ 527601
		Fax No.:	088 - 413626
		Email:	-
Sabah Biodiversity Centre	Pejabat Hasil Bumi, Jabatan Ketua Menteri, Tingkat 7, Menara Tun Mustapha, Teluk Likas, 88502 KOTA KINABALU	Tel No.:	088 - 423111
		Fax No.:	088 - 430 573
		Email:	sabc@sabah.gov.my
Sabah Forestry Department	Ibu Pejabat, Jabatan Perhutanan, Beg Berkunci No. 68, 90009 SANDAKAN	Tel No.:	089 - 660811/ 660125/ 660824
		Fax No.:	089 - 672579/ 671303
		Email:	htan@sabah.gov.my
Sabah Wildlife Department	Tingkat 5, Blok B, Wisma MUIS, 88100 KOTA KINABALU	Tel No.:	088 - 215167/ 214515
		Fax No.:	088 - 222476/ 254767
		Email:	jhl@sabah.gov.my
Department of Agriculture	Aras 1, 5, 6 dan 7, Wisma Pertanian Sabah, Jalan Tasik, Luyang, Off Jalan Maktab Gaya, Beg Berkunci No. 2050, 88632 KOTA KINABALU	Tel No.:	088 - 283283
		Fax No.:	088 - 283283
		Email:	doasabah@sabah.gov.my
Department of Irrigation and Drainage	Aras 5, Wisma Pertanian, Jalan Tasik, Luyang, Off Jalan Maktab Gaya, Beg Berkunci 2052, 88767 KOTA KINABALU	Tel No.:	088 - 280500
		Fax No.:	088 - 242770
		Email:	did@sabah.gov.my
Town and Regional Planning Department	Tingkat 3, 4 dan 5, Blok B, Wisma Tun Fuad Stephens, KM 2.4, Jalan Tuaran 88646 KOTA KINABALU	Tel No.:	088 - 222336/ 222337/ 222031
		Fax No.:	088 - 222557
		Email:	-
Department of Environment, Sabah	Aras 4, Blok A, Kompleks Pentadbiran Kerajaan Persekutuan Sabah, Jalan UMS-Sulaman, 88450 KOTA KINABALU	Tel No.:	088 - 488166
		Fax No.:	088 - 488177/ 488178
		Email:	sabah@doe.gov.my

Appendix 4: List of Environmental Consultants/ Study Team

The following list includes the expertise, which in most cases should form part of the assessment team for oil palm plantation EIAs depending on site characteristics and environmental issues identified. Some team members may cover two or more of these fields of expertise:

- Soil Erosion
- Hydrology
- Ecology/ Flora and Fauna
- Socio-Economic
- Waste Management

Each member of the team, involved for their specialist subject(s), should be involved in the entire environmental assessment cycle from scoping, baseline data collection, impact prediction and evaluation, and identification of mitigation measures.

The list of registered environmental companies related to environmental report preparation can be referred to on the website of EPD: http://www.sabah.gov.my/jpas/

Appendix 5: Standard List of Content

The content of the environmental assessment report shall consist of the following:

CHAPTER 1:	**EXECUTIVE SUMMARY**
	Project Description
	Findings
CHAPTER 2:	**GENERAL INFORMATION**
	Project Title and Project Proponent
	Environmental Consultant
	Public Hearing (for Special EIAs)
CHAPTER 3:	**PROJECT DESCRIPTION**
	Statement of Need
	Concept and Phases
	Description of Location
	Project Status
CHAPTER 4:	**IMPACT PREDICTION AND EVALUATION**
	Significant Environmental Impacts
	EIA Matrix
	Impact Assessment
CHAPTER 5:	**RECOMMENDED MITIGATION MEASURES**
	Recommendations
	Additional Mitigation Measures
CHAPTER 6:	**RECOMMENDED MONITORING PROGRAMME**
	Compliance of Mitigation Measures
	Residual Impacts
ANNEXES	Annex 1: Baseline Environmental Data and Information
	Annex 2: Methodologies and Analysis of Data
	Annex 3: List of References
	Annex 4: Terms of Reference