State Environmental Conservation Department (ECD), Sabah, Malaysia

Environmental Impact Assessment (EIA) Guidelines Oil Palm Plantation Development

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The publication of these guidelines has been approved by the Minister of Tourism, Environment, Science and Technology as required under Paragraph 5 of The Conservation of Environment (Prescribed Activities) Order 1999

Appreciation
The Department appreciates the support from DANCED (Danish Cooperation for Environment and Development) in the preparation of these guidelines

Abbreviations

AEC	Agreement on Environmental Conditions
ECD	Environmental Conservation Department (State of Sabah)
EIA	Environmental Impact Assessment
ha	hectare
TOR	Terms of Reference

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Preface

In the state of Sabah, the cultivation of oil palm is an important economic activity which strongly influences the rate of land development in the state, which in turn is often the catalyst for regional infrastructure development, particularly the opening up of road networks within interior areas.

Oil palm cultivation may, however, result in the destruction of important habitats, change the hydrological regime of a region, and contribute to waterway pollution in terms of increased suspended solids and elevated levels of agro-chemicals. As oil palm cultivation extends over large land areas, the impacts are regional in nature. In order to manage and reduce the environmental impacts related to plantation development implementation activities need to be subject to holistic planning

In Sabah, the Environmental Conservation Department is charged with regulating the development of oil palm plantation effective September 1999 to ensure that plantation development takes place in an environmentally responsible manner.

The guidelines are intended for use by project proponents, environmental consultants and approving authorities when initiating, assessing and approving Environmental Impact Assessments (EIA) for oil palm plantation development activities in the State of Sabah. The guidelines also provide direction as to the scope of environmental considerations required during the planning stage of plantation development. Early identification of potential environmental considerations will ensure that subsequent development will be carried out with minimal adverse environmental impacts.

The Environmental Conservation Department would like to express their appreciation to the Danish Cooperation for Environment and Development (DANCED) for assistance in the preparation of these guidelines through the Departments Capacity Building Project. Appreciation is also extended to all government agencies, organisations and individuals that contributed towards the formulation of these guidelines.

Eric Juin
Director
Environmental Conservation Department

1 Introduction

Oil palm plantation development is defined as opening up of land areas for the purpose of cultivating oil palm and carrying out other related activities such as land clearing, biomass management and disposal, earthworks, planting and re-planting activities. Throughout this guideline, *oil palm plantation development* is used as an abbreviated form to cover all of the above activities.

The aim of these Environmental Impact Assessment (EIA) Guidelines is to provide a framework for the preparation of an EIA report for oil palm plantation development under the requirements specified in the *Conservation of Environment Enactment 1996* and *Conservation of Environment (Prescribed Activities) Order 1999*.

The guidelines provide an easy to follow and practical means for assessing environmental impacts, recommending mitigation measures and proposing monitoring programmes within the State of Sabah for:

- Planning the actual extent and location of area to be planted
- Land clearing activities
- Biomass management and disposal

The guidelines may also be applied to replanting activities for palms that have exceeded their reproductive life span and conversion of other types of cultivation and crops into oil palm plantation.

The guidelines should be used in conjunction with the *Handbook for Environmental Impact Assessment (EIA) in Sabah*, as well as the *EIA Guidelines for logging and forest clearance activities* published by the Environmental Conservation Department Sabah (ECD).

EIA procedures – a quick reference

The seven steps	Summary of main required activities
Step 1: Project screening	Project proponent: • Check Annex 1 to see if the project is required to undertake an EIA • Consult the ECD as to whether the project should undertake an EIA
Step 2: Selection of consultants	Project proponent: • Select consultants to undertake preparation of TOR and the EIA
Step 3: Preparation of TOR	EIA consultant: • Undertake scoping activities and present the results to ECD • Prepare a draft TOR • Undertake the public hearing activities required for Special-EIA • Finalise the TOR and obtain final approval from ECD
Step 4: Undertaking the EIA study	EIA consultant: • Assess environmental impacts • Assess mitigation measures • Assess monitoring programmes
Step 5: Preparation of the EIA report	EIA consultant: • Adhere to the ECD requirements and 'standard table of content' in the preparation of the EIA report • Prepare the EIA report in line with the ECD chapter-by-chapter recommendations
Step 6: Review of the EIA report	EIA consultant: • Submit the EIA report to ECD • Undertake the public hearing activities required for Special-EIA • Participate in review meetings • Submit additional information if required and finalise the EIA report
Step 7: Agreement of Environmental Conditions	Project proponent: • Review the draft Agreement of Environmental Conditions prepared by ECD • Co-sign the Agreement of Environmental Conditions (AEC) • Implement mitigation measures and monitoring programmes.

Sabah context

** Pictures not included*

Sabah context

** Pictures not included*

2 Sabah context

2.1 Geographical overview

As of December 1999, the area of land in Sabah planted with oil palm far exceeded that of other states in Malaysia (Table 2.1). The Division and District planted with the largest area of oil palm is Sandakan (464,038 ha) and Kinabatangan (265,111 ha) respectively (Table 2.2).

Table 2.1: Distribution of oil palm planted areas by State in Malaysia [as of December 1999]

State	***Total oil palm planted Area ha***	***%***
Johor	612,708	(18.5)
Kedah	52,558	(1.6)
Kelantan	80,407	(2.4)
Melaka	39,596	(1.2)
Negeri Sembilan	118,781	(3.6)
Pahang	542,855	(16.4)
Pulau Pinang	13,968	(0.4)
Perak	303,089	(9.1)
Selangor	132,149	(4.0)
Terengganu	155,484	(4.7)
Sabah	941,322	(28.4)
Sarawak	320,476	(9.7)
Malaysia	3,313,393	(100.0)

Source: Palm Oil Registration and Licensing Authority *(PORLA) (http://161.142.157.2/home2/home)*

Table 2.2: Distribution of oil palm planted areas by Division and District in Sabah, Malaysia [as of December 1997]

Division	***District***	***Area, ha***	***Area percentage (%)***	
			Divisional	***Sabah***
Tawau	Tawau	85,410	23.8	10.1
	Semporna	32,777	9.1	3.9
	Lahad Datu	188,826	52.7	22.4
	Kunak	51,385	14.3	6.1
	Total	358,398	100.0	42.5
Sandakan	Sandakan	85,788	18.5	10.2
	Kinabatangan	265,111	57.1	31.4
	Tongod	474	0.1	0.1
	Beluran	78,322	16.9	9.3
	Telupid	34,343	7.4	4.1

	Total	464,038	100.0	55.0
Kudat	Kudat	1,440	21.2	0.2
	Pitas	1,725	25.4	0.2
	Kota Marudu	3,625	53.4	0.4
	Total	6,790	100.0	0.8
Pantai Barat	Kota Belud	46	1.4	0.0
	Ranau	144	4.5	0.0
	Tuaran	413	12.8	0.0
	Kota Kinabalu	0	0.0	0.0
	Penampang	0	0.0	0.0
	Papar	2,630	81.3	0.0
	Total	3,233	100.0	0.4
Pedalaman	Beaufort	10,543	91.7	1.2
	Sipitang	20	0.2	0.0
	Kuala Penyu	113	1.0	0.0
	Tenom	34	0.3	0.0
	Keningau	374	3.3	0.0
	Sook	405	3.5	0.0
	Tambunan	0	0.0	0.0
	Pensiangan	4	0.0	0.0
	Total	11,493	100.0	1.4
Sabah		843,952		100.0

Source: *Report on Crop Hectareages in Sabah 1997 (*Department of Agriculture *99/1)*

Although the conversion of land for agricultural activities is a necessary component of social-economic development, the impacts associated with the conversion are severe and irreversible and therefore require an appropriate amount of consideration and planning.

2.2 Legal requirements and approving authorities

Effective September 1999, Environmental Impact Assessment (EIA) is a mandatory requirement for agricultural development activities in Sabah under the *Conservation of Environment Enactment 1996* and the *Conservation of Environment (Prescribed Activities) Order 1999*. Oil palm plantation development is a Prescribed Activity included under the following section:

Section 1: Agricultural Development

> *Paragraph (i): development of agricultural estates or plantations covering an area of 500 hectares or more – (a) from land under secondary or primary forests; (b) which would involve the resettlement of 100 families or more; or (c) which would involve modification in the use of the land;*
>
> *Paragraph (ii): conversion of mangrove swamps and other wetland areas into agricultural estates having an area of 50 hectares or more; or*
>
> *Paragraph (iii): development of agricultural area adjacent to any conservation area, park or sanctuary declared under any written law.*

Failure to observe this directive, the authority, body or person in default shall be guilty of an offence and shall, on conviction, be liable to a term of imprisonment for 5 (five) years and a fine of Ringgit 50,000.00 (Malaysian Ringgit fifty thousand only).

Any person who intends to undertake oil palm plantation development activities in the State of Sabah shall submit to the Director of the Environmental Conservation Department (ECD) an ***EIA Report*** for approval. The Department contact is:

The Director
Environmental Conservation Department
Tingkat 2 & 3, Wisma Budaya
88000 Kota Kinabalu, Sabah

Attention:	Environmental Assessment Section
Tel:	088-251290/1
Fax:	088-238120
E-mail:	jkas@sabah.gov.my
Homepage:	*www.sabah.gov.my/jkas*

Oil palm plantation 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 Sabah Agricultural Policy (1992–2010) states that:

Section 10. Commodity Policy. Item 10.1.1 Oil Palm – To maximise returns from palm oil, production will be increased through expansion, productivity improvement, and upgraded efficiency particularly in the smallholder sub-sector. The adoption of automation and intensified mechanisation will be encouraged to increase productivity and efficiency and as a long-term solution to the problem of labour shortage. Milling, bulking installation and refining facilities will be upgraded, expanded and increased to cater for increased production. Downstream processing to produce locally manufactured value-added palm oil products, such as oleochemicals, will be encouraged to ensure a balanced and sustained growth of the industry. Environmentally friendly methods of oil palm cultivation, production and processing will be promoted.

Responsible development of oil palm cultivation should not only meet the needs of investors and developers but also compliment in a broader sense the State's socio-economic interests. Environmentally friendly methods of oil palm cultivation are clearly emphasised in the current Sabah Agricultural Policy.

Effective September 1999, land applications for oil palm plantation development activities in the State of Sabah are subject to the requirements of an EIA.

The procedure for developing an oil palm plantation begins with the application for land (Figure 2.1). The procedure is summarised as follows:

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

- The Assistant Collector of Land Revenue shall refer the application to the Land Utilisation Committee (LUC) for technical comments. Permanent members of the Land Utilisation Committee are the Director or Deputy Director of Lands and Survey Department (Chairperson), District Surveyor, Department of Agriculture, Forestry Department, Department of Irrigation and Drainage, Fishery Department and community leaders. Community leaders and surveyors will ensure that the land is available and unencumbered. The Department of Agriculture provide technical comments in terms of land suitability 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 Survey 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 Survey Department who will then forward it to the Secretary of Natural Resources for approval by the YAB Chief Minister
- An approved application is returned to the Director of Lands and Survey 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
- The Draft Survey Plan will be reviewed and checked by the District Surveyor before the Plan an survey data are submitted to the Lands and Survey Department for official registration
- Upon completion of the tasks required by Lands and Survey 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 (if it is a prescribed activity) for submission to the ECD. The EIA 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 on Environmental Conditions (AEC) to be entered between the Project Proponent and the ECD

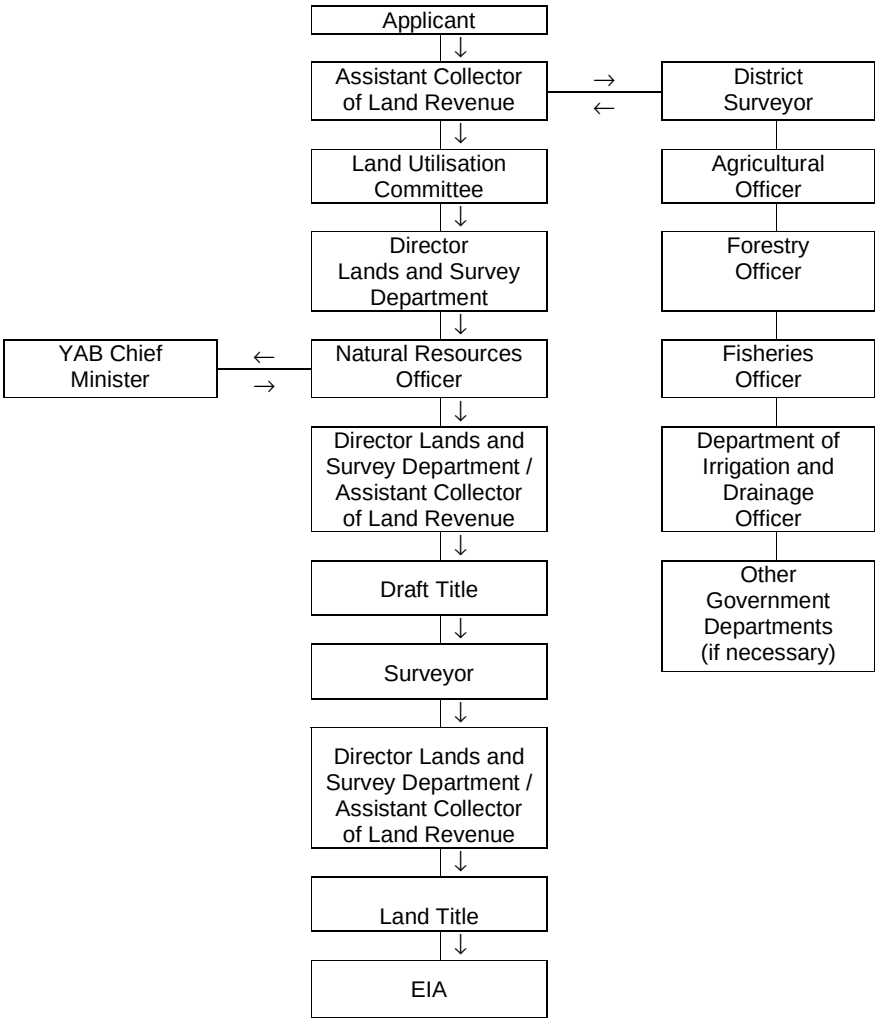


Figure 2.1: Application procedures for oil palm plantation development (details in Annex 1)

2.3 Typical project activities

Typical activities associated with oil palm plantation development may be divided into six main stages, namely:

- Pre-development. This stage involves feasibility studies, application/acquisition of land, preparation of EIA, and survey of boundary and plantation blocks
- Nursery establishment. Normally one ha nursery will cater for a planting area of 100 ha. This stage will prepare high quality seedlings for field planting when the plantation proper site has been developed
- Site preparation. Existing vegetation is cleared and removed to enable earthworks (particularly terracing & drainage). Cover crops will be planted and maintained
- Field establishment. Field lining and holing will be carried out. Suitable seedlings from the nursery will be transplanted on prepared planting field
- Maintenance and harvesting. Planted palm trees are maintained by manuring and control of diseases, weed and pests. Harvesting will normally commence within 2.5 to 3 years after field planting

- Re-planting/abandonment. After completion of the productive life span (20 to 25 years), decision will be made on either to replant or abandon the oil palm plantation.

A project flow diagram for a typical activities related to oil palm plantation development is shown (Figure 2.2).

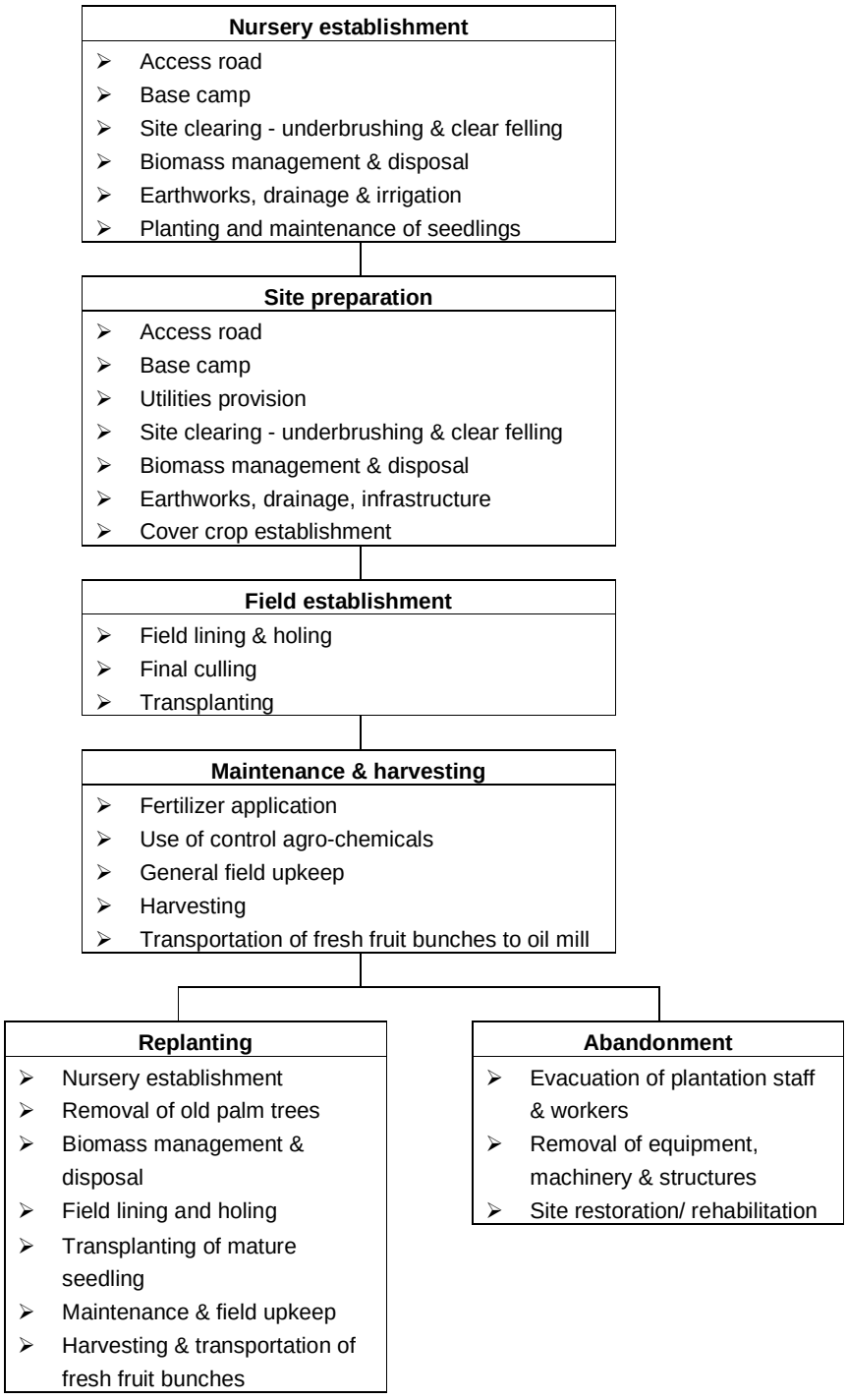


Figure 2.2: Flow diagram of typical oil palm plantation development activities

2.4 Key stakeholders

Key stakeholders involved in the development of oil palm in Sabah include:

- *Oil palm plantation developers* - to carry out oil palm planting and to supply FFB (fresh fruit bunches) to palm oil mills, either as a company or private individual/smallholders
- *Palm oil mill operators* - to obtain Fresh fruit bunches from oil palm planters to produce palm oil
- *Oil palm planters association* - a group of oil palm cultivating companies and organisations for East Malaysia
- *Department of Agriculture* - to review and comment on the plantation development plan and land/soil suitability for oil palm cultivation
- *Department of Irrigation and Drainage* – to comment on potential concern over hydrology and drainage issues in relation to the oil palm plantation development
- *Environmental Conservation Department (ECD)* – to approve EIA to commence activities for oil palm plantation development within the State
- *Land & Surveys Department* – to issue a Land Title to develop oil palm plantation within the State
- *Malaysian Palm Oil Board* – a new statutory body established on 01st May 2000 pursuant to the Malaysian Palm Oil Board Act 1998 (Act 582). Palm Oil Registration and Licensing Authority and Palm Oil Research Institute of Malaysia have ceased to exist since then as the two bodies are merged into Malaysian Palm Oil Board. The main role of the Board is to promote and develop the oil palm industry in Malaysia as well as developing national objectives, policies and priorities for the orderly development of the industry.

Environmental impacts

** Pictures not included*

Environmental impacts

** Pictures not included*

3 Environmental impacts

Steps	*Activities*	*Issues*
Step 1	Assessment of impacts	Key environmental impacts include: • 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
Step 2	Mitigation measures	
Step 3	Monitoring	

The purpose of this chapter is to outline procedures that can help identify the environmental impacts associated with the development of an oil palm plantation. Methodologies are suggested for evaluating the scale and extent of the impact.

If the project location was subject to an EIA for Logging and Forest Clearance activities then this document should be referred to as many of the assessments and proposed mitigation measures should already be in place, or if additional measures are required, they should compliment existing ones

3.1 Environmental impacts

The key adverse environmental impacts of oil palm plantation development are:

- *Ecological impacts* due to destruction of habitats for flora and fauna as a result of land development
- *Soil erosion and water pollution* due to land clearing and development
- *Disposal of biomass and air pollution* due to open burning
- *Local water supply issues* from encroachment into catchment for water supply.

Additional adverse environmental impacts of oil palm plantation development are:

- *Development on river floodplain* leading to loss of riparian habitat and function
- Over abstraction of *water resources*
- *Water pollution* due to usage of agro-chemicals
- *Land and water pollution* from hazardous materials

3.2 Initial project description and assessment

In order to be able to propose realistic mitigation measures, the following initial information should be obtained prior to embarking on any field surveys or assessments. This information has to be included in the scoping note and the draft *Terms of Reference* submitted to the ECD and will provide the basic framework for the assessments made in the EIA report.

- ***Initial data I: Clearly identify the geographical location and area of the project.*** Depending on the size of the project area, the EIA study may extend well beyond the project boundary and should include an assessment of downstream, adjacent and coastal impacts (Figure 3.1, also refer to ECD EIA Handbook)

- ***Initial data II: Description of the project site, including maps.*** It is imperative that the all maps include an indication of scale and a clearly marked coordinate system (e.g. longitude and latitude). One of the location maps should also clearly identify and describe neighbouring land-use which should include the nearest protected area, other sensitive habitats including position in relation to river system. All text presented on the map should be readable. It should be borne in mind that duplicate copies of reports will be required and provision should be made so that all maps remain legible (Figures 3.2 and 3.3)

- ***Initial data III: Description of river systems***. River systems and catchment areas as represented on the National 1:50,000 maps should be digitally presented (Figures 3.4 & 3.5). This information should be taken as indicative and not absolute (Figure 3.5 & 3.6). All 4^{th} order rivers and higher must be clearly identified and marked. In part this matches the requirements of the Water Resource Enactment (1998), i.e. to provide a 20 m river reserve for rivers wider than 3 metres, as most 4^{th} order rivers are at least this size

  Using the river drainage system data, the project area should then be classified into individual catchment areas (Figure 3.6). Photographic information can provide useful supplementary information (Plate 3.1)

  Water quality samples/measurement can be taken in order to indicate the general condition of rivers in the project area. Total suspended solids would normally be the parameter of interest, however, the number of parameters may vary depending upon site-specific requirements. An interpretation of the data needs to be clearly presented

- ***Initial data IV: Provide details on agreements governing the initiation of the project*.** This includes for example the project status in relation to approvals (received/applied) and other comments from official authorities

- ***Initial data V: Listing all main project activities.*** This includes the timing of the planned project activities, proposed clearance system and activities, road plan, machineries to be used, transportation routes, proposed layout plan, phase of development and schedule of activities under each phase.

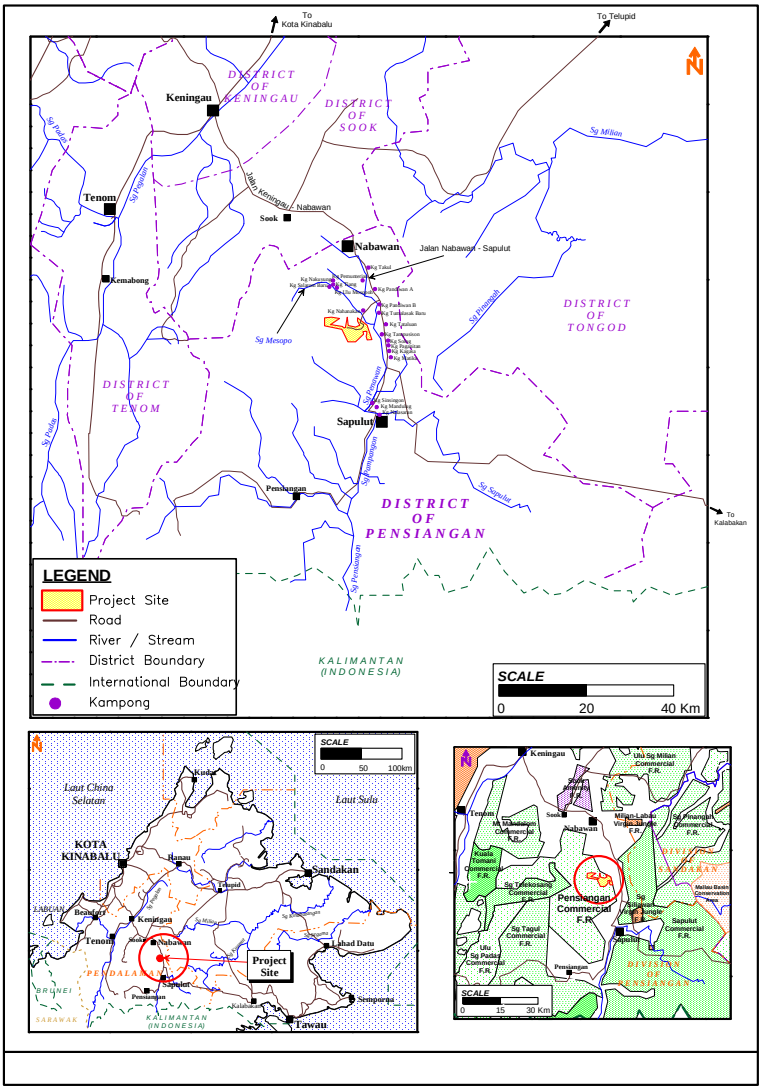


Figure 3.1 Project locality map

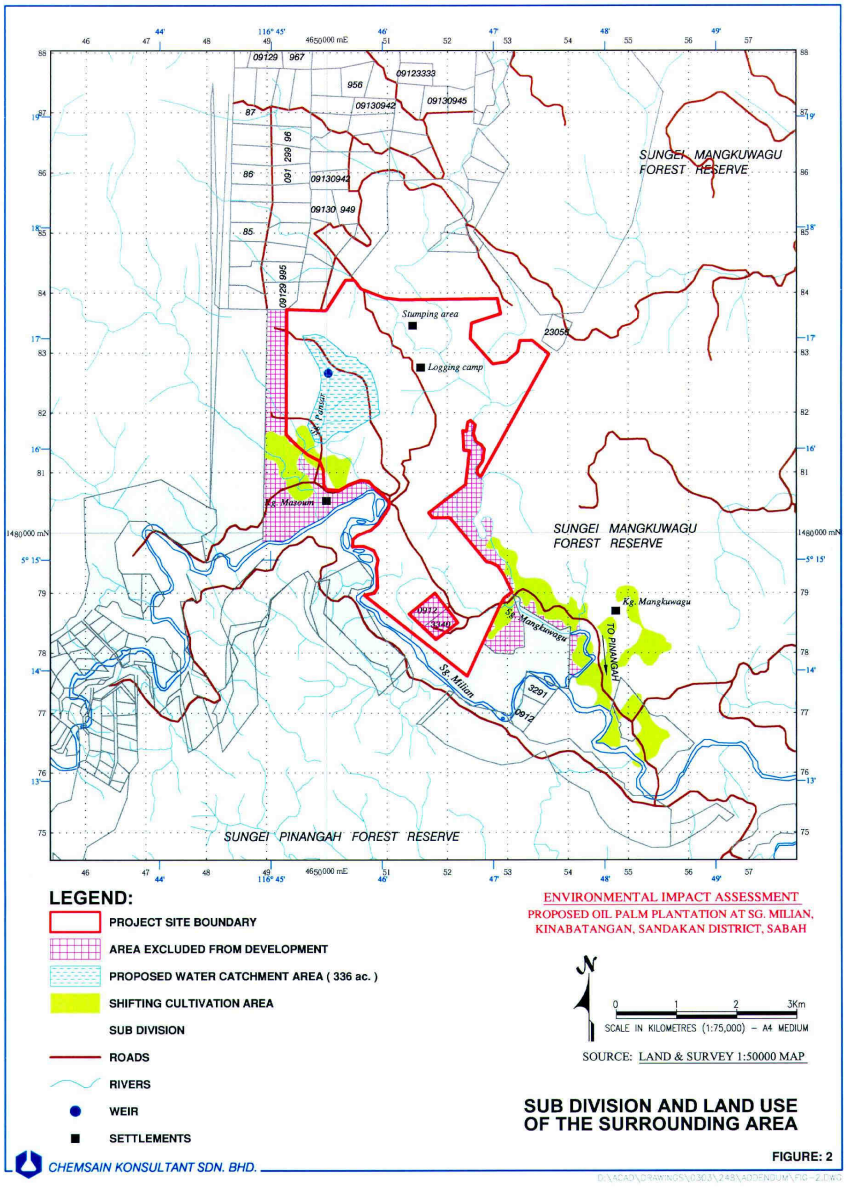


Figure 3.2 Example of existing land use map

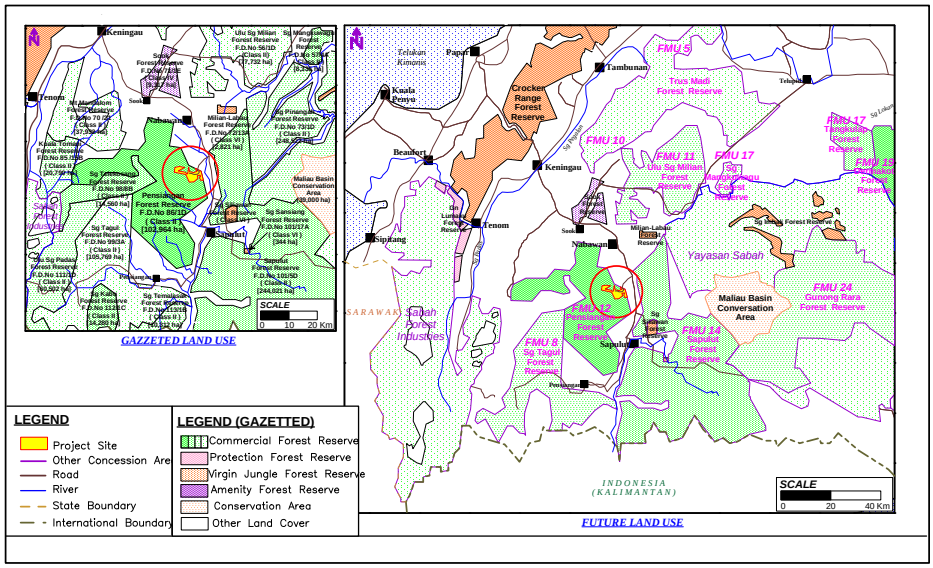


Figure 3.3 Example of future land use map

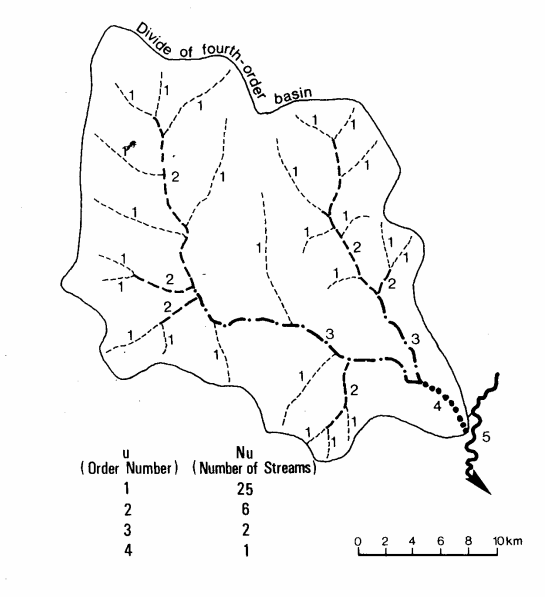


Figure 3.4 Assessment of stream order (after Strahler, 1964). When two first order streams meet, the river becomes 2nd order and when two 2nd order streams join the river is then classified as 3rd order.

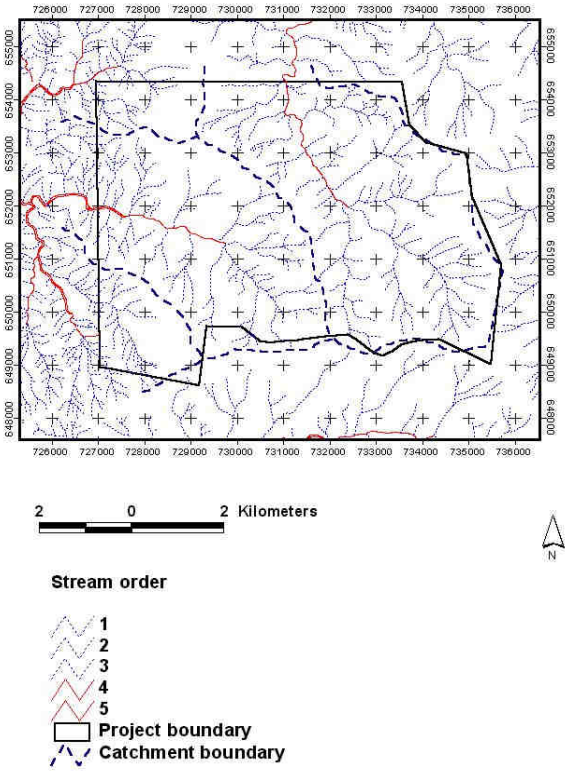


Figure 3.5 Assessment of river size based on stream order

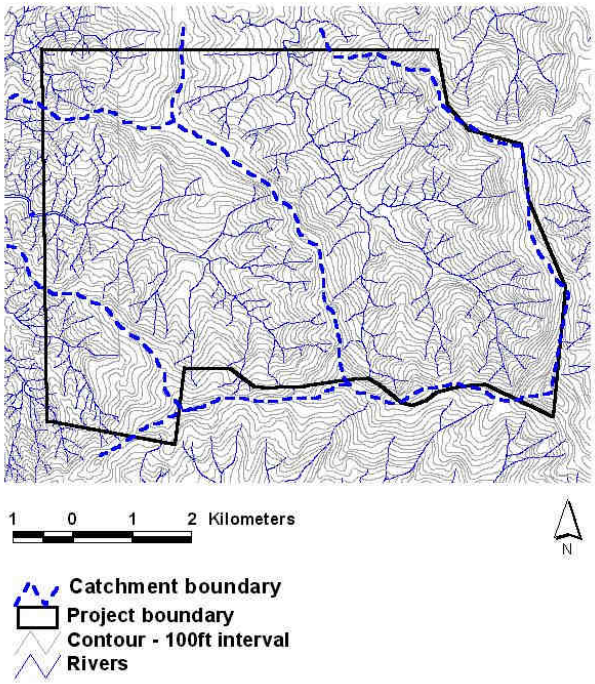
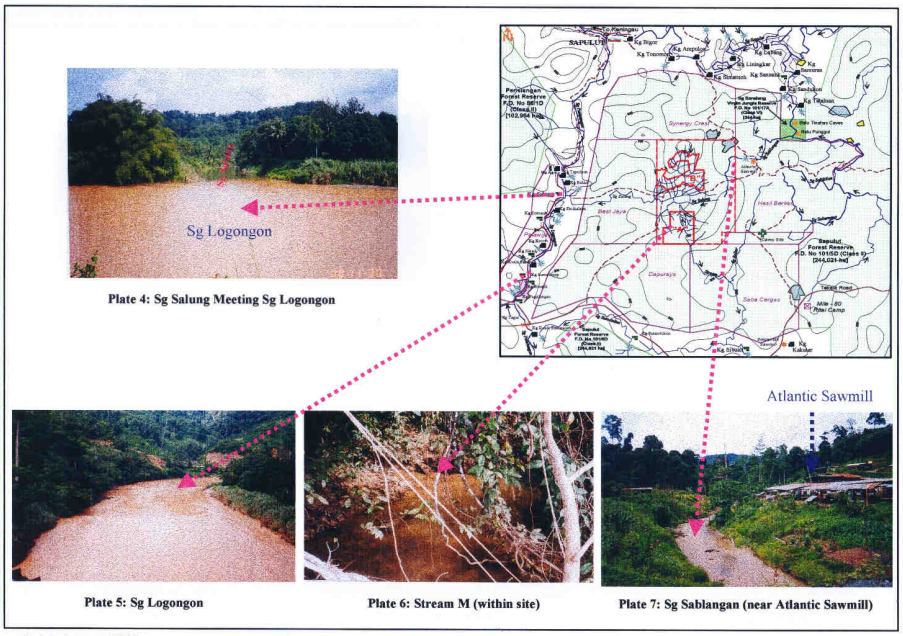


Figure 3.6 Catchment boundaries for the project area as abstracted from a 1:50,000 map

Plate 3.1 Example of photographic data used to supplement the assessment



The environmental assessment for oil palm plantation development shall be based on size and sensitivity of the locality. Size and sensitivity are defined in Table 3.1:

Table 3.1. Project size & sensitivity definition

Size	*Area (inclusive of adjacent lands for oil palm plantation)*
Small	Less than 500 ha
Medium	500 to 5000* ha
Large	More than 5000 ha
Sensitivity	*Locality*
Normal	Anywhere not listed as 'sensitive'
Sensitive	Riparian reserve; gazetted conservation areas; high risks erosion sites; flood plains; mangrove swamp/forest; water supply catchment and intake point

**As a rule of thumb, a planted area of at least 5000 ha justifies the establishment of a palm oil mill*

The representation of spatial data by means of a Geographical Information System (GIS) provides an appropriate tool for representing and analysing spatial data sets, particularly for larger, more complex and sensitive projects. Geographical Information Systems therefore offer good opportunities to examine the environmental impact of conversion activities.

Results obtained from computer 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 ECD actual procedures must be made available. Before using computer models, prior consultation and approval with ECD is required.

3.3 Key impact I: Ecological impacts

The establishment of plantations will result in the permanent loss of forest and the local extinction of nearly all species. If nearby 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 die or out-compete the resident individuals, resulting in their displacement or eventual loss of the residents.

Locality and site preparation activities are the two main aspects that create 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 methods for impacts on flora and fauna

Assessment A: Determine the need to study flora and fauna impact

Whether or not flora and fauna impacts need to be addressed in the EIA depends on a number of factors, some of which would have been determined in the initial assessment of the project (section 3.2 above). For example:

- 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
- Assessment of existing regulatory bodies and agreements governing the project
- Assessment of the main project activities
- Assessment of the project site.

Based on the above is might be assessed that there is no need for a flora and fauna study, and related proposal of mitigation measures and monitoring programmes. For a small to medium scale clearance project, there would generally be no need or little purpose to study the flora and fauna impacts as the land has already been designated for alienation.

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

Assessment B: Assessment of impacts on flora and fauna

If the review in Assessment A above determines a need for studying flora and fauna, or if an assessment has been specifically requested in the Terms of Reference (TOR), a more detailed study shall be undertaken.

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.

The following assessment method might be applied:

- **Step 1. Habitat classification and mapping of the project site and surrounding areas**. A useful inventory for management purposes is a habitat map based on aerial photography or satellite imagery with ground checks augmented by information on the distribution of important species. Habitat mapping based on surrogate factors such as altitude and precipitation are other possible ways of further subdividing the landscape (Figure 3.7). The habitat scale of analysis may provide opportunities for estimating the given range of a species. For example, it may be known that a particular species occurs from sea level to nearly 1,000 meters in elevation, as long as there is adequate forest cover. Existing data and maps of habitat and species distribution should be consulted to prepare the habitat maps. Range data are often more readily available for mammals such as primates or popular bird species. Reptiles, fish, insects and plant range data are generally not as well documented. A faunal survey of Sabah was compiled in 1982 (Davies & Payne, 1982).

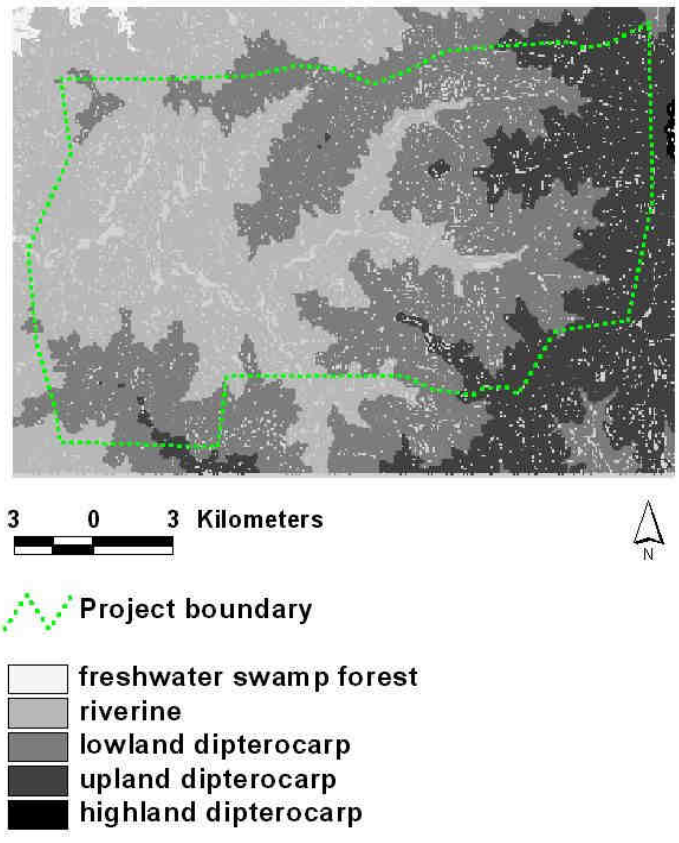


Figure 3.7 Zoning of a project area by vegetation type

- **Step 2. Initial flora and fauna inventory survey.** An initial flora and fauna inventory survey should be undertaken. The survey should include collection of the following data: (i) Data from Wildlife Department and other relevant governmental and non-governmental organisations, (ii) data from the local villagers. List of consulted persons shall be included in the EIA report

  An assessment, based on step 1 and 2, should identify sensitive habitats/species by determining the conservation status of the habitat/species within the project area and the surrounding areas. For example, if the conversion is likely to result in the extinction or endangerment of a species at an international level, there would be strong grounds for conducting a more detailed survey with the ultimate aim of protecting the habitat to ensure the survival of the species. However, if for example the species is found elsewhere or is sufficiently protected in other conservation areas - then the assessment would have to acknowledge that locally the loss of that species might not be significant Legally protected are listed by the State *Wildlife Conservation Enactment (1997)*

- **Step 3. Design the field survey**. If it is specified in the Terms of Reference (TOR) for the EIA study that a detailed flora and fauna assessment must be conducted, a relevant specialist or team shall be commissioned. Detailed flora and fauna surveys are time consuming and are typically associated with actual field observations. It is strongly advised that the Wildlife Department are consulted in planning the survey and that the overall approach is approved by the ECD prior to embarking on any fieldwork

  The survey should answer the following question: what species occur within the project site, where and in approximately what numbers? Data should be collected on those species which are ecologically dominant forms, endangered species or species whose numbers reflect important ecological processes.

  Step 4. Indicator species survey. Given the limited time and resources available for assessments, it is recommended that the survey be selective and should restrict observations to a few *indicator species* or key phenomena that reflect broader trends, and to other measurements that give an indication of the general biological condition of the environment.

  Data represented spatially on maps are easier to evaluate than a database format only (Figure 3.8).

  For the largest most important sites, habitat maps should ideally, consist a polygon-structured base map to which point structured wildlife data are related.

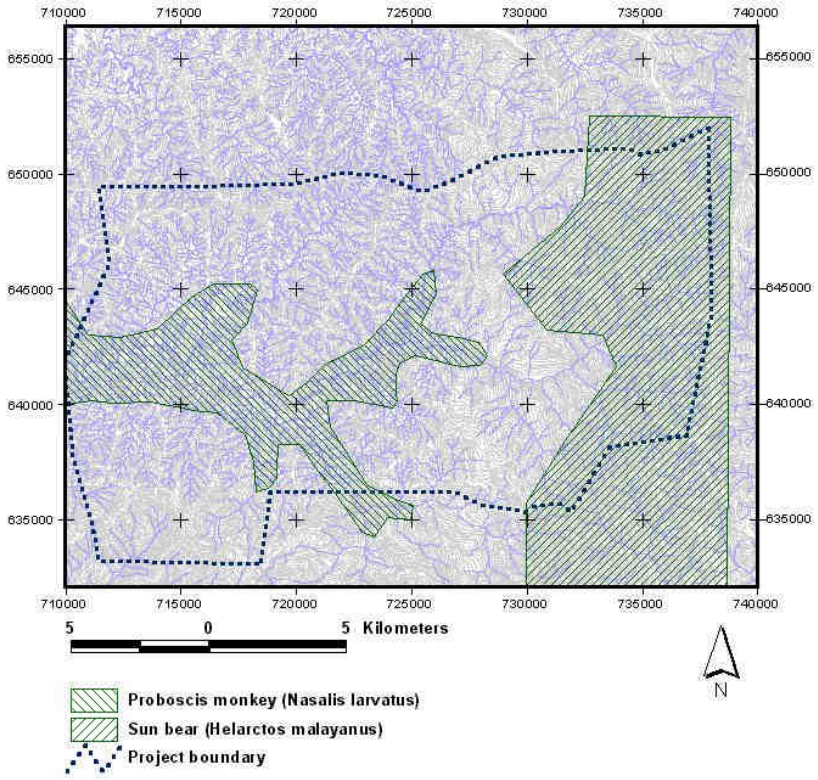


Figure 3.8 Approximate range of two indicator selected species for the project area

- **Step 5. Assessment of procedures to provide protection.** If the steps above have shown the presence of important species the study should proceed with an assessment of alternatives for providing protection. The assessment as to whether or not some form of protected status should be given to an area is a difficult and complicated process and is largely dependent upon an assessment of the protected area needs of the State alongside the conservation requirements of a given habitat/species. Ideally, in the first instance, this should be determined at a national/State level using some form of spatial analysis (GIS) of existing protected areas, habitat and species distribution. Conservation gaps – gap analysis – highlight the difference between what needs to be protected and what is actually being protected. The protection of an individual site would generally not be sufficient to protect general levels of biodiversity, instead an appropriate and well-planned network of protected areas is needed. Protected area gaps then need to be assessed alongside mechanisms for providing protection, i.e. what are the options for gazetting an area and affording it realistic long-term protection. Whereas some opportunities may exist to incorporate parts of the plantation into existing protected areas, or if the area is of sufficient importance it could be gazetted as a protected area on its own right, it must be recognised that as part of the overall economic development process, large areas of State land will continue to be alienated. As such, opportunities for conservation will often be related to the size and location of the project.

Protection options available include buffer zones, forest fragmentation and wildlife corridors:

- *Buffer Zones.* As a general principle, oil palm plantations and protected areas do not make good neighbours and the development of buffer zones or some areas of intermediate land use is often desirable between the two. Sometimes it may be sufficient to utilise an adequate natural barrier such as a river, estuary, ridge crest or swamp that forms a deterrent to exotic species and human incursion. Protected area buffer zones can be defined as areas adjacent to protected areas, on which land use is partially restricted to give an added layer of protection to the protected area itself while providing valued benefits to the neighbouring land-user. Extension buffering extends the areas of those habitats contained within the protected area into the buffer zone, thus allowing larger total breeding populations of plant and animals than could survive within the reserve alone

  In determining the type and extent of buffer zones needed, the following factors should be considered: (i) Needs of threatened wildlife species for use of additional habitat outside the reserve boundaries. Knowledge of the habits and range of the species will give some indication of the extent of the buffer zone, (ii) the need of the buffer zone to serve other protective functions, such as soil and water conservation or fire break protection, (iii) the need to contain wildlife species likely to move out of the reserve, (iv) the amount of land available for buffer use, whether it is currently under natural or other vegetation and whether it is vacant or being used

- *Forest Fragmentation.* As land and vegetation is converted, forests become fragmented until the remaining undisturbed habitats are isolated as patches. In tropical forests the isolation process may take many years, undergoing several stages of development, particularly if the forest is part of a rotational production stand. Rates of species survival will depend upon the remaining habitat and the proximity to other undisturbed areas. The fate of the remaining habitat islands and the changes that result from the isolation has drawn much research. The impacts are complicated by a number of variables and no one example is representative of all, however, it is generally acknowledged that larger reserves minimise edge effects and are better able to accommodate wide ranging species. However, it is also acknowledged that small well-placed reserves play an important role as a number of small reserves may be better able to conserve a greater variety of habitat types and more populations of rare species than a large block of the same area

  As a fragmented area diminishes in size it will eventually reach a stage when it is no longer able to support the critical minimum population size for more and more species. A species in a patch may become locally extinct, only to recolonise later. This will depend on the species and the proximity of the next fragment containing the species

- *Wildlife corridors.* It has been argued that, by conserving corridors of land between similar habitats, recolonisation may be aided and the overwhelming problem of habitat fragmentation may in part be addressed. However, some researchers and practitioners who argue that the negative aspects of corridors are detrimental to the larger conservation area dispute this. Corridors may

provide a pathway for the spread of disease and fire. After the debate, however, often there is no other choice than to manage the remaining fragments as best possible

Corridors that facilitate the natural patterns of migration will probably be most successful at protecting species, however, the equatorial humid tropics with limited seasonality experiences little or no migrations of terrestrial land vertebrates although there may be irregular grouping and movements of some animals such as pigs and elephants. Corridors facilitating the movement of wildlife have to be well thought out with a priority of joining areas of *like* habitat. Often there are only very limited options for expanding the protected area network with corridors.

3.4 Key impact II: Soil erosion

When site clearing is carried out, removal of the protective vegetation cover and disturbance to the soil surface will inevitably increase soil erosion rates. The activities that impact these rates are tabulated in Table 3.2.

Table 3.2: Summary of soil erosion impacts for oil palm plantation development

Key impacts	*Possible cause*	*Typical effects*
Soil Erosion	Clearing and earthworks - construction of access road	Reduction in arable soil from plantation area
	Clearing and earthworks - establishment of base camp	Elevated Total Suspended Solids content and turbidity in waterways downstream
	Site clearing and earthworks for the nursery site clearing and earthworks – terracing, drainage works, infra-structure	Reduction in channel capacity of waterways due to sedimentation leading to potential localised floods

Eroded soil as a result of oil palm plantation development will be deposited in the waterways. The washing of surface runoff laden with eroded soil particles will increase the total suspended solids (TSS) 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.

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, channel capacity will be reduced. Soil loss to the streams or rivers is expected to reduce as time progresses when palm trees mature and ground vegetation establishes and grows.

The dominant factor controlling soil erosion in the humid tropics is *rainfall volume and intensity*, which in turn is controlled by:

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

For at specific project the key soil erosion issues relate to:

- The project location
- The area of land exposed to erosion
- The period of exposure.

Assessment methods for soil erosion risk

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
- *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 poor resolution of available 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:

- **Step 1: Elevation 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 (Figure 3.9 & 3.10) 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

- 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, such a map will provide important indicative information as to high risk areas. It is also recognised that in some cases when other data is not available, then slope may be the only indicator of erosion hazard available

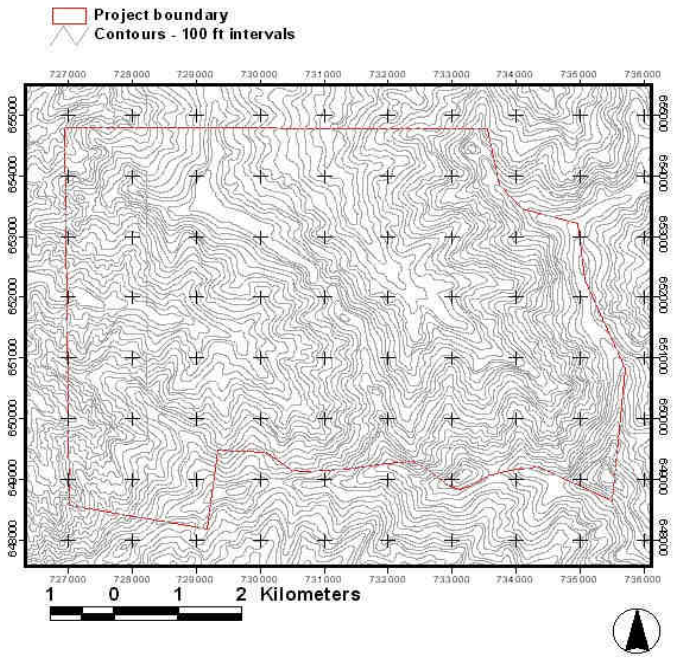


Figure 3.9 Elevation and geographical location of project abstracted from 1:50,000 map sheet (Required to derive slope – RSO projection).

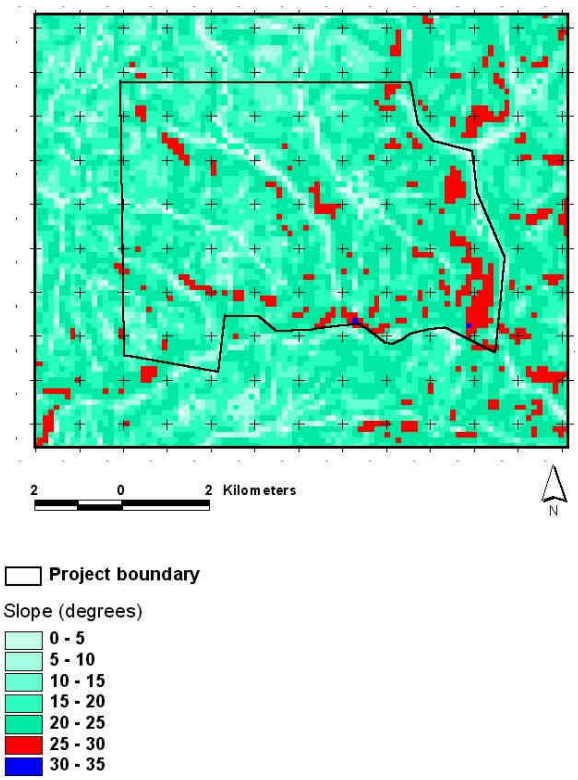


Figure 3.10 Slope as derived from elevation (Figure 3.9).

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

- *Vegetation*: Available data on vegetation cover, habitat and/or current land-use 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, remotely sensed data e.g. satellite imagery or air 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 important information for the data layer

- *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, Department of Irrigation and Drainage, etc., 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 hazard, 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 (1975). 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. It should be borne in mind that following disturbance the physical properties of most soils are changed so dramatically that often there is little relationship to the original data and survey results. If soil data is used for erosion risk modelling or is presented as part of the assessment, the significance of the data must be stated. For example, one soil type may be more erodible because it has a higher percentage of sands and silts. The presentation of soil data without accompanying explanatory information is not acceptable

- **Step 2: Schedule and phasing of operations.** The schedule and phasing of operations should be clearly stated and when possible represented in a spatial format. Information on the time lag between logging, clearance and conversion to oil palm plantation is required. The conversion should preferably take place in phase or immediately after the forest 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

- **Step 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 hazard or isolated areas of high erosion hazard i.e. single hill slopes (Figures 3.11). 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.

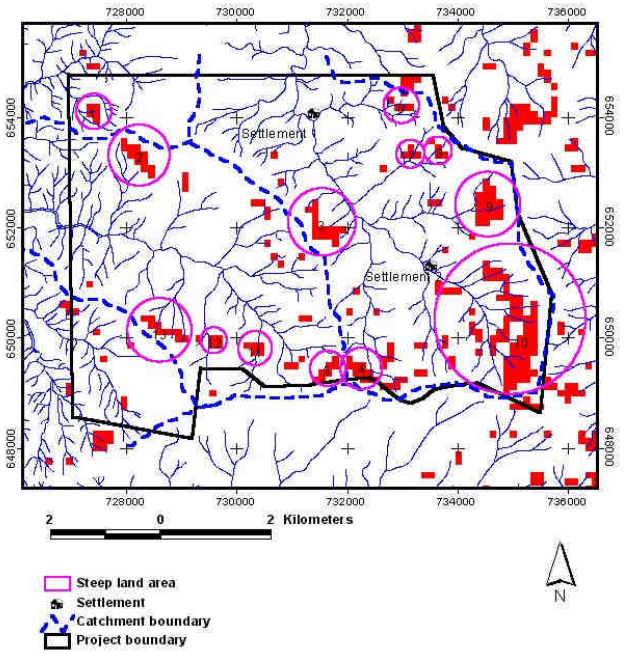


Figure 3.11 Erosion risk as derived from data on slope, vegetation and rainfall.

3.5 Key impact III: Biomass disposal

Site preparation and field maintenance result in generation of large quantities of biomass. Site clearing comprises activities such as underbrushing and clear felling that generate 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 needs to be removed from the project site to enable terracing and other works to proceed. Improper biomass disposal into streams and rivers may block or pollute rivers and thereby impact downstream settlements.

In the past, burning and re-burning of dried biomass has been practised on the grounds that it was the easiest and most economical means of disposal. However, since the occurrence of transboundary haze problems experienced by the nation in 1997, the result of widespread open burning for land development, a zero burning policy has been implemented.

The zero-burning technique is a method of land clearing whereby the remaining tree stands are felled and chipped and left to decompose *in-situ* or used as mulch for young palms. Zero burning enhances the soil organic matter status, thus helping to restore and improve the fertility and physical status of soils as plant nutrients are recycled, thereby the need for the inorganic fertilisers could be reduced. However, this method does not go without disadvantages; one of which is that termites proliferate in the rotting wood material and the other is that plant diseases may be not be fully eliminated (i.e. the diseased parts of the plant or plants are not removed or eliminated). Controlled application of pesticide may eradicate these problems.

Assessment method for biomass disposal

- **Estimate of biomass to be generated.** 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 off by sorting/recovery of re-useable biomass (segregate re-useable timber from vegetative wastes). After undergoing sorting and recovery of useable biomass, the leftover biomass from clearing activities, which is mainly vegetative wastes, must be disposed off by adopting the zero burning technique.

3.6 Key impact IV: Impact on human settlements

Oil palm plantation development can result in a number of interrelated adverse impacts on human settlements. The potential impacts that require investigation include:

- *Deterioration of drinking water quality.* Increased sediment loads and improper waste handling may degrade the quality of drinking water obtained from Gravity Feed Systems or water intake points, and thereby increase health hazard issues. In remote areas, especially areas where piped treated 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). Quality of water supply may be affected and the local people 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

- *Landownership 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* related to road construction, operation and haulage.

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

If the EIA study reveals other adverse impacts on local settlements, these must also be documented, studied and assessed in the EIA study.

Assessment method for impacts on human settlements

The objective of the assessment is to identify areas that may need special attention, and appropriate assessment methodologies need to be identified depending upon the scale and significance of the project. The following steps are suggested:

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

- **Step 2. Survey of potential affected settlements.** 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; 'Where do your house get water from?' '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 problems associated with the project?' and, 'What are the important mitigation measures that you would like to have imposed'. An example questionnaire is shown (Box 3.1)

  The results of the questions have to be quantified and/or documented. Two maps of the settlements/houses shall be provided. The first map should be at the same 1:50,000 base scale as the other data layers and the second shall be at a larger scale and include the name and/house location of the respondents. If logistically feasible, all directly impacted settlements should be included in the survey (Figure 3.12). Photographs may also be used to supplement survey data (Plates 3.2)

- **Step 3. Detailed study and assessment of the key adverse impacts.** Based on the results of step 1 and 2, a detailed study and assessment of specific impacts should be undertaken. For example:

  Deterioration of potable water supply, for example mapping existing catchments used for potable water, documenting number of on-site and downstream users, investments costs to install alternative water supply, with reference to the physical impacts state the probable length of time the impact will last e.g. during the period of active clearance only, short term or permanent (Figure 3.13)

  Landownership issues, for example the reason and seriousness of land ownership conflicts, or number of settlers to be relocated. Land alienated for the proposed oil palm plantation development may be subject to claims as native customary rights, which are stipulated in Part IV of the Land Ordinance (Sabah Cap. 68). The definition of native customary rights is specified in Section 15 of the Land Ordinance as follows: *15. Native customary rights shall be held to be - (a) land possessed by customary tenure; (b) land planted with fruit trees, when the number of fruit trees amounts to fifty and upwards to each hectare; (c) isolated fruit trees, and sago, rotan, or other plants of economic value, that the claimant can prove to the satisfaction of the Collector were planted or upkept and regularly enjoyed by him as his personal property; (d) grazing land that the claimant agrees to keep stocked with a sufficient number of cattle or horses to keep down the undergrowth; (e) land that has been cultivated or built on within three years; (f) burial grounds or shrines; (g) usual rights of way for men or animals from rivers, roads, or houses to any or all the above.*

  Status of land may be determined by obtaining the cadastral map for the relevant area. If the land is not yet alienated, ground truthing should be carried out to verify whether there are any claimants. Any land under dispute or claims by the locals should be clearly demarcated until decisions are made as to whether it will be acquired or excluded. Under Section 16 of the Land Ordinance, the procedure to follow is as follows: 'Native customary rights established under section 15 shall be dealt with either

by money compensation or by a grant of the land to the claimant and in the latter case a title shall be issued under Part IV'

Landscape degradation and loss of existing and potential eco-tourism opportunities, for example the severity and extent of landscape degradation (e.g. compared to other similarly plantation sites, the extent of damage to water ways, mapping and photographing existing valuable landscapes as for example waterfalls, rocky streams, flat riverbanks for picnics, hills with views, plateaus with hills, scenic lookouts, wildlife, rare plants, scenic forest stands, geological formations, archaeological sites, culture heritage sites

Dust and noise problems related to road construction and transportation to be assessed by predicting the increase in traffic, the timing and scheduling of the transport activities, comparisons with transport activities in similar areas in Sabah, the number and location of settlements affected. The existing or intended route should be clearly marked alongside settlements that potentially may be impacted.

Water resource issues. If it is intended to abstract water for the purpose of irrigation or to meet the domestic needs of the workforce, the following shall be described: (i) intended pumping schedule (ii) volume of water to be abstracted, (iii) pumping and storage device and, (iv) intended source of water i.e. the river system. If there are other users on the same river system then existing usage and demand should be described. The volumetric assessment shall include details on the water resource of the intended source river, i.e. actual discharge if the river is gauged or an estimate if the river is ungauged. For the latter, the estimate should be based on extrapolation of data from a short term gauging exercise or by estimating the discharge using a water balance equation.

Project Title:
Household no./address:
Name:
Open questions (to be qualitative reported and analysed), for example:

Main problems associated with the project
_____
_____

Ideas for improvements of project implementation
_____
_____

Closed questions (to be quantitatively reported and analysed), for example:

	4	3	2	1
I strongly support the implementation of the project				
Etc				

Box 3.1 Sample semi-structured questionnaire form

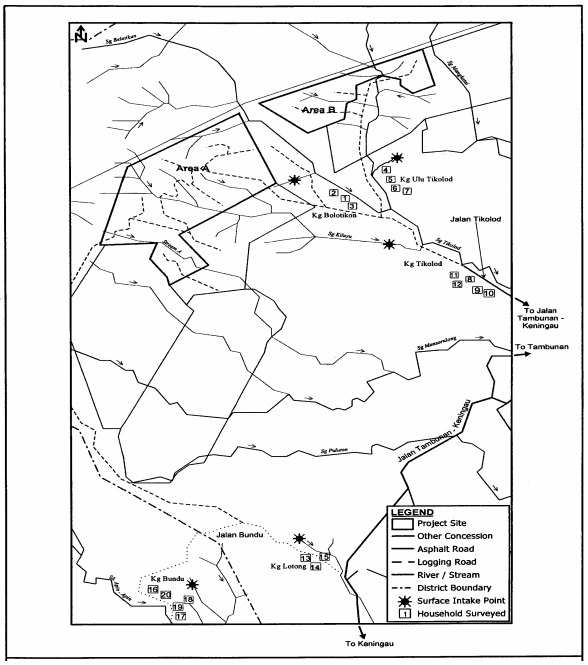


Figure 3.12 Example of location map to supplement survey data at a project site

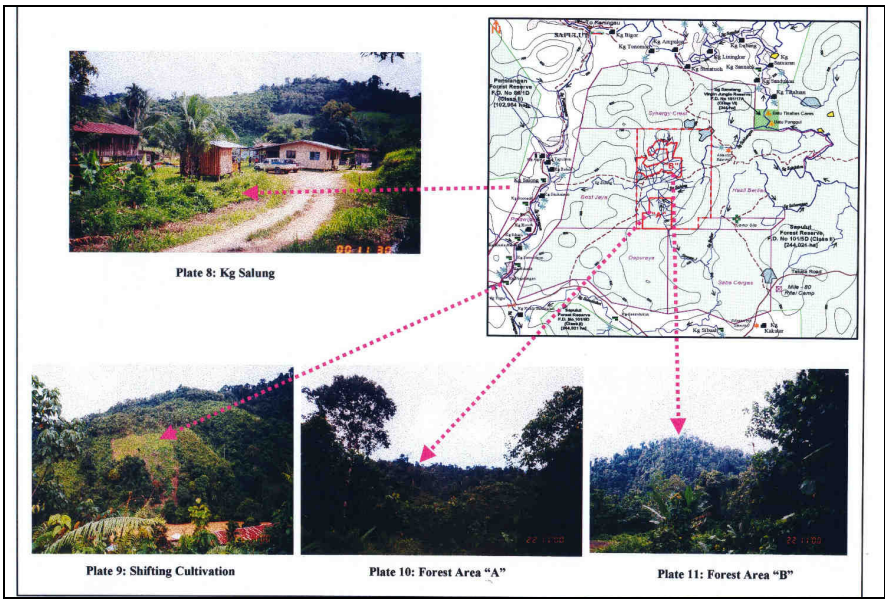


Plate 3.2 Photographs used to supplement social survey

(a) (b)

Plate 3.3: Any encounter with (a) boundary marker for local water supply catchment area or (b) local water intake points, shall be noted and mapped into the overall land use map

Plate 3.4: An example of a land ownership marking. Such markings need to be noted and marked in the land use map and further investigated

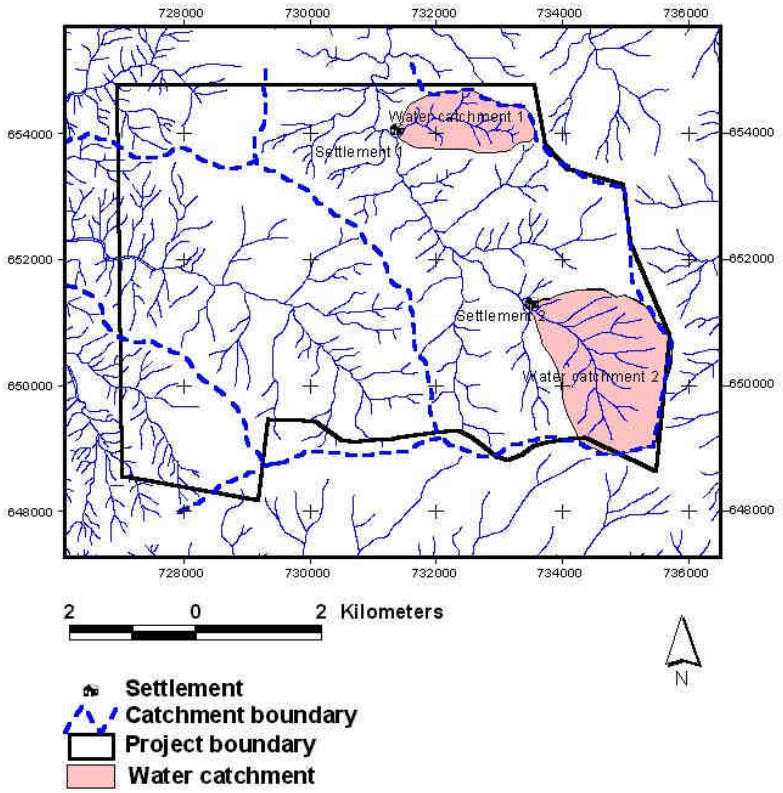


Figure 3.13 Social assessment highlighting gravity feed water supply catchments

3.7 Additional impacts

Additional impact I: 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. To maximise floodplain development, heavy bank protection may be widespread and the channel width may well be artificially reduced. Because channels in rural areas receive little or no operational maintenance or flood defence works, the landuse on the floodplain should be planned accordingly. The inclusion of river flood plain areas within plantation areas is a frequent occurrence as such lands are often fertile and easy to cultivate due to low lying nature of the land, however, it should be acknowledged that there are impacts and risks associated with such a practice and the impact of modifying existing or natural vegetation should be assessed.

The purpose of mapping a floodplain is to characterise the presence, size and nature of the low-lying area around the river channel, extending to the valley sides.

Vegetation plays several important roles in floodplain hydrology, overbank hydraulics and sediment dynamics. It is useful to know the type of vegetation assemblage on the floodplain

to gauge its influence on present hydrological, hydraulic and sediment processes, and to assess the potential for instability induced by changes in vegetation, landuse or floodplain management.

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.

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 air photo interpretation. It is relatively simple to identify old river channels and flow paths from air 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 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. 1,5,10,50 year floods. The flood plain area should be mapped on the topographic or river catchment base map.

Plate 3.5: Flood plain areas should be developed with caution. The removal of riparian vegetation weakens the bank, leading to bank erosion and collapse. Crops planted on the flood plain of larger river systems may be periodically inundated which may lead to crop mortality. This example shows that even for a relatively small 3rd order stream, disturbance of the flood plain can result in degradation and loss of river bank and damage to crops.

Additional impact II: Drainage of land (wetlands)

Wetland environments are heavily influenced by the pattern of water movment. 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 to generate aluminium. When both acid and aluminium are released into streams they have the potential to cause levels of deoxygenation lethal to wetland lifeforms. This causes biological death in waterways.

Subsidence is another problem associated with drainage of peat soils. When peat soils dry out they lose their buoyancy and increase the load on underwater layers of peat. The loss of water and reduced porosity causes the peat soils to consolidate, gradually lowering the level of the land. In low-lying areas this can lead to increased frequency of flooding, increased salinity due to the inflow of sea water 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.

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 are 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.

Additional impact III: 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 weedicides. 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 ways into the natural water sources 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 water sources.

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 condition. 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 euthrophication 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.

Fertilisers, if applied at the correct rate and evenly distributed over the ground surface during fine weather conditions should not pose environmental hazards as they are readily absorbed by plant roots. Some surplus that is not taken up by the roots would become absorbed or be converted into more insoluble forms within the soil environment and be released slowly, thereby posing no pollution hazards. Excessive and inappropriate applications will, however, create the potential for significant environmental impacts.

The use of pesticides on oil palm plantations is normally minimal. Biological control methods have proven to be quite effective (e.g. encouraging owl and snake populations). Under such a scenario, environmental impacts from pesticides will not usually be of concern unless pest infestations occur.

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.

Site assessment: Produce a map indicating areas at risk. The landuse map and topographic base map should be prepared to identify areas that may potentially be at risk due to the usage of agro-chemicals in and outside the plantation. As a minimum requirement *human settlements and water intake points should be identified. In addition, the* risk assessment *should be based on topography (flat, undulating, steep or very steep, soil types (different soil types will have different erosion rates), and usage of agrochemicals (different amount and properties of agrochemical will give different scenarios of pollution impacts).*

Additional impact IV: Land and water pollution from hazardous materials

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.

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. An *assessment of the potential amount of lubricants to be used and agrochemicals,* including storage requirements and location, should also be made.

Additional impact V: Land and water pollution from workforce housing

Environmental problems that can be associated with the development of workforce housing include the 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.

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 alongside the areas downstream areas that will be affected due to surface water pollution.

Mitigation measures

** Pictures not included*

Mitigation measures

** Pictures not included*

4 Mitigation measures

Steps	*Activities*	*Issues*
Step 1	Assessment of impacts	
Step 2	Mitigation measures	Key mitigation measures include: • Demarcation of water catchments as boundary • Exclusion of high risk soil erosion areas • River reserves • Reducing soil erosion • Zoning of flood prone areas • Buffer zones • Zero burning • Securing potable water supply.
Step 3	Monitoring	

This chapter covers identification of the major mitigation measures for the key environmental impacts identified, elaboration on implementation methodologies to be used to help minimise or eliminate the impacts, and description of other mitigation measures.

Mitigation measures include:

- *Preventive* to be addressed during the pre-feasibility study and land application including site selection, exclusion of areas e.g. risk areas for soil erosion and flooding, plantation layout particularly for drainage system and road network

- *Control* to be addressed during development and operational phases and related to working practices such as implementing zero burning, controlled fertiliser application and usage of pesticides, establishment of cover crops at cleared areas

- *Compensatory* whereby it is recognised that there will be an impact and that some compensation for the loss is to be made. This could include compensations to local settlements.

4.1 Key mitigation measures

Key mitigation measures for oil palm plantation development activity include:

- *Provision of zones* to buffer adjacent or nearby protected areas
- *Demarcation of water catchments* as the boundary for the plantation development area
- Exclusion of *high risk soil erosion areas* or steep areas to minimise soil erosion and water pollution
- *River reserves* to act as filter for soil erosion and protect important ecological habitats
- Implement *practices to reduce soil erosion when developing the plantation*
- Exclusion of *flood prone areas*
- Practice *zero burning* to eliminate air pollution problem
- Exclusion of catchment areas or provision of alternatives for local water supply.

Other additional mitigation measures include:

- Use of agro-chemicals
- Pest control
- Maintenance of waterways
- Sanitation facilities
- Management of hazardous materials.

4.2 Key mitigation I: Match 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. 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 residing in a given catchment. This will also facilitate enforcement as well as clearly defining the spatial responsibility of the Project Proponent.

Assessment of and proposals for mitigation measures for demarcation of water catchment as boundary 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

4.3 Key mitigation II: Zoning of high soil erosion areas

Exclusion of high risk soil erosion areas or very steep slopes will substantially reduce soil erosion rates and improve water quality. Reserved areas will furthermore provide habitat for flora and fauna within the plantation area.

Assessment of and proposals for mitigation measures for zoning of high risk soil erosion areas have to be made. The following can be used as a guide:

- **Step 1: Zoning.** From the results of the soil erosion high-risk hazard assessment, the project site should be zoned accordingly. Areas comprising of significant regions of high risk shall 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. No trees are to be felled within the hill reserves (Plate 4.1). Machine access is prohibited in the hill reserve

- **Step 2: Localising.** The risk areas shall be clearly mapped (Figure 4.1), numbered and described in the EIA report. Global positioning system (GPS) or other waypoint data of all high-risk areas are required (Table 4.1). If it is already possible to access the site, the boundary of the high-risk area should be surveyed. If it is not possible to access the site, the coordinates of the boundary should be abstracted from the 1:50,000 base map (Figure 4.2). To facilitate the monitoring of compliance and to aide implementation, recommended mitigation measures should be described or mapped in such away i.e. information transferred back to the original 1:50,000 base map scale, so as to allow position location to be unmistakably determined in the field

- **Step 3: Demarcation.** The identified high-risk soil erosion areas to be demarcated in the field (e.g. red or yellow paint) within two months of signing the Agreement of Environmental Conditions

- **Step 4: Estimate of Cost.** If it is proposed to excise an area then an *estimate of lost revenue* should be made.

Plate 4.1 A steepland/hill reserve

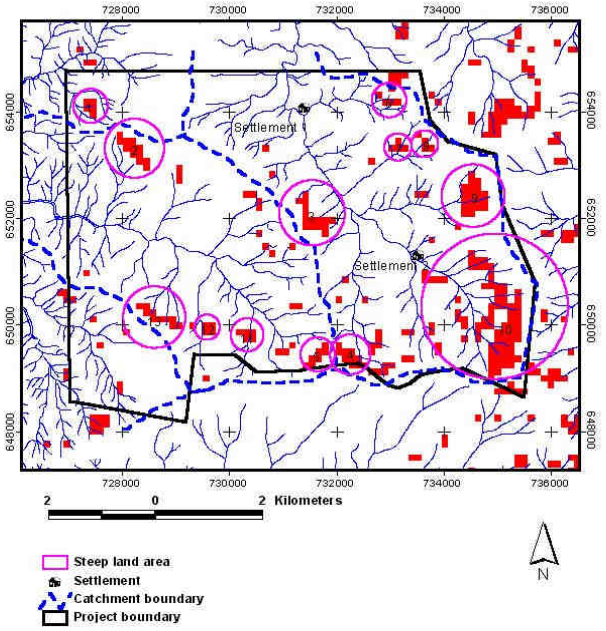


Figure 4.1 Identified high risk erosion / steep land areas

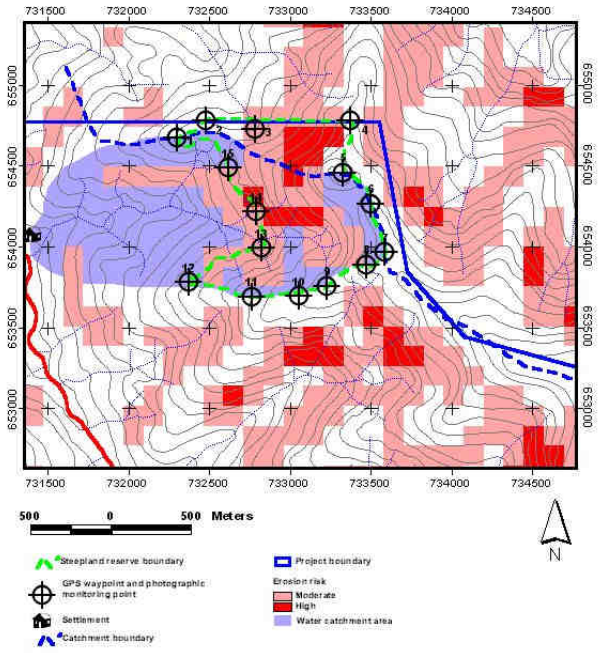


Figure 4.2 In this mitigation example it is proposed to exclude the upper part of a catchment, an area of high risk soil erosion coinciding with a catchment area, which is used to supply water by means of a gravity feed system. At intervals along the boundary, waypoint data is provided. The waypoint will later be used for photographic monitoring points

Table 4.1 Example of GPS (Geographical Positioning System) waypoint data for locating and demarcating steep land reserve

N4.76712	E116.92590	Point 1
N4.76900	E116.92423	Point 2
N4.76984	E116.92176	Point 3
N4.74087	E116.96955	P5A
N4.74454	E116.96515	P5B
N4.74336	E116.97051	P5C
N4.74318	E116.88271	P6A
N4.73634	E116.88340	P6B
N4.73292	E116.88396	P6C
N4.74250	E116.91799	P7A
N4.75357	E116.91913	P7B
N4.76394	E116.92719	P7C
N4.76710	E116.92588	P 1

4.4 Key mitigation III: Zoning of river reserves

The impact of plantation development in terms of ecology, soil erosion and water pollution can be minimised by the provision of river reserves for waterways affected by or related to the plantation.

The purpose of maintaining river reserves along rivers is to minimize the amount of sediments entering the river system, to minimize erosion of riverbanks and to minimize destruction of riparian habitat. River reserves serves 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 provide evacuation corridor and sanctuary for mobile fauna. In the long run, these excluded areas will provide habitats for most of the original species prior to the plantation development thus preventing their extinction. In addition the reserves maintain an aesthetic value and provide cover for some wildlife. The implementation of river reserves will also help protect the hydrological environment.

Assessment of and proposals for mitigation measures for zoning of river reserves have to be made. The following can be used as a guide:

- **Step 1: Mapping.** The river reserves to be clearly mapped. In accordance with the Water Resources Enactment (1998), all permanent watercourses *more than 3 metres wide should maintain a river reserve of at least twenty metres from the top of each riverbank*. During clearance activities this should be adhered to at all times. However, the width of the river might be wider depending on elevation contours, landscape and the provision of protection for flora and fauna protection. River reserves shall be clearly mapped and described in the EIA report

- **Step 2: Location.** Global positioning system (GPS) or other waypoint data of all proposed reserves are required for the demarcated area. If it is not possible to access the site, coordinates defining the proposed boundary to be excised should at least be abstracted from the 1:50,000 base map (Figure 4.3)

- **Step 3: Demarcation.** The identified river reserves to be demarcated in the field (e.g. red or yellow paint) within two months of signing the Agreement of Environmental Conditions. Irregular terrain may complicate demarcation of the reserve strip in the field, particularly for smaller rivers in steeper terrain but any proposed reserve must be clearly identified and maintained. No trees are to be felled within the river reserves. Trees immediately outside the river reserves must be felled in a direction away from the reserve. Machine access is prohibited in the river reserve, except for the specifically assigned road routes.

- **Step 4: Cost estimation.** The economic implications of limiting the project i.e. volume of timber lost, productive land lost, shall be assessed (Table 4.2).

Table 4.2 An indicative estimate of land area excised for provision of river reserves in Sabah

Plantation size	Length of rivers	Percentage land area excised
970 hectares	8 km	32 hectares

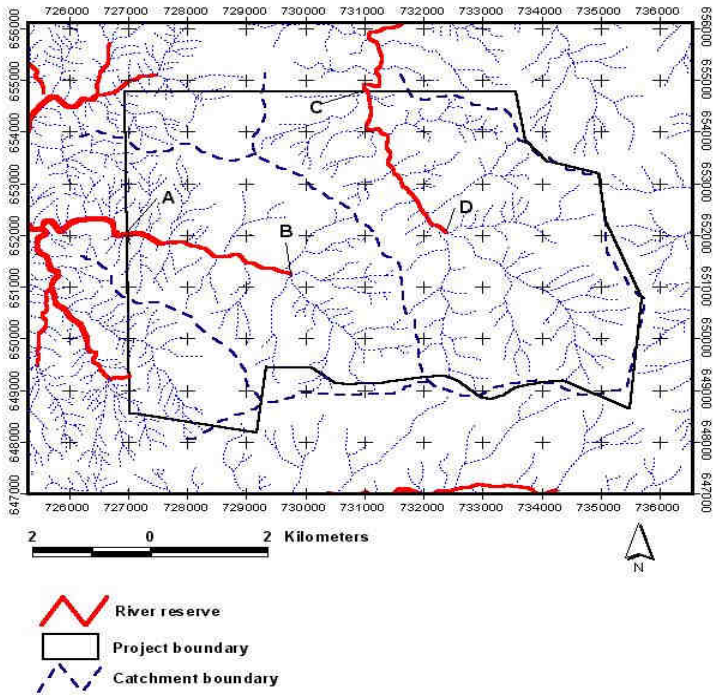


Figure 4.3 Rivers assessed as requiring riparian reserves. In this example all fourth order rivers and above have been identified. Waypoint data for the start and finish of each river reserve section is required. For example: River section A – B RSO coordinates = (7270051, 652003) (729097, 651088) and River section C – D RSO co-ordinates = (731751, 654945) (732909, 652088)

4.5 Key mitigation IV: Reducing soil erosion

Soil conservation practices will minimise or eliminate the impact of soil erosion within the plantation, which in turn will prevent related impacts such as water pollution due to high total suspended solid content in stream water.

A major step is recognising the potential soil hazard sites and the subsequent zoning of activities. Areas comprising significant regions of high soil erosion risk – steep areas - shall be excised from the project, see section 4.1.2. Provision of river reserves also contributes to reduced soil erosion, see section 4.1.3.

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. A summary of approaches to soil conservation practices are given in *Annex 3.1.*

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

- **Step 1. 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 should be re-vegetated with fast growing species such as *Centrosema pubescen*, *Calapogonium caerulum*, *Calapogonium muconoides*, *Pueraria phaseoloides* and *Pueraria javanica* or indigenous species of same attribute. Ground cover not only protects against soil erosion but if leguminous plants are used they may 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 entrain them. Compaction or other soil management practices may be implemented to reduce as much as possible detachment of soil particles. Practices intended used should be clearly stated in the EIA report

- **Step 2. Use existing access roads.** 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 road during nursery establishment and site preparation stages should be based on available existing logging tracks in order to minimise or prevent fresh clearing of vegetation. This approach will also reduce the cost for site development as the only cost that is necessary is for upgrading of these existing access roads. Existing and new road structures should be clearly marked in the EIA report.

- **Step 3. Provision of surface runoff control measures.** Drainage system for effective conveyance of surface runoff away from disturbed areas will minimise the extent of erosion. For plantation planting field, roadside drains may play this function and river reserves provided will further retain direct discharge of eroded soil particles into the waterways. However, for areas that were cleared for the plantation complex, 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 sedimentation of eroded soils prior to discharge into existing waterways. Any intended application of surface runoff control systems should be clearly indicated in the EIA report.

Plate 4.2: Typical site clearing sequence that entails clearing of underbrush followed by felling of tree stands. To reduce ground surface exposure to erosion, the activities may be modified by carrying out tree felling first and followed by spot clearing of under brush along oil palm planting lines

Plate 4.3: Rapid establishment of cover crops will prevent further erosion of cleared areas within the plantation

Plate 4.4: Establishment of cover crops at areas not meant for further development will significantly reduce soil erosion

4.6 Key mitigation V: Zoning of flood prone areas

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

Plate 4.5: The effect of developing oil palm plantation on flood plains – floodwater inundates oil palm trees. Prolonged inundation may result in tree mortality.

4.7 Key mitigation VI: Buffer zones to protected areas

The impacts of oil palm plantation development on the biodiversity of nearby protected areas can be minimised by provision of buffer zones between the plantation site and the protected area.

Proposals for mitigation measures for buffer zones to protected areas have to be made. The following can be used as a guide:

- **Step 1: Demarcation.** Clearly demarcation of areas where the plantation borders protected areas

- **Step 2: Type of buffer zone.** Assess and propose the most appropriate buffer zone system. In practice this will be restricted to the zoning of land use around the protected area, for example, leaving a strip of forest cover immediately adjacent to the protected area.

- **Step 3: Width of buffer zone.** Assess and propose width of the buffer strip from boundary of the protected area.

- **Step 4:** Plantations immediately adjacent to forested areas will find it necessary to consider other wildlife exclusion measures such as ditches or fences.

Plate 4.6: The newly constructed boundary ditch that serves as a physical barrier preventing possible elephant encroachment into areas already planted with oil palm.

Plate 4.7:Non-maintenance of ditch leads to re-colonisation by vegetation.

4.8 Key mitigation VII: Zero burning

Zero burning practiced during the development stage of an oil palm plantation will eliminate air pollution impacts.

Assessment of and proposals for mitigation measures for air pollution have to be made. The following can be used as a guide:

- **Step 1: Zero burning.** Zero-burning technique is a method of land clearing whereby the remaining tree stands are felled and left *in-situ* to decompose naturally or to be used as mulch for young palms. Zero burning enhances the soil organic matter status, thus help to restore and improve the fertility and physical status of soils. Large quantities of plant nutrients are recycled in the soil through decomposition of crop residues. With the recycling of plant nutrients, the input of inorganic fertilisers could be reduced. With zero burning, the decomposing debris would enrich the underlying soil (substitute for the applied inorganic fertilisers) and less erosion thereby resulting in better conservation of the natural soil resource and less water pollution.

- The windrow is a process whereby vegetative wastes are stacked in the inter-rows for natural decomposition to take place. Windrowing conserves the chemical nutrients in the vegetative wastes and enhances the soil nutrients or organic matter status.

- The EIA report should assess the practicability of the application of the zero-burning technique for the specific project, and make recommendations regarding the application

- **Step 2: Alternatives or modifications.** The EIA report should elaborate alternatives or improvements of the zero burning system particularly in relation to plantation pests within vegetative wastes.

Should the zero-burning policy change, making open burning allowed, particularly for first cycle development where the biomass volume might not be effectively disposed through natural decomposition, the air pollution impact may be minimised by limiting the area per burning session. Based on past experience, ease of control and acceptable level of air pollution due to burning activity can be achieved by only allowing 50 ha of fully dry biomass to be burned at any one time. Adjacent farms may have to negotiate on their respective burn area in order not to compound the pollution impact.

Plate 4.8: Typical effect of open burning for biomass disposal

Plate 4.9: Vegetative wastes from site clearing may be left on site (preferably properly stacked) to degrade naturally instead of being burnt

Plate 4.10: Pruned fronds disposed on site for natural decomposition

4.9 Key mitigation VIII: Securing water supply

Exclusion of water supply catchment areas from 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 made responsible for providing an alternative water supply for the affected community.

Assessment of 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:

- **Step 1: Mapping.** Water supply areas shall be clearly identified on a map (Figure 4 4) and waypoints to be supplied (Figure 4.5). The boundaries of the local water supply catchment areas have to be agreed upon by the Project Proponent and the claimants. The Lands and Survey Department should be involved

- **Step 2: Demarcation.** Project Proponent to mark and maintain a 2-m wide rentice marking catchment boundary.

- **Step 3: Cost estimation.** Estimated costs for securing potable water supply to affected settlements should be stated. If tanks are proposed, the number of tanks and intended recipients should also be detailed.

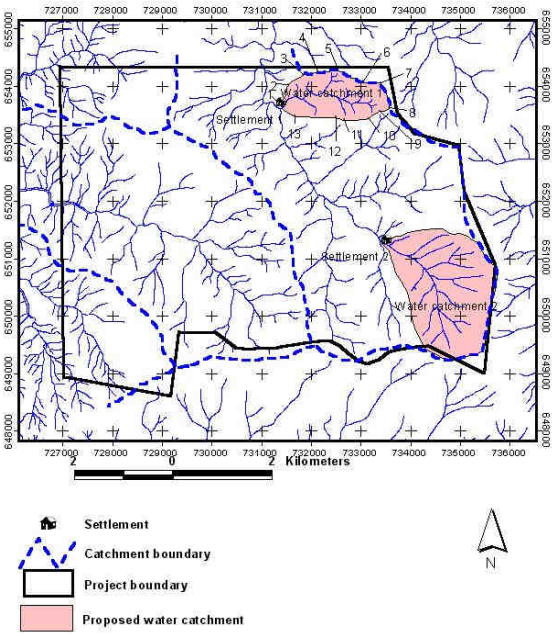


Figure 4.4 Identification of water supply catchments. For this example geographical positioning system (GPS) waypoint locations have been identified for water catchment 1

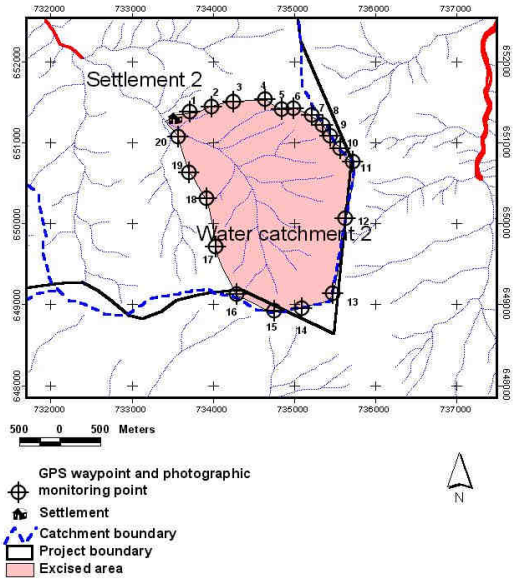


Figure 4.5 Waypoint/GPS (geographical positioning system) locations for water catchment 2 (See Figure 4.4)

Mitigation B. Alternatives for local water supply:

- **Step 1: Potential sources.** Identification of alternative water resources. This includes assessment of nearest Government piped water mains, the nearest existing reservoirs (for water supply or hydropower generation that can be modified to supply water), as well as rainfall collection

- **Step 2: Provide sources.** If nearest Government piped water mains are available, the Project Proponent shall 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 shall assist in providing the necessary resources (e.g. cost, labour and materials) for the water supply to be extended to the affected community. However, before decisions are made to mplement 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, the stage that Project Proponent may initiate assistance and support from the relevant Government agencies 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 excluded existing catchment areas from plantation development

- **Step 3: Cost estimation.** Estimated costs for securing alternative potable water supply to affected settlements should be stated. If tanks are proposed, the number of tanks and intended recipients should also be detailed.

Plate 4.11: A typical headland where weirs for water supply are constructed to impound water for the gravity feed water supply

4.10 Additional mitigation measures

4.10.1 Additional mitigation I: 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. Manuring/fertiliser application should be based on the palms requirements (i.e. through foliar sampling and analysis). Use of pesticides, weedicides and the like should be minimised and limited to serious cases of infestation and 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.

Plate 4.12: Manuring control

4.10.2 Additional mitigation II: Pest control

When carrying out zero burning method for biomass disposal, pests such as rats and termites may become a concern. The problem may be mitigated by:

- 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.

Plate 4.13: An example of a pest (rat) attack on palm fruits

4.10.3 Additional mitigation III: 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 prevention of flash floods on site.

As far as possible, stream crossings should be provided where natural waterways within the oil palm plantation are affected. This approach will prevent occurrence of flash flooding as well as ensuring smooth conveyance of surface runoff. 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.

Plate 4.14: Vegetative wastes blocking a waterway

Plate 4.15: A collapsed temporary crossing obstructing a stream channel

4.10.4 Additional mitigation V: Location of workforce camp

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

- Toilets with septic tanks that are maintained regularly to ensure their effectiveness
- Domestic waste disposal system that is capable of ensuring proper disposal, prevention of scavenging by rodents and other scavengers.

It is important that the Project Proponent allocates sufficient funds for providing the above facilities adequately for the plantation population.

4.10.5 Additional mitigation VI: 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 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 following measures may be implemented to minimise potential environmental pollution arising from these materials:

- Agrochemicals – used containers to be returned to suppliers or collected for approved disposal – the disposal procedure should be described.
- Used lubricants – collected for reuse and/or disposed off as scheduled wastes
- Fuel dispensing to be carried out at bunded area and by trained and experienced personnel to prevent spillage
- Containers for fuel and fuel enhancers to be collected and disposed of by approved procedures.

4.10.6 Additional mitigation VII: Joint-ventures with locals (smallholders)

When the native rights had been established, recognizing 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 acreage 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 Land and Survey Department for exclusion of such areas from the Land Title and thus will effect some reduction in payable premiums as well as other payments related to the holding the land. On the landowners' side, this information will ascertain their land area that will be included 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 the smallholders to work at the plantation.

The concept brought forward in the *Handbook on New Concept of Development on Native Customary Rights (NCR) Land : Policies, Benefits, Issues & Responses* published by Ministry of Land Development, Sarawak, may be modified to suit the Sabah context.

Monitoring

** Pictures not included*

Monitoring

** Pictures not included*

5 Monitoring

Steps	*Activities*	*Issues*
Step 1	Assessment of impacts	
Step 2	Mitigation measures	
Step 3	Monitoring	Environmental monitoring includes: • Compliance monitoring • Impact monitoring.

This chapter includes (i) monitoring requirements to ensure compliance of the recommended mitigation measures, and (ii) procedures for monitoring residual environmental impacts.

5.1 Compliance Monitoring

The ECD requires that compliance monitoring is afforded high priority, and as such, the suggested mitigation measures should be practical to implement and easy to monitor.

The overall objective of compliance monitoring is to employ relatively easy and economically viable methods to check the compliance of mitigation measures. Therefore, the EIA report must design in detail a compliance-monitoring programme for all key proposed mitigation measures. The EIA report should include the first data set for monitoring compliance e.g. photographs of existing river reserves, GPS (geographical positioning system) reading and location map indicating where photographs were taken.

The details will be specified in the Agreement on Environmental Conditions (AEC) between the Project Proponent and the ECD.

The following are examples of monitoring requirements that could be considered in relation to the key mitigation measures.

5.1.1 Demarcation of water catchment

Based on the flow chart on the land application procedure in Figure 1.1, the project proponent, upon issuance of the Draft Land Title, should carry out an EIA study for submission to and approval by the ECD. The findings in the EIA shall be used to determine the final plantation boundary that has taken into consideration the water catchments relevant to the proposed plantation.

The project proponent should provide the ECD with a layout plan showing the boundaries of water catchment within the plantation and the proposed project site that will be used by the Lands and Survey Department to issue the Final Land Title to the Project Proponent.

5.1.2 Zoning of high risk soil erosion areas

The project proponent should provide the following:

- The high-risk soil erosion areas identified in the assessment, with proposed mitigation measures, to be clearly mapped in the EIA report
- GPS (geographical positioning system) waypoint data used for demarcation as proposed under mitigation measures to be provided (Figure 5.1)
- Self-monitoring to include submission to the ECD of, for example (i), a description of works undertaken in relation to protection and demarcation of the high risk soil erosion area, (ii) a map at the largest available scale showing the actual demarcated area, and (iii) pictures of the demarcation as per map in the EIA report, from at least five different locations (locations to be indicated on map)
- Schedule to follow up site visits to provide updated information on the above. This should include at least a midterm and end of project compliance report.

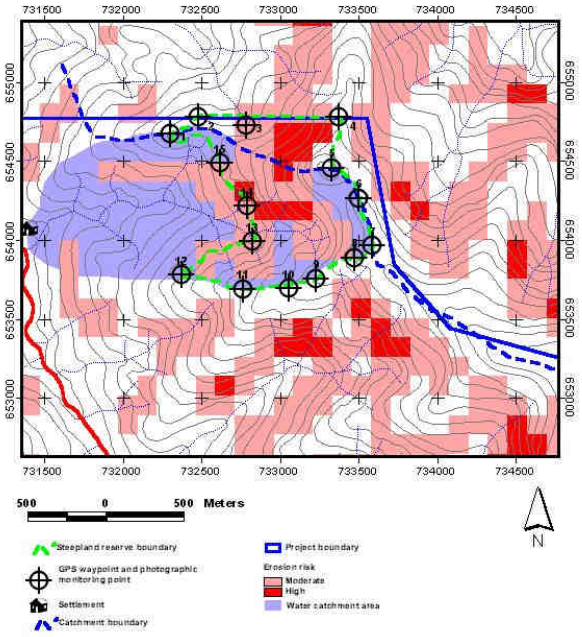


Figure 5.1 Compliance monitoring locations for the proposed mitigation measures

5.1.3 Zoning of river reserves

The project proponent should provide the following:

- The river reserves to be clearly mapped in the EIA report
- GPS (geographical positioning system) waypoints for the demarcated area to be provided
- Self-monitoring to include submission to the ECD of, for example (i), a description of works undertaken in relation to protection and demarcation of the river reserves, (ii) a map at the largest available scale showing the actual demarcated area, and (iii) pictures of the demarcation as per map in the EIA report, from at least five different locations (locations to be indicated on map – Figure 5.2 and Table 5.1)
- Schedule two follow up site visits to provide updated information on the above. This should include at least a midterm and end of project compliance report.

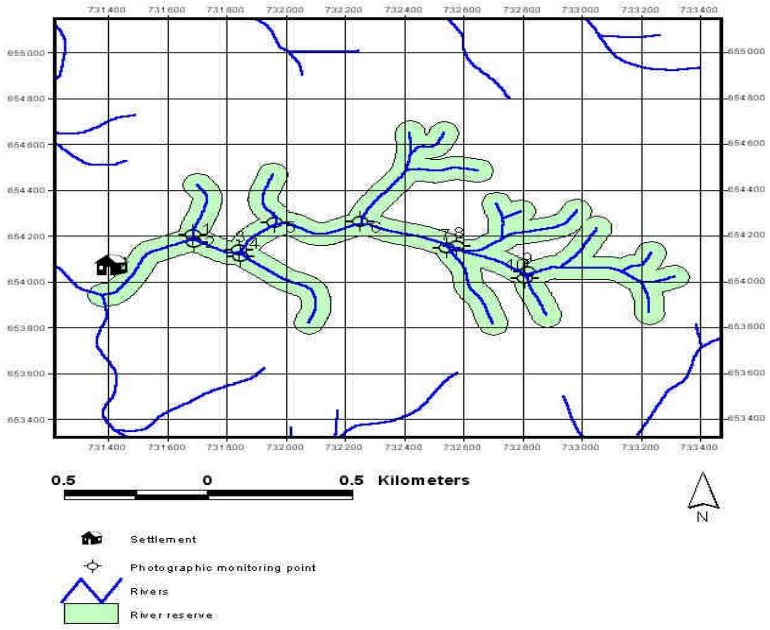


Figure 5.2 Example of map used to plan river reserve compliance monitoring activities

Table 5.1. Example coordinates for photographic monitoring

Photographic monitoring	X coordinate (RSO)	Y coordinate (RSO)
1	731682.04	654223.74
2	731692.33	654172.31
3	731846.63	654141.45
4	731849.20	654108.02
5	731967.5	654262.32
6	732255.53	654264.89

5.1.4 Reducing soil erosion

The project proponent should provide records on implementation of soil conservation practices – supported with photographs – after completion of new phases or as per the Agreement of Environment Conditions (AEC).

5.1.5 Exclusion of flood prone areas

The project proponent should provide a layout plan clearly marking excluded flood prone areas. The updated map should be submitted to ECD upon completion of any new development phases or as per the AEC.

5.1.6 Buffer zones to adjacent protected areas

The project proponent should provide the following:

- A layout plan clearly marking areas bordering protected areas
- GPS (geographical positioning system) waypoints for the demarcated area to be provided
- Self-monitoring to include submission to the ECD of, for example (i), a description of works undertaken in relation to the demarcated area, (ii) a map at the largest available scale showing the actual demarcated area, and (iii) pictures of the demarcation as per map in the EIA report, from at least five different locations (locations to be indicated on map)
- Schedule two follow up site visits to provide updated information on the above. This should include at least a midterm and end of project compliance report.

5.1.7 Zero burning

The project proponent should provide the record on practice of zero burning methods supported with photographs. The information should be submitted to ECD upon completion of any new development phases or as per the AEC.

5.1.8 Securing local water supply

The project proponent should, if water catchments are excluded, provide

- The site location map overlay onto topography map showing boundaries of local water supply catchment found within the project site.
- The map showing the above exclusion should be submitted to ECD upon completion of any new development phases or as per the AEC
- Self-monitoring to include submission to the ECD of, for example, a description and map of mitigation measures implemented to secure continued supply of drinking water
- Schedule two follow up site visits to provide updated information on the above. This should at least include a midterm and end of project compliance report.

The project proponent should, if alternative water supply is provided, provide the following information:

- Overall land use map showing the plantation and locations of the nearest Government piped water mains and approximate alignment of water pipelines to affected villages; and/or
- Overall land use map showing the plantation and the locations of water catchment, reservoirs/intake points and approximate alignment of water pipelines to affected villages; and/or
- Photographs showing implementation of the above and/or provision of tanks/drums for collection of rainwater.

The above information should be submitted to ECD upon completion of any new development phases or as per the AEC.

Monitoring techniques

Compliance monitoring will be undertaken primarily by means of the techniques listed below:

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

- Provision of hill/steep land reserves
- Provision of river reserves
- Reducing the time of soil exposure after disturbance
- Provision of buffer zones
- Proper hazardous waste handling.

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

Field checks. Periodic field checks at appropriate stages of the operation should be undertaken in order to ensure compliance of e.g.

- Provision of hill/steep land reserves
- Provision of river reserves
- Reducing the time of soil exposure after disturbance
- Maintaining potable water supply
- Provision of buffer zones.

Impact statements concerning affected settlements. Periodic statements, in written or oral form, from affected settlements can be used to check compliance of for example

- Provision of hill/steep land reserves
- Provision of river reserves
- Resolving landownership issues
- Maintaining potable water supply.

Satellite images. Larger projects or projects nearby sensitive sites, might be required to utilise satellite imagery taken at various stages during the life cycle of the project to monitor compliance i.e. implementation of mitigation measures such as:

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

All requirement laid down in the Agreement of Environmental Conditions, which is possible to check through the use of satellite images, as for example the above, 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 20 metres for multi-spectral images and 10 metres for panchromatic. The land area covered by a full SPOT image is 60km x 60km.

Normally two satellite images will be required: One before initiation of the project and one (or two or more for large scale projects) at the near end of the project activities (Plate 5.1).

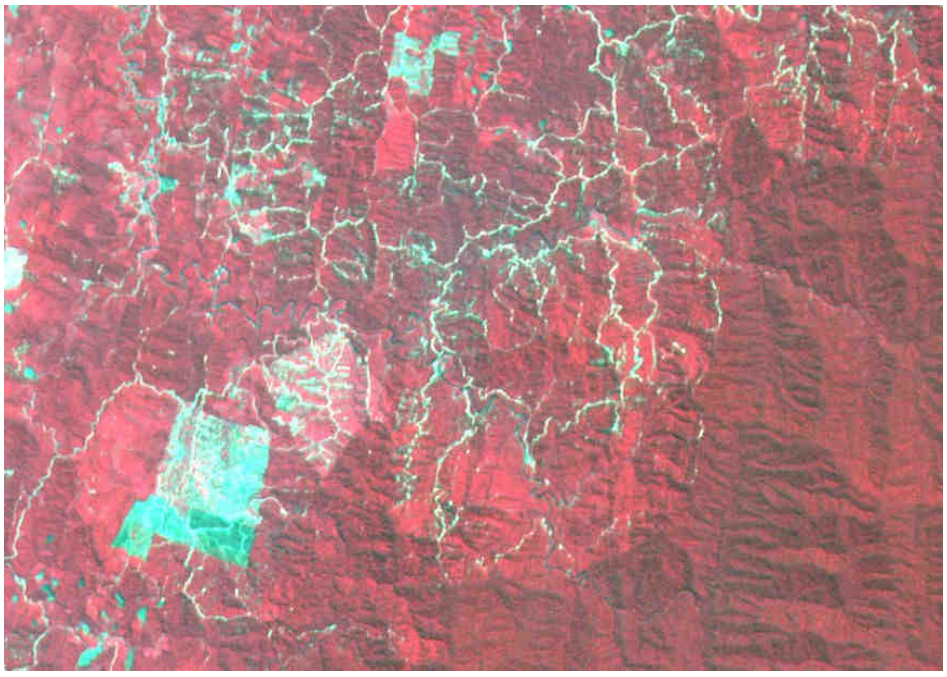


Plate 5.1 This SPOT image shows undisturbed forest (far right) and logging roads and skid trails (centre and above). The bright area left of centre represents an area that has been clear felled for oil palm plantation development.

Table 5.2 Approximate costs as of September 2000. If the image is purchased overseas, costs will also vary with exchange rates

Description	Unit Price (Ringgit)
SPOT Scene in level 1B Multi-spectral (XS) Full scene / Quarter scene 60km x 60km or 30km x 30 km	8,580
SPOT Scene in level 1B Panchromatic (P) or Multi-spectral (XI i.e. SPOT 4) Full scene / Quarter scene 60km x 60km or 30km x 30 km	11,440

Scheduling and responsibilities

As the EIA covers the entire project period the need for images and other monitoring requirements should be planned accordingly. The monitoring programme should be formulated in advance, by the EIA consultant in collaboration with the ground operator in accordance with the schedule of operations, and be approved by the ECD through the Agreement of Environmental Conditions.

The EIA should clearly state the responsibilities and actions to be taken in relation to compliance monitoring:

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

Non-compliance

Non-compliance will normally be followed by the issuance of an Order to comply and a simultaneously and immediate compounding of the non-compliance offence according to the *Compounding of Environmental Offences Rules, 1999, Environmental Conservation Department*.

Penalties for not complying with the mitigation measures should be spelt out.

5.2 Impact monitoring

If environmental assessment shows that the project may result in significant residual impact to the environment, the project proponent might be required to provide additional information to the ECD for impact monitoring purposes.

Impact monitoring will serve as the *red flag* whereby any monitoring components exceeding the stipulated limit for their respective parameters will be taken as an indication that the mitigation measures for that particular aspect are either ineffective, defective or not in place. Such findings may be used to enforce proper implementation of mitigation measures.

5.2.1 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 riparian 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, etc.). The baseline data will serve as the yardstick to ascertain the extent of changes taking places.

5.2.2 Soil Erosion

If the environmental assessment indicates that the oil palm plantation may result in significant soil erosion, periodical monitoring might be required carried out for signs of soil erosion on site and water quality deterioration that could be attributed to the soil erosion.

Visual inspection of soil erosion incidence 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 water quality of waterways relevant to the plantation, will have to be determined. Physical appearance on site - photographs of these erosion incidences gully, sheet, etc. shall be included in the report. Test results and assessment shall be reported and submitted to the ECD as per the AEC.

5.2.4 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 ECD. Report on the variations to be submitted to the ECD as per the AEC.

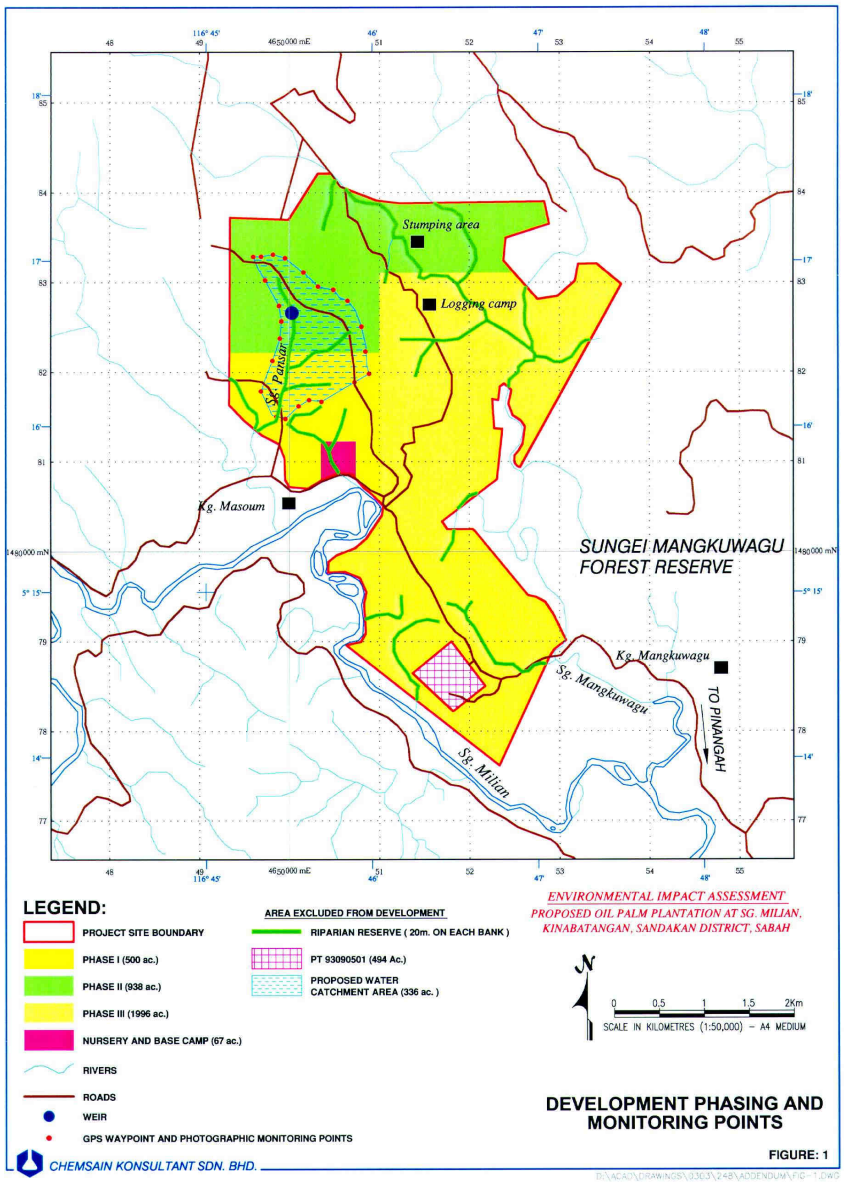
Water quality changes for waterways relevant to the oil palm plantation can be ascertained by determining variations between the existing water quality and the baseline data. Parameters that should be determined are total suspended solids, turbidity, dissolved oxygen, pH, biochemical oxygen demand (BOD), chemical oxygen demand (COD), oil and grease, agro-chemicals. Known aquatic life for the area such as fish may be used as the biological indicator for water pollution.

5.2.5 Water supply

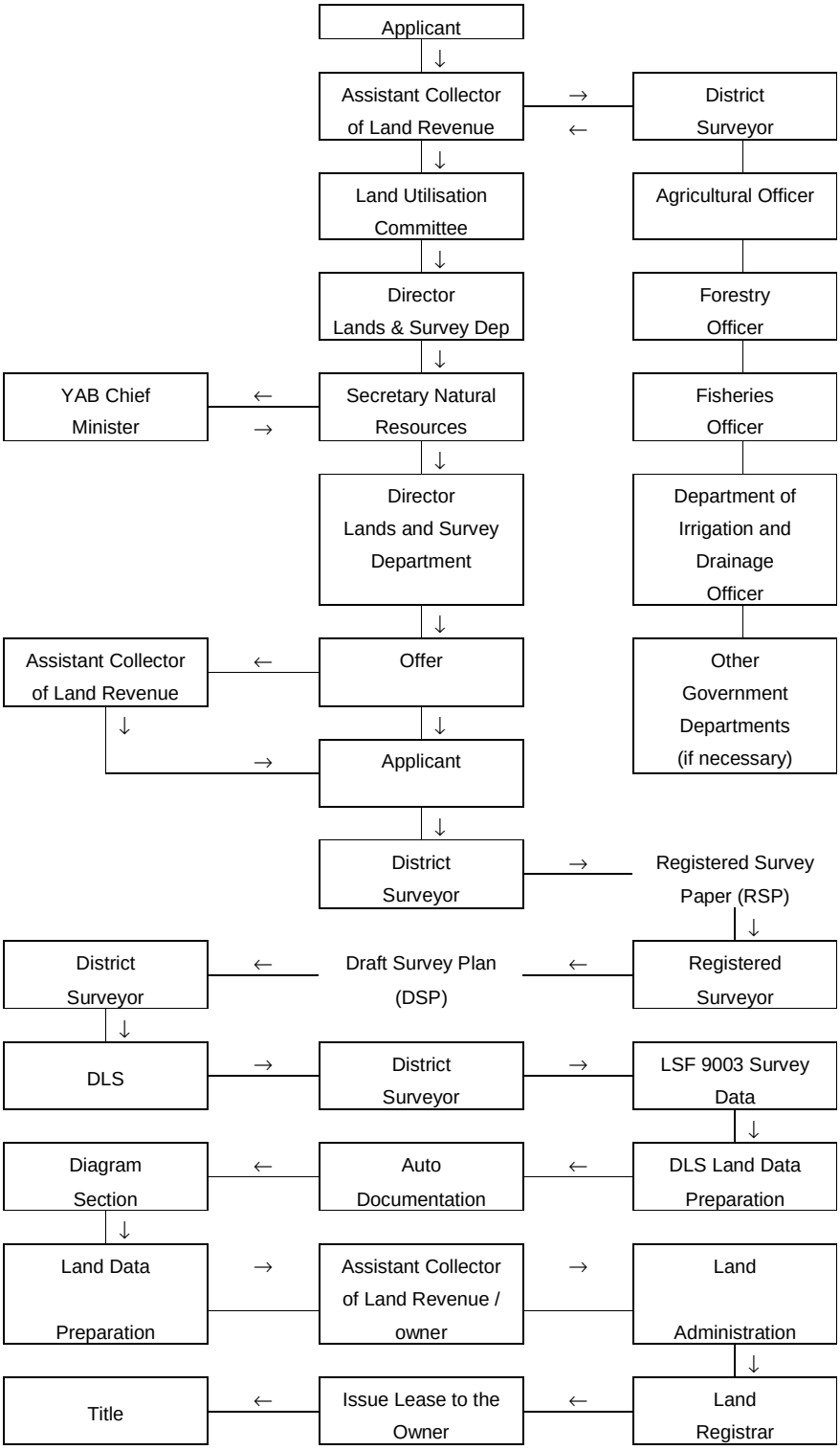
Matters pertaining to water supply that has not been properly planned and implemented will result in possible conflicts between the Project Proponent and those affected. In extreme situation, hostility may ensue, particularly when livelihood of the locals is seriously affected.

The impact monitoring on water supply 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 to be submitted to the ECD as per the AEC.

Any negative feedback or grievances can be considered as the presence of unresolved water supply issues. The Project Proponent, being the party that had initiated the change within the affected communities, should be responsive to these feedbacks by taking actions that could minimize or eliminate the negative or adverse impacts to all parties. Involvement or cooperation with the relevant Government agencies, especially the District Office, should be looked into.



Annex 1: Application procedure for oil palm plantation development in Sabah



Annex 2: Impact assessment criteria

A summary impact matrix for oil palm plantation development is shown in Table below. The criteria used for the impact assessment are:

- The *magnitude* of change/effect, which is the importance in relation to the spatial boundaries
- The *permanence* of the impact, which defines whether the condition is temporary or permanent
- The *reversibility* of the condition, which defines whether the condition can be changed and is a measure of the control over the effect of the condition
- To what extent the impact is *cumulative*, which is the effect will have a single direct effect or whether there will be a cumulative effect over time, or a synergistic effect with other conditions.

Project stage	Major environmental impacts	Magni-tude	Perma-nence	Reversibi lity	Cumu-lative
Nursery establishment	Ecology	1	3	2	3
	Vegetative waste	1	2	3	3
	Soil erosion	1	2	3	3
	Water quality	2	2	3	3
	Air pollution	3	2	3	3
	Pest infestation	1	2	3	1
Site preparation	Ecology	1	3	3	3
	Vegetative waste	1	2	3	3
	Soil erosion	1	2	3	3
	Water quality	3	2	3	3
	Floods	3	2	3	3
	Air pollution	3	2	3	3
	Pest infestation	1	2	3	3
Field establishment	Vegetative waste	2	2	3	3
Maintenance/harvesting	Water quality	3	2	3	3
	Vegetative waste	1	2	3	3
	Traffic	1	2	1	3
Replanting	Vegetative waste	1	2	3	3
	Water quality	3	2	3	3
	Air pollution	3	2	3	3
	Pest infestation	1	2	3	3
Abandonment	Traffic	1	2	1	1

Magnitude of change/effect: 1:within project site; 2:local conditions; 3: regional/national/international. Permanence: 1:no change/not applicable; 2: temporary; 3: permanent. Reversibility: 1: no change/not applicable; 2: reversible; 3: irreversible. Cumulative: 1: no change/not applicable; 2: non-cumulative/single; 3: cumulative/synergistic

Annex 3: Soil conservation approaches

Summary on effect of various soil conservation practices on the detachment and transport phases of erosion.

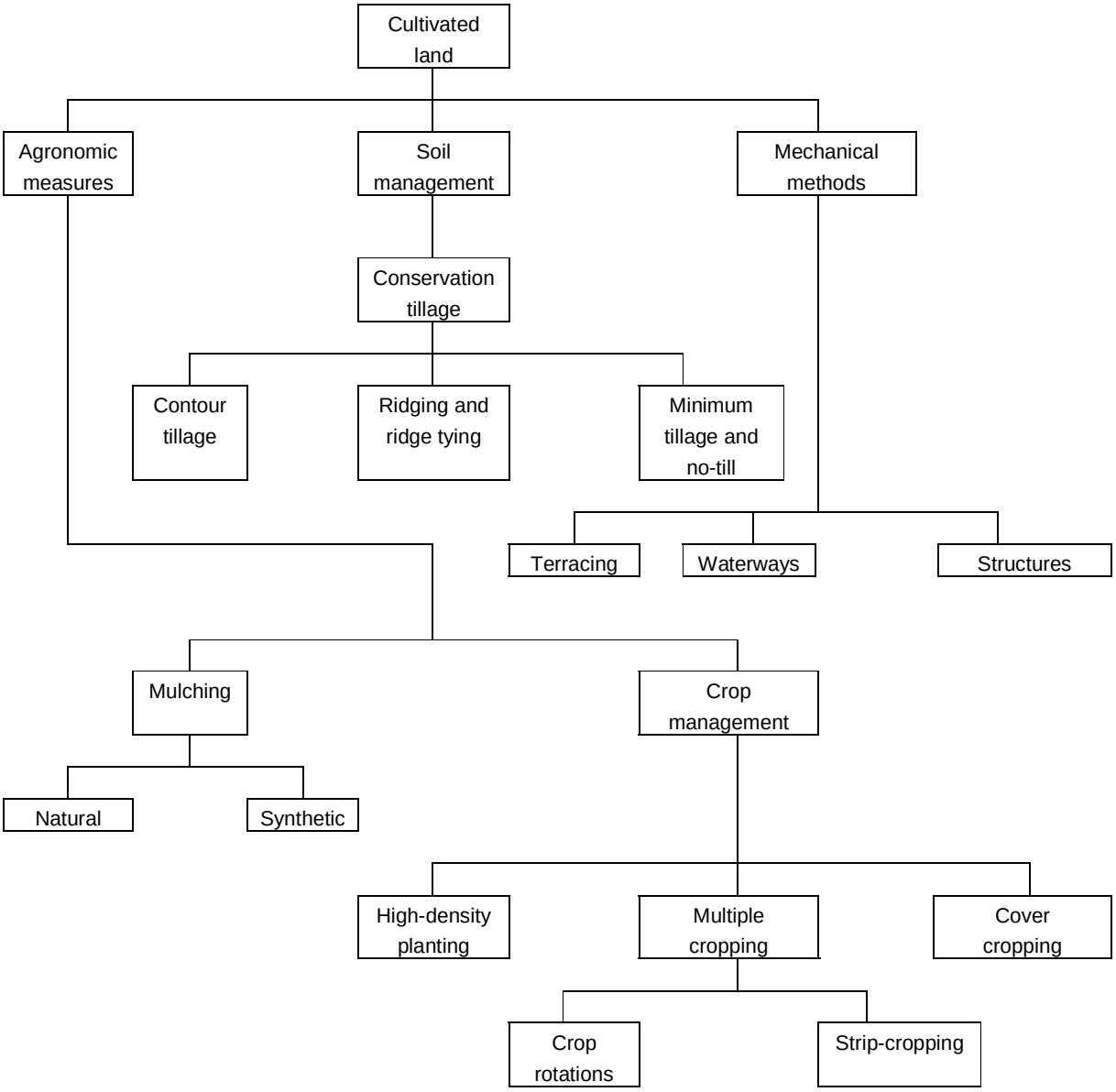
Practice	Control over					
	Rainsplash		Runoff		Wind	
	D	T	D	T	D	T
Agronomic measures						
Covering soil surface	*	*	*	*	*	*
Increasing surface roughness	-	-	*	*	*	*
Increasing surface depression storage	+	+	*	*	-	-
Increasing infiltration	-	-	+	*	-	-
Soil management						
Fertilisers, manures	+	+	+	*	+	*
Subsoiling, drainage	-	-	+	*	-	-
Mechanical measures						
Contouring, ridging	-	+	+	*	+	*
Terraces	-	+	+	*	-	-
Shelterbelts	-	-	-	-	*	*
Waterways	-	-	-	*	-	-

Source: Morgan (1986)

Legend:

-	No control	D	Detachment
+	Moderate control	T	Transport
*	Strong control		

Soil conservation strategies on cultivated land (Morgan, 1986).



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