TECHNICAL GUIDANCE ON SCOPING

PREPARATION OF EIA REPORT FOR DEVELOPMENT ON HILL AND SLOPE AREA

Department of Environment
Ministry of Natural Resources and Environment Malaysia

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LIST OF ABBREVIATIONS

DOE	Department of Environment
ESA	Environmentally Sensitive Area
DMG	Department of Mineral and Geosciences
MSMA	Manual Saliran Mesra Alam
NPP	National Physical Plan
NWQS	National Water Quality Standards
RUSLE	Revised Universal Soil Loss Equation
SSA	Site Suitability Assessment
FOS	Factor of Safety
LDP2M2	Land Disturbing Pollution Prevention and Mitigation Measures
WASP	Water Quality Analysis Simulation Program
DID	Department of Irrigation and Drainage
PWD	Public Works Department
DO	Dissolved Oxygen
BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
TCPD	Town and Country Planning Department
TSP	Total Suspended Particulate
PM2.5	Particulate matter less than 2.5 µm

SECTION 1 : INTRODUCTION

1.1 THE PURPOSE OF GUIDANCE DOCUMENT

The Handbook of Environmental Impact Assessment (EIA) Guidelines was formulated by the DOE to assist EIA practitioners in their preparation of the EIA reports. The scoping guideline was designed to address a broader range of activities and lacked specific information for different types of projects.

This technical guideline aims to be more focused and targeted specifically for scoping of activities related to development in hill areas or slope areas under the **First Schedule** of the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015.

The scoping for the preparation of the EIA shall address the following key areas:

(a) Potential impacts associated with developments on hill and slope areas
(b) Methods for assessing environmental impacts
(c) Appropriate mitigation measures
(d) Improve effectiveness of the present EIA procedures by :
- Assisting project proponents to understand the scope of EIA study;
- Assisting EIA team to focus on specific aspects;
- Providing reliable methods of assessing impacts

1.2 PRESCRIBED ACTIVITIES

This Technical Guidance on scoping for the preparation of EIA report is for the following prescribed activities contained in the First Schedule of the EIA legislation:

a) Activity No 12 (b) – Development in Coastal and Hill Area
Construction of hill-station resort or hotel at 300 meters or more above mean sea level covering an area of 20 hectares or more.

b) Activity No 13 – Development in Slope Area
Development or land clearing less than 50 per cent of an area with slope greater than or equal to 25^0 but lesser than 35^0 **(Figure 1-1)**.

Explanation for Activity No 13:

Any project on a site containing Class III slopes is a prescribed activity and is subjected to an EIA.

The extent of the total Class III slope areas within the overall project boundary will determine whether the project is subject to the First Schedule or Second Schedule of the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015.

- **If the total Class III slope area is less than 50% of the total project area, the activity is subjected to the First Schedule (Activity 13 of the EIA Order).**

- **If the total Class III slope area is equal to or more than 50% of the total project area, the activity is subjected to the Second Schedule (Activity 13 (a)) of the EIA Order.**

As long as there are Class III areas / slopes within the project boundary, the project will be subject to an EIA regardless whether the Class III areas will be developed or not.

However, construction on engineered slopes and works relating to remediation of slopes from landslides is not a Prescribed Activity

Examples of projects subjected to Activity No 13 of the First Schedule are shown in **Figure 1-2 to Figure 1-5**.

Figure 1-1 Definition of Activity 13

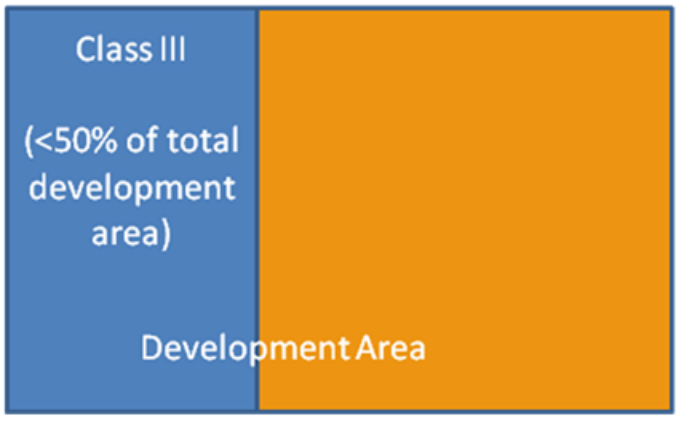

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Figure 1-2 Example A of Activity No 13 Project (with development on Class III slope)

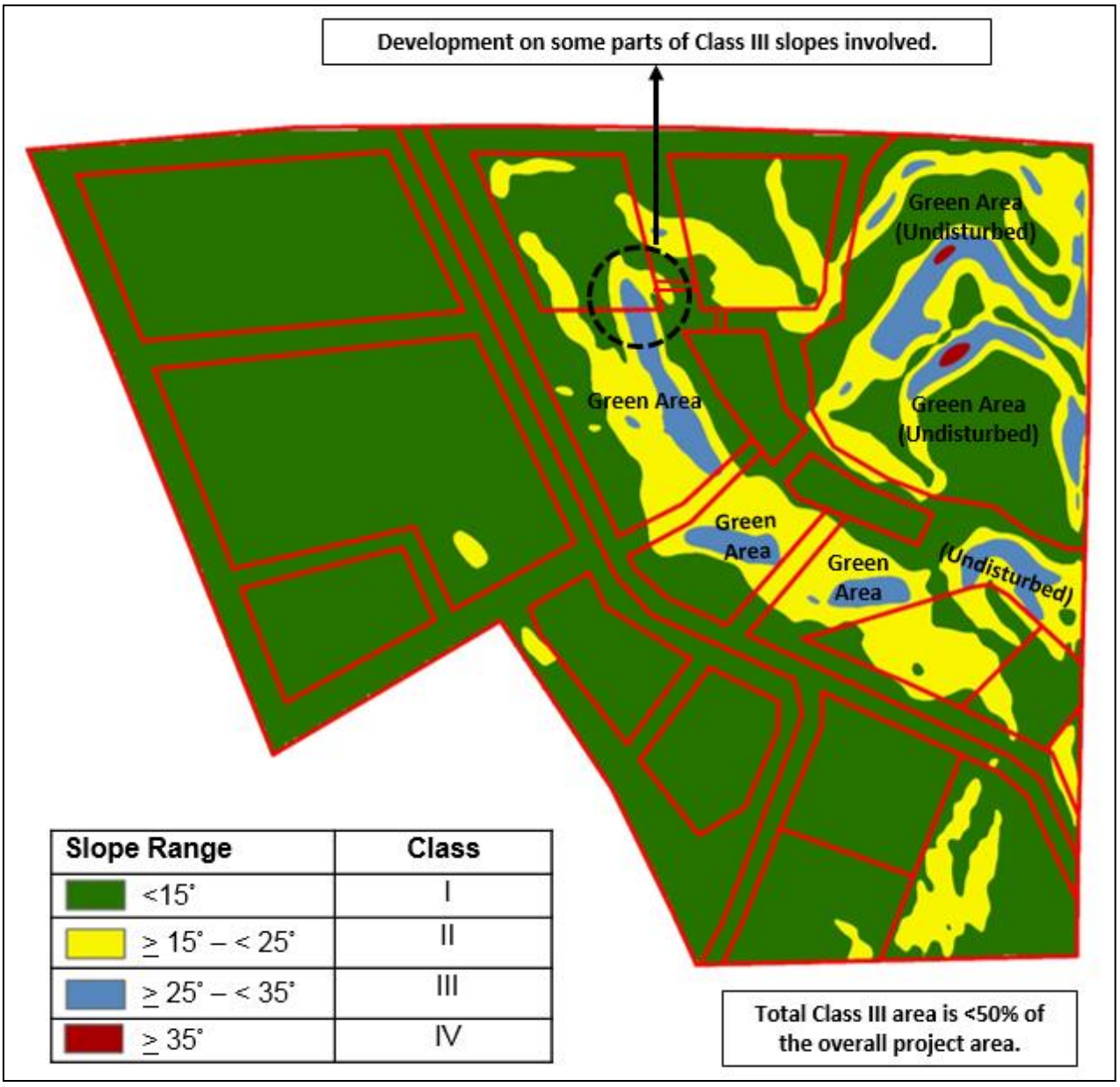

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Figure 1-3 Example B of Activity No 13 Project (with development on Class III slope)

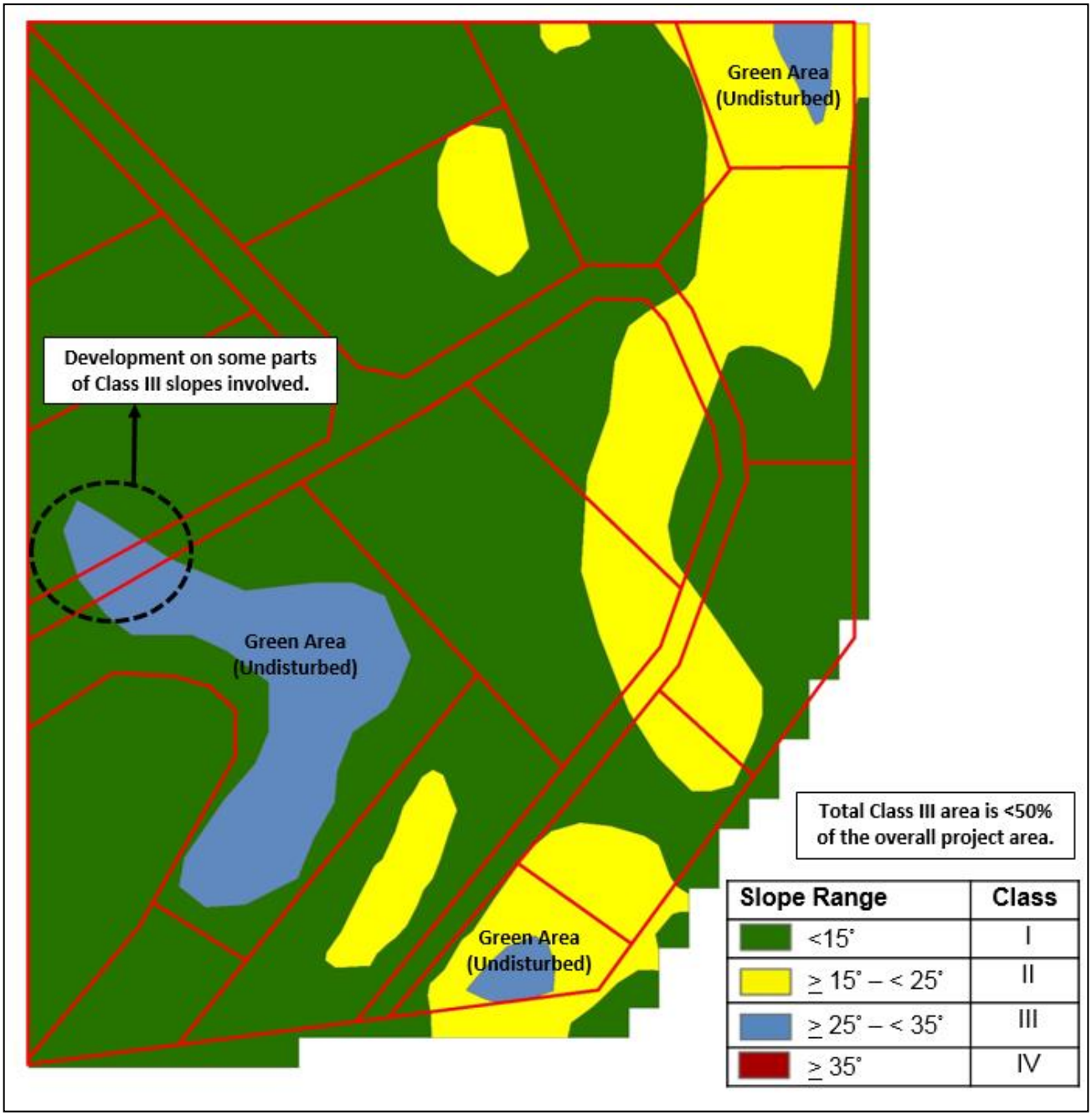

Figure 1-4 Example C of Activity No 13 Project (without development on Class III slope)

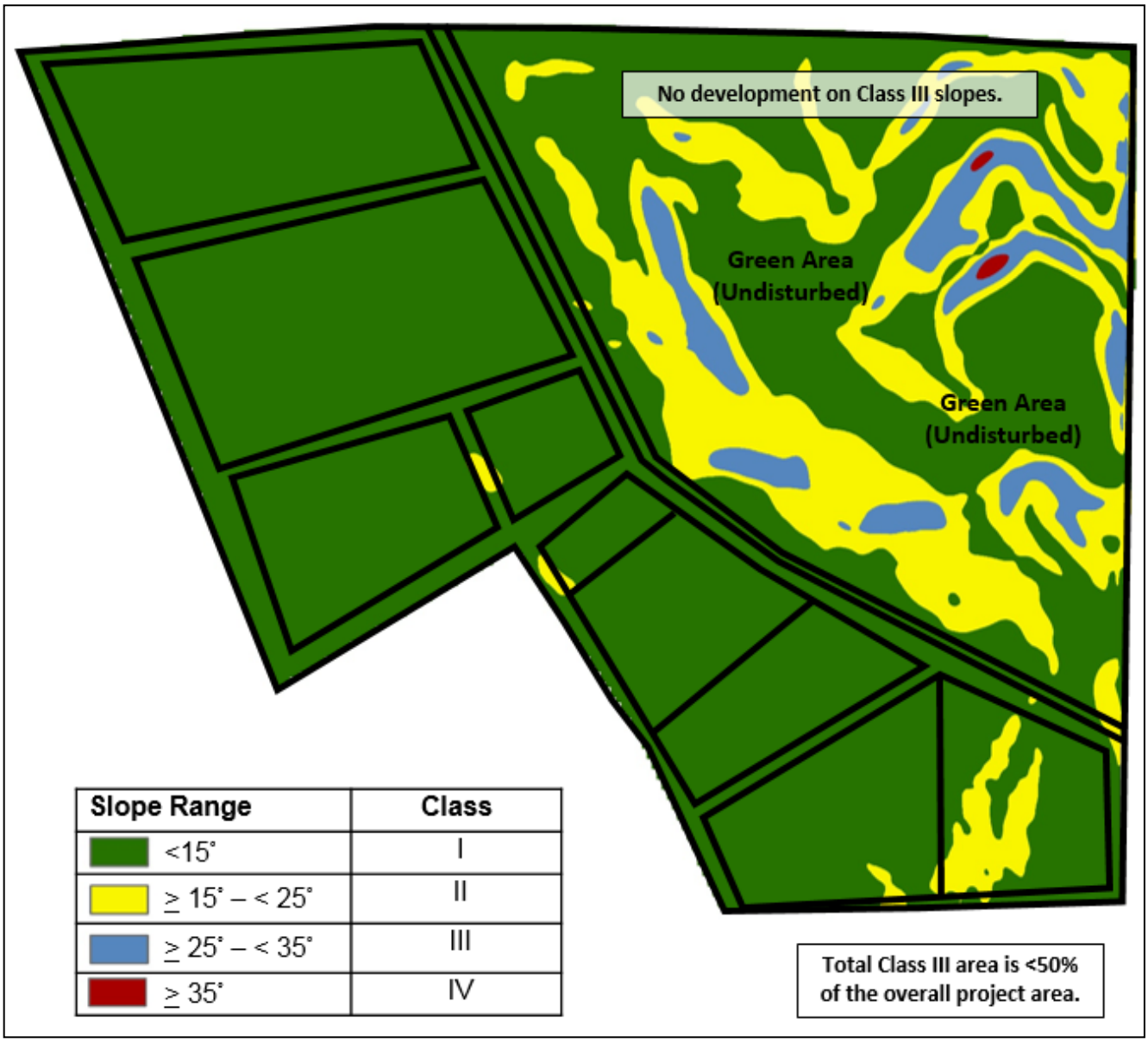

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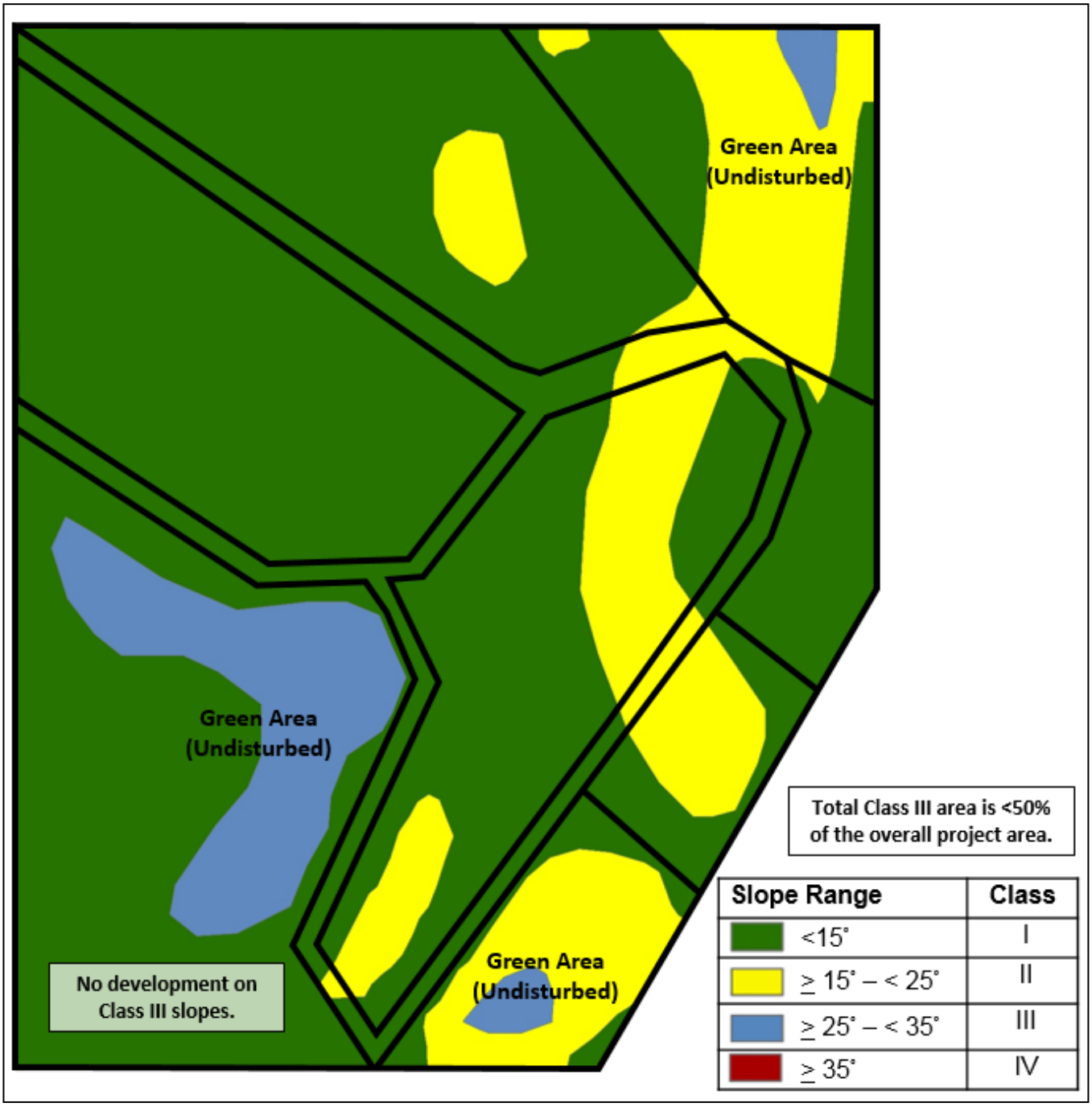
Figure 1-5 Example D of Activity No 13 Project (without development on Class III slope)



1.3 HILLY AND SLOPE AREAS IN MALAYSIA

Developments in Malaysia are mainly on lowlands due to various factors such as easy access, lower cost, availability of facilities etc. However, as development progresses, lowland areas are starting to get scarce and development on hilly and slope areas are required or already gazetted for development. Hill and slope areas can be found near urban or rural areas regardless of the type of development.

1.4 DEFINITIONS

1.4.1 Hill Areas

There is presently no legal or uniform definition of what constitutes a hilly area. Different agencies have devised their own classification and definition to suit their needs, where it is generally based on altitude as well as slope gradient as the main criterion of the existing topography.

The DOE has adopted areas greater than 300m above mean sea level to be defined as hill areas (as per Activity 12 (b)).

1.4.2 Slopes

Slope gradients are quantified in degrees and the range of slopes are ranked by class to determine the steepness of the terrain, where Class III and IV slopes are considered as steep slopes (**Table 1-1**).

Table 1-1 Ranking of Slope by Class

Class	Slope Range
I	$<15^{\circ}$
II	$\geq 15^{\circ}$ to $< 25^{\circ}$
III	$\geq 25^{\circ}$ to $< 35^{\circ}$
IV	$\geq 35^{\circ}$

1.5 PROCESS AND PROCEDURES

The EIA processes for activities relating to development in hill or areas sited on steep slopes include **(Figure 1-6)**:

(a) Identification of the requirement for an EIA based on the list of prescribed activities

(b) Verification of the project siting for compatibility with existing or future land use, as well as any encroachment into any environmentally sensitive areas

(c) Documentation of the siting verification in the Site Suitability Assessment (SSA) – self-assessment

(d) Conducting land use survey, measuring and collecting base line data, identification of sensitive receptors and potentially significant impacts, formulation of mitigation and management measures, post-EIA monitoring plan and preparing the EIA for submission to the DOE

(e) Review of the EIA report by DOE and the technical agencies.

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Figure 1-6 EIA Process

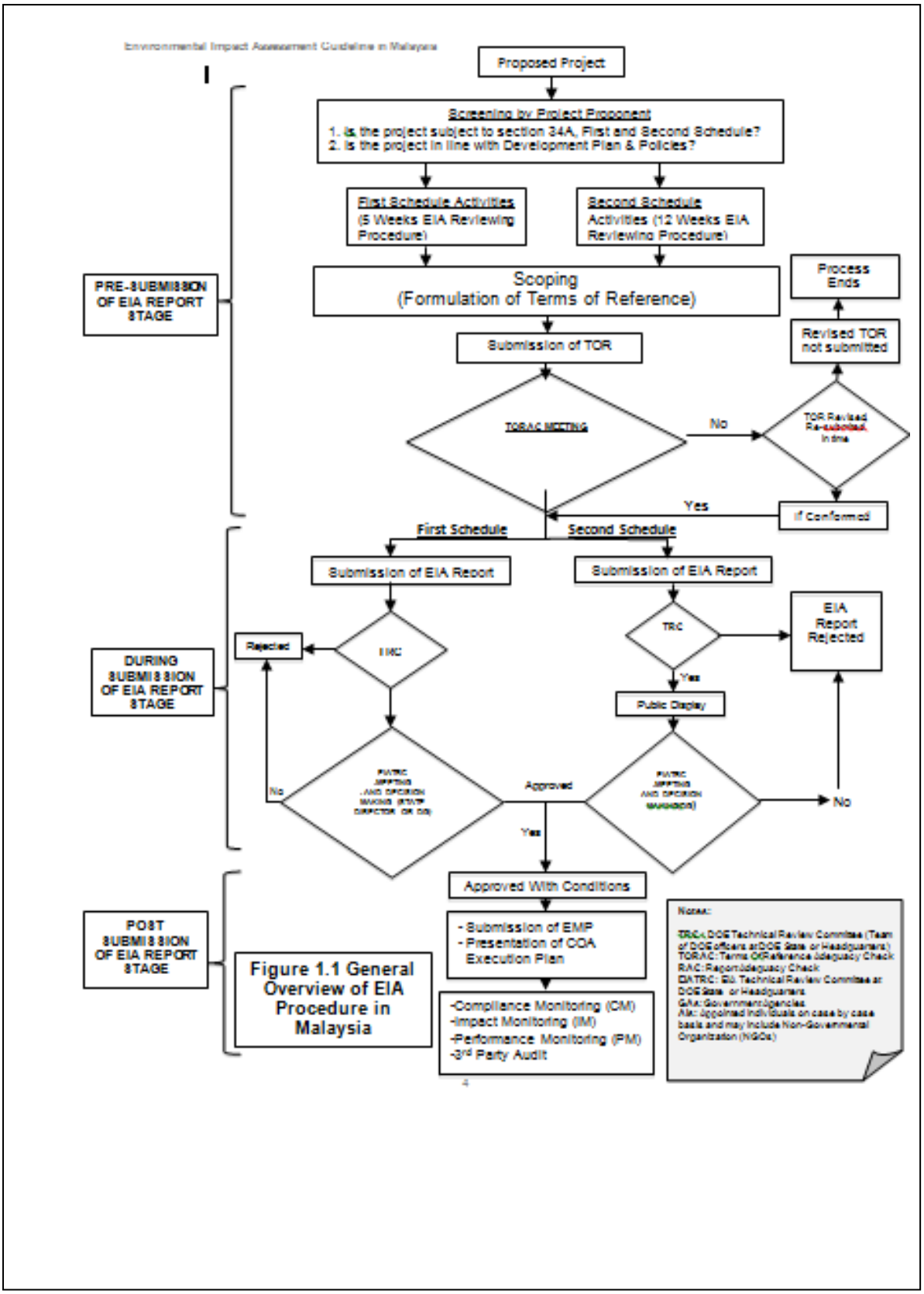

Figure 1.1 General Overview of EIA Procedure in Malaysia

1.6 RELEVANT NATIONAL POLICIES AND GUIDELINES

Presently, several federal and state agencies have established policies and developed guidelines on the development on hills and areas with steep slopes.

National Physical Plan (TCPD)	Provides guidance for hill areas at a national level
State Structure Plans and Local Plans	Provided guidance for hill areas at a state and local level
Guidelines for Hillside and Highland Areas Development Planning (TCPD)	Guidelines for development restrictions at steep slopes for all states other than Selangor and Penang
Developments in Hill and Highland Areas in Selangor (Selangor State Government)	Guidelines for development restrictions at steep slopes in Selangor only
Safety Guideline for Hillsite Development in Penang (Penang State Government)	Guidelines for development restrictions at steep slopes in Penang only
Guidelines for Slope Design (PWD)	Slope design guidelines by the Public Works Department
EIA Guidelines for Development of Hill Resorts (DOE)	Guidance specially for hill resorts
Guidelines for Hillside and Slope Areas Development Planning for the Federal Territory of Kuala Lumpur, 2010 (GPWPKL2010) (Kuala Lumpur City Hall)	Guidelines for development restrictions at steep slopes in Kuala Lumpur only

1.6.1 National Physical Plan

The National Physical Plan (NPP) classifies areas 150m above sea level as Environmentally Sensitive Areas (ESA) vulnerable to hazards.

The ESA are ranked to describe the sensitivity of the area. The ranking and the description for each number is shown in **Table 1-2.** The EIA shall take note of the restrictions identified in the NPP.

Table 1-2 ESA for Hill Areas

ESA Ranking	Environmentally Sensitive Area	Management Criteria
Rank 1	Areas above 1,000 m contour	No development, agriculture or logging shall be permitted except for ecotourism, research and education.
Rank 2	Areas between 300m - 1,000 m contour Areas located within the 500m buffer zone around Rank 1 areas*.	No development or agriculture. Sustainable logging and eco-tourism may be permitted subject to local constraints.
Rank 3	Areas between 150m - 300m contour, all areas with erosion risk above 150 tons/ha/yr, all areas experiencing critical or significant coastal erosion. Areas located within the 500m buffer zone around Rank 2 areas*.	Controlled development whereby the type and intensity of the development shall be strictly controlled depending on the nature of the constraints.

Source : National Physical Plan 2 (2013)
Note : * The widths of these buffer zones may be revised at the local level to take into consideration site-specific constraints.

1.6.2 Guidelines for Hillside and Highland Areas Development Planning by the Town and Country Planning Department

In 2009 following a severe landslide in Bukit Antarabangsa in Kuala Lumpur, the Cabinet issued a directive limiting development in hilly areas with the publication of the **Guidelines for Hillside and Highland Areas Development Planning** by the Town and Country Planning Department**.**

The criteria for development are categorized through elevation and slope degree as summarized in **Table 1-3**. The guideline also outlined areas to be protected, buffer requirements, and the submission process for local authority approval.

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Table 1-3 Development Control according to Class and Height

Height Class	Lowlands (<150m)	Hilly Lands (150m-300m)	Highlands (300m – 1,000m)	Mountains (> 1,000m)	EIA requirement based on slope class
Class I In-situ terrain < 15°	All developments considered, subject to local plan / development plan.	All developments considered, subject to local plan / development plan.	Low impact eco-tourism and recreation development considered	No development allowed except construction of infrastructure such as roads, tunnels, bridges, telecommunications, and low density electrical facilities of national importance	For Class I & II slopes, requirement of EIA will be based on prescribed activities requirement
Class II In-situ terrain ≥ 15° - < 25°	• High density housing • Commercial rows • Offices (Free Standing) • Tourism • Training Institutions	• High density housing • Commercial rows • Offices (Free Standing) • Tourism • Training Institutions	Low impact eco-tourism and recreation development considered		

Source: Town & Country Planning Department Malaysia, 2009

SECTION 1 : INTRODUCTION

Table 1-3 Development Control according to Class and Height (Cont'd)

Height Class	Lowlands (<150m)	Hilly Lands (150m-300m)	Highlands (300m – 1,000m)	Mountains (> 1,000m)	EIA requirement based on slope class
Class III In-situ terrain ≥ 25° - < 35°	• Medium density housing • Commercial rows • Offices (Free Standing) • Tourism • Training Institutions	• Medium density housing • Commercial rows • Offices (Free Standing) • Tourism • Training Institutions	Low impact recreation without the need for construction of structures can be considered such as camp sites and other conservation activities.	No development allowed except construction of infrastructure such as roads, tunnels, bridges, telecommunications, and low density electrical facilities of national importance.	• For Class I & II slopes, requirement of EIA based on prescribed activities • EIA required for developments for Class III slopes
Class IV In-situ terrain ≥ 35°	No development allowed except construction of infrastructure such as roads, tunnels, bridges, telecommunications, and low density electrical facilities of national importance.	No development allowed except construction of infrastructure such as roads, tunnels, bridges, telecommunications, and low density electrical facilities of national importance.	No development allowed except construction of infrastructure such as roads, tunnels, bridges, telecommunications, and low density electrical facilities of national importance.		• Detailed EIA required for developments on > 1000m elevation and Class IV slopes.

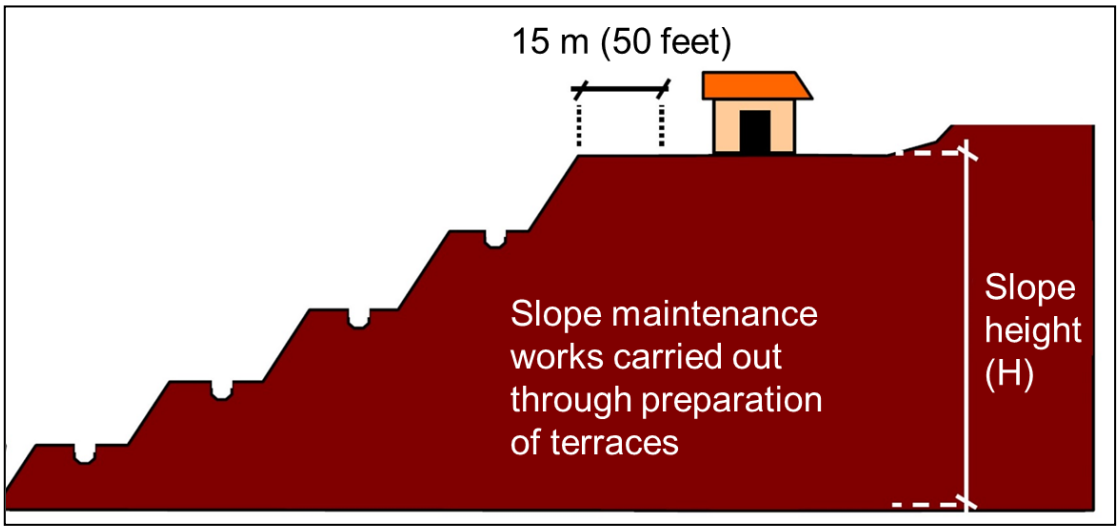
Source: Town & Country Planning Department Malaysia, 2009

1.6.3 Planning Guidelines for Developments in Hill and Highland Areas in Selangor

For projects in Selangor, the hill slope developments shall follow guidelines stipulated in the Planning Guidelines for Developments in Hill and Highland Areas in Selangor (*Garis Panduan Perancangan Pembangunan Di Kawasan Bukit & Tanah Tinggi Negeri Selangor)*

The content is largely similar to the Guidelines for Hillside and Highland Areas Development Planning by the Town and Country Planning Department, but contains additional information on setbacks for buildings to the edge of the slope **(Figure 1-7)**.

Figure 1-7 Setbacks for Siting of Buildings Next to a Slope



(Source : Planning Guidelines for Developments in Hill and Highland Areas in Selangor 2010)

1.6.4 Safety Guideline for Hillsite Development, 2012 (Penang)

The Penang Government's Safety Guideline for Hillsite Development looks at the potential risks of the various slopes and for the design of structures in hill areas (**Table 1-4)**. This guideline includes planning submission requirements, qualifications of design engineers and the maintenance / inspection of completed slopes and associated structures.

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Table 1-4 Slope Classification for Design Purposes

Class	Slope Gradient	Associated Risk			Maximum Allowable Hard Surface[2] Footprint
		Natural Slope	Man-made slope[1]		
			Cut	Fill	
1	0° - 15°	Low	Low	Low	Refer to current policy
2	> 15° - 25°	Low	Low	Low	
3A	> 25° - 35°	Medium	Medium	Not Applicable	35%
3B	> 25° - 35°	Not Applicable	Not Applicable	High	35%
4A	> 35°	High	High	Not Applicable	30%
4B	> 35°	Not Applicable	Not Applicable	Very High	30%

Source: Penang Town & Country Planning Department, 2012

Note:

1 For man-made slope within a proposed development area, which is formed previously prior to the current application for development.

2 Hard Surface is an impervious surface as defined in MASMA.

1.6.5 Guidelines for Slope Design (Public Works Department)

The Public Works Department (Slope Engineering Branch) published the **Guidelines for Slope Design**, to assist engineers in preparing safer designs for hill areas. The design guidelines cover aspects such as earthworks, rock, cut and fill slopes, reinforced structures, and geotechnical design criteria.

1.6.6 Guidelines for Hillside and Slope Areas Development Planning for the Federal Territory of Kuala Lumpur, 2010 (GPWPKL2010) (Kuala Lumpur City Hall)

The Kuala Lumpur City Hall's guideline is targeted for all developments within Kuala Lumpur. The guideline has identified sensitive areas such as Bukit Arang, Bukit Gasing and Bukit Dinding and allowed only limited development, such as infrastructure, utility, recreational facilities and maintenance of hilly areas only.

The classification of the slopes and highlands is also similar to the Guidelines for Hillside and Highland Areas Development Planning (TCPD). However, this guideline has an additional category with the development areas with a mixture of slope classes or patchy distribution of slope classes.

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The guideline has also specified setbacks required for buildings at the edge of slopes based on various scenarios such as:

1. Setbacks between buildings and natural slopes
2. Setbacks between buildings and artificial earth slopes
3. Setbacks between buildings and retaining wall without slopes above it
4. Setbacks between buildings and retaining wall with artificial earth slopes above it
5. Setbacks between buildings and retaining wall with natural slopes above it.

SECTION 1 : INTRODUCTION

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SECTION 2 : KEY ACTIVITIES AND IMPACTS

2.1 INTRODUCTION

This section aims to detail the key activities that are involved in the hill slope developments and the significant impacts expected during the construction stage. The projects carried out in hill and slope areas vary greatly, ranging from housing and resorts to infrastructure such as roads and power transmission lines, as well as agriculture.

Among the major activities that require considerations are site clearing, earthworks, hill cutting, blasting and slope stabilization works. The construction methods for each of these activities have to be detailed in order to identify the potential impacts.

2.2 KEY ACTIVITIES

2.2.1 Site Clearing

Site clearing is defined as the removal of vegetative cover over the existing soil. The main activities are:

Activities	Description
Clearing and grubbing	• Removal of existing trees and vegetation using bulldozers and excavators. Chainsaws may be needed for large tree felling • Topsoil is extracted and stockpiled for later use if suitable • Excavated biomass is removed using lorries for disposal
Construction of temporary access	• Clearing of a narrow corridor of vegetation for access • Minor earth cutting or filling to form the track • Compaction of the track and the laying of sand/gravel at muddy or soft stretches to allow heavy vehicles to pass

2.2.2 Earthworks

Earthworks involves slope cutting and filling – embankment. Hill areas form the head waters of many streams and rivers and any pollution to the waters will have consequences downstream.

The key activities are:

Activities	Description
Earth filling / construction of embankments	• Transportation of fill material to the site using dump trucks, via the temporary access • Filling valley areas with earth or suitable fill material to achieve desired level, using excavators and dump trucks • Filling sides of slopes with earth to create an embankment. • Compaction of filled platform to consolidate the soil using vibrating rollers
Earth cutting	• Slope cutting or trimming to achieve desired level • If there is rock encountered, cutting may involve ripping, chemical blasting or explosive blasting • Unsuitable material, excess cut or rock shall be removed from the site using dump trucks

2.2.3 Blasting

Blasting may be required when hard rock is encountered and is difficult to be removed mechanically or by excavation during earthworks for preparation of foundation platform. The option to blast using explosives breaks the hard rocks into manageable pieces for ease of removal. Such practices have been used in many development sites found to be effective and economical.

Activities	Description
Bench Blasting	Bench blasting is the most common controlled rock blasting activity. It is used to reduce the hills to its specified heights.
Slope Shaping Blasting	This is another type of controlled blasting and generally this type of blasting involves pre-splitting techniques with the use of detonating cords.

2.2.4 Construction Activities

For the construction of buildings, resorts and hotels, there are other activities that are also critical and may cause significant impacts in a hillslope environment.

Activities	Description
Construction of roads	Site clearing and earth cutting and filling, and the construction of earth retaining structures
Construction of buildings, resorts and hotels	Transportation of construction materials, piling, concreting, and operation of workers camps and stockpile areas
Construction of infrastructure and utilities	Excavation works, piling and concreting works

SECTION 2 : KEY ACTIVITIES AND IMPACTS

2.3 ENIVRONMENTAL IMPACTS

This section shall identify the potentially significant impacts arising from each of the key activities from the project, along with the expected environmental issues.

Significant impacts shall mainly be, but not limited to environmental aspects such as soil erosion, sedimentation of water courses, slope failures and landslides, and flooding. The detailed assessment of these identified impacts will be discussed in **Section 4**.

2.3.1 Major Impacts

Major impacts expected from project activities on hill and slope areas include:

Environmental Aspects	Potential Impacts
Soil erosion	• Sedimentation of watercourses and water bodies
Landslide and Slope Failure Risk	• Loss of life and damage to property • Sedimentation of watercourses and water bodies • Mudflow
Changes to Hydrological Regime and Flooding	• Increase in water yield, high sediment load and turbidity level • Changes in drainage pattern and channel morphology, higher storm flow volume or peak discharge, resulting in flooding downstream • Loss of life and damage to property • Sedimentation of watercourses and water bodies • Mudflow
Water quality	• Sedimentation of watercourses and water bodies • Affecting receptors downstream such as raw water supply intake, recreational activities, aquaculture, and other beneficial uses as well as the river ecology
Geological and Seismic Events	• Loss of life and damage to property
Blasting activities	• Noise and vibration • Damage and injury from flyrock
Stakeholders issues	• Residents and other stakeholders have concerns on the impacts of the project

2.3.2 Other Impacts

Other possible impacts from project activities are also to be considered for assessment, and presented briefly in the EIA if there are sensitive receptors present.

Environmental Aspects	Potential Impacts
Noise	• Noise from construction activities such as earthworks and piling
Air pollution	• Dust generated from earthworks and movement of heavy vehicles
Ecology	• Flora and fauna affected by the development such as land clearing or forest fragmentation
Sewage and wastewater	• Possible pollution of river water from the discharge of treated sewage and other wastewater
Construction waste	• Issues from disposal of construction waste generated in hill areas
Solid waste	• Issues from disposal of domestic waste generated in hill areas
Scheduled waste	• Issues from management and disposal of scheduled waste in hill areas
Visual impact	• Loss of vista and reduced quality of life
Socio economic	• Potential improvement or disruption of local socio economy

SECTION 2 : KEY ACTIVITIES AND IMPACTS

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SECTION 3 : DATA REQUIREMENTS

3.1 INTRODUCTION

This section describes the baseline data required for site selection and also for assessment of identified impacts.

The siting of the project has a major correlation to its potential impact to the surrounding environment, especially in areas with steep gradients. The criteria for selecting a new site on hilly and slope areas largely involves engineering, geology, slope class, percentage of steep areas, environmental and social aspects.

The Site Suitability Assessment (SSA) shall be prepared (self – assessment) to determine whether a project falls under the First Schedule or Second Schedule of the EIA Order 2015. The project layout superimposed on the Construction Suitability Map and information on the land use in accordance with the statutory development plans shall be considered.

3.2 DATA REQUIREMENT FOR IMPACT ASSESSMENT

Data required to carry out proper analysis and assessment of impacts from hill slope development is as follows (**Table 3-1**):

- Project description
- Buffer zones
- Surrounding land use – existing and future
- Legal requirement, zoning and land use policies
- Overall topography, hydrology, geology
- Existing infrastructure
- Nature reserves and parks, wildlife
- Archaeological sites
- Maps and photographs
- Topographical survey
- Terrain mapping and construction suitability map
- Soil profile
- River basin and catchment details /hydrological profile
- Rainfall and climate
- Earthworks plan
- Geotechnical design considerations
- Construction Methods, schedule and duration
- Sensitive Receptors
- Baseline sampling (water, air and noise)

The relevant data needed shall follow the assessment requirements as detailed in **Section 4**.

SECTION 3 : DATA REQUIREMENTS

Table 3-1 Description of Data Requirements

Project Description	The project description shall detail the project layout, project components, development density, and development concept. ***Purpose****: to describe the project and its components.*
Buffer Zones	The project site shall adhere to the mandatory buffer zones detailed in the following guidelines: • Guidelines for Hillside and Highland Areas Development Planning by the Town and Country Planning Department • Planning Guidelines for Developments in Hill and Highland Areas in Selangor For specific buffer requirements, refer DOE Guidelines for Siting and Zoning of Industry and Residential Areas, 2012. ***Purpose****: to ensure that the regulatory buffer requirements are met.*
Surrounding Land Use	The existing and future land use of the project site and surrounding area to be taken into consideration. ***Purpose****: to determine the land use of the project site and surrounding area.*
Legal Requirement, Zoning Or Land Use Policies	Compliance to Section 34A of the Environmental Quality Act, 1974: Report on impact on environment resulting from prescribed activities, National Physical Plan, State Structure plans, local plans, special area plans, specific development master plans and relevant statutory guidelines ***Purpose****: To ensure compliance to all the relevant laws, regulations and guidelines*
Topography, Hydrology, Geology,	Describe the existing topography including terrain and rivers, as well as the geological map of the area. ***Purpose****: To gain understanding of the physical environment*
Infrastructure	Accessibility to the project site, and the availability of existing and future utilities such as water supply, sewerage systems, telecommunication network and power supply. ***Purpose****: To determine if additional works need to be carried out to provide infrastructure services where they are unavailable*

SECTION 3 : DATA REQUIREMENTS

Table 3-1 Description of Data Requirements (cont'd)

Nature Reserves And Parks, Wildlife	Existing flora and fauna within and surrounding the project site. ***Purpose****: To describe the ecosystem in the surrounding area.*
Archaeological sites	Presence of heritage areas, burial grounds and areas of archaeological importance. ***Purpose****: To plan the project around these areas.*
Maps and photographs	The maps showing location of project relative to surrounding physical, natural and man-made features. ***Purpose****: To determine the sensitive receptors in the area.*
Rainfall	Rainfall is higher at mountain ridges and is often a major factor in landslides and slope failures. ***Purpose****: to take into consideration the amount of rainfall at the project site and help in planning of site clearing and earthworks*
Topographical Survey	Preliminary topographical information to be obtained from topography maps produced by the Department of Survey and Mapping with scales of 1:50000 and 1:12500 for town areas. Detailed site survey plans produced by land surveyors shall have the scale of 1:1500 to 1:500 and contour intervals of 5m. ***Purpose****: to describe existing elevation and terrain of the site.*
Terrain Mapping and Construction Suitability Map*	The project site shall be mapped to show the different slope classes, and which areas the steep Class III and IV slopes are located. ***Purpose****: to identify locations of Class III and IV slopes and determine the extent of development on the slopes.*
Geological Profile	The geological profile at the project site can be obtained from the Geological Map of Malaysia produced by the Department of Minerals and Geosciences. ***Purpose****: to look for potential sensitive areas such as limestone, fault lines etc.*

Note: * The terrain mapping and construction suitability map are to be prepared during the Site Suitability Assessment stage (self-assessment) to determine whether the project falls under the First Schedule or Second Schedule of the EIA Order 2015

SECTION 3 : DATA REQUIREMENTS

Table 3-1 Description of Data Requirements (cont'd)

Soil Profile	The soil profile of the project site shall be mapped from the borelogs from the soil investigation carried out. ***Purpose****: To determine characteristics and type of rock and soil found in the area (soil strata) that are essential for the geotechnical design.*
River Basin and Catchment Details	As the hill and highland areas normally form the headwaters of rivers, the watershed where the project site is located is to be mapped ***Purpose****: to indicate the possible receptors downstream of the rivers.*
Geotechnical Design Considerations	Design considerations such as the Factor of Safety (FoS) and slope gradients for cut and fill slopes, as well as FoS for foundation and earth retaining design have to be established from the soil and geological data. Groundwater and soil permeability also have to be taken into consideration as often slope failures are associated with sub-soil drainage. ***Purpose****: to ensure optimal design for safety*
Construction Methods	Construction methods statements are to be detailed in the EIA. Consideration of the most suitable and available construction methods for hill areas. The construction schedule and duration of key activities such as earthworks will also be required. ***Purpose****: To ensure that the methods of construction will have the least impact to the environment and to determine the severity of potential environmental impacts.*
Sensitive Receptors	Identification of sensitive receptors surrounding the project site such as : • rivers and its beneficial uses downstream • populated areas • areas of significant biodiversity • sites of cultural importance ***Purpose****: to assist in assessing potential impacts and further propose specific mitigation measures targeted at the receptors.*

3.2.1 Baseline Sampling

Baseline environmental sampling requirements aims to document the existing environmental conditions in and surrounding the project site which can also be used for comparison during the Post EIA stage.

3.2.1.1 Water Quality Sampling

- Mandatory to be carried out for projects of all sizes
- Number of sampling stations: Depending on number of waterways crossing through or passing by the project site.
- Mandatory sampling parameters – TSS and Turbidity
  Optional sampling parameters: DO, BOD, COD, Oil and Grease, Ammoniacal Nitrogen, *E. coli*

  Optional parameters to be sampled depending on site conditions such as the presence of workers camp.
- Frequency: minimum once before submission of EIA

3.2.1.2 Air Quality

- Optional. Depending on site condition.
- To be carried out for projects if there are sensitive receptors present within 500m of the Project Site. As development on hill and slope areas are usually smaller in scale due to space constraints, impact on air quality more than 500m from the project site can be considered negligible.
- Sampling parameters – TSP, $PM_{2.5}$
- Frequency: once before submission of EIA

3.2.1.3 Noise Level

- Optional. Depending on site conditions.
- To be carried out for projects if there are sensitive receptors present within 500m of the Project Site. As development on hill and slope areas are usually smaller in scale due to space constraints, impact on noise levels more than 500m from the project site can be considered negligible.
- Sampling parameters – L_{90}, L_{10}, L_{max}, L_{min} L_{eq}
- Frequency: once before submission of EIA

SECTION 4 : ASSESSING POTENTIAL ENVIRONMENTAL IMPACTS

4.1 INTRODUCTION

This section discusses the assessments for the impacts arising from each of the key activities from the project.

The impacts will be assessed in terms of magnitude, prevalence, duration and frequency of occurrence whichever is applicable and their consequence to populated areas, water courses, land use, ecology and the environment in general. Following that, the impacts shall also be ranked to determine which ones require the highest priority in terms of mitigation measures. For most cases, quantitative assessment shall be deemed as necessary to enable a better assessment of the potential impacts.

4.2 SCOPING REQUIREMENTS

4.2.1 Activity No.12 (b)

For Prescribed Activity No. 12 (b), the scoping requirements shall address issues pertaining to construction and operation stages in hill areas. The requirements are as follows:

- Soil erosion analysis
- Terrain mapping
- Land Disturbing Pollution Prevention and Mitigation Measures (LDP2M2)
- Water quality modelling
- Hydrological analysis
- Socio economic study
- Baseline and post EIA monitoring for water quality

4.2.2 Activity No. 13

For Prescribed Activity No.13, the scoping for the projects on hill and slope areas shall depend on the size of the project area, and classified into four categories (**Table 4-1 and 4-2).**

- 1 ha or less
- More than 1 ha to 5 ha
- More than 5 ha to 10 ha
- Greater than 10 ha

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Table 4-1 Scoping and Assessment Requirements for Activity 13

Project Area	Scoping and Assessment Requirements
1 ha or less	• Mitigation measures for soil erosion and sedimentation – conceptual LDP2M2
More than 1 ha to 5 ha	• Soil erosion analysis • Terrain mapping / construction suitability map • Geotechnical analysis • LDP2M2 • Baseline and post EIA monitoring for water quality
More than 5 ha to 10 ha	• Soil erosion analysis • Terrain mapping / construction suitability map • Geotechnical analysis • LDP2M2 • Water quality modelling • Baseline and post EIA monitoring for water quality
Greater than 10 ha	• Soil erosion analysis • Terrain mapping / construction suitability map • Geotechnical analysis • LDP2M2 • Water quality modelling • Hydrological analysis • Landslide risk analysis • Geological and seismic analysis • Stakeholder consultation • Socio-economic study • Baseline and post EIA monitoring for water quality

These requirements are not exhaustive and additional investigation or analysis that is deemed necessary by the Director-General of Environmental Quality shall be carried out by the project proponent.

SECTION 4 : ASSESSING POTENTIAL ENVIRONMENTAL IMPACTS

A checklist to accompany the submission of the EIA shall be prepared (**Appendix 2)**. This checklist will help both EIA consultants and DOE officers to determine if all necessary assessments specified in this technical guidance are carried out to ease the EIA approval process. Diagrams simplifying the assessment requirements are attached in **Appendix 3**.

Table 4-2 Scoping Matrix

Assessment Requirements	Prescribed Activity				
	No 12 (b)	No. 13			
		Project Area			
		≤1 ha	>1 ha –5ha	> 5 ha –10ha	>10ha
Conceptual LDP2M2		●			
LDP2M2	●		●	●	●
Soil erosion analysis	●		●	●	●
Terrain mapping and construction suitability map	●		●	●	●
Geotechnical analysis			●	●	●
Water quality modelling	●			●	●
Hydrological Analysis	●				●
Landslide risk analysis					●
Geological and seismic analysis					●
Stakeholder consultation					●
Socio economic study	●				●
Base line and post EIA monitoring of water quality	●		●	●	●

4.3 ASSESSING POTENTIAL IMPACTS

4.3.1 Soil Erosion

Soil erosion on slopes is a crucial impact that can lead to adverse impacts like landslides and sedimentation of watercourses. The rate of soil erosion is dependent upon factors such as soil characteristics, climate, topography, and soil cover. If the effects of each of these can be quantified, the rate of soil erosion can be predicted.

The most common method of quantification is the more updated Revised Universal Soil Loss Equation (RUSLE) based on the "Guidance Document for Addressing Soil Erosion and Sediment Control Aspects in Environmental Impact Assessment (EIA) Report" by DOE, 2010.

Impact	Sedimentation of watercourses and water bodies
Assessment	Revised Universal Soil Loss Equation (RUSLE) - especially critical in large scale projects such as agriculture Equation used: **A = R . K . LS . C . P**
Output	Compute the soil loss rate, and compare with Erosion Risk Map of Malaysia to determine severity of soil loss

The severity of the soil erosion can be compared to the soil loss tolerance rates from the Erosion Risk Map of Malaysia (**Table 4-3**)

Table 4-3 Potential Soil Loss

Soil Erosion Class	Potential Soil Loss (ton/ha/year)
Very Low	<10
Low	$\geq$ 10 – < 50
Moderate High	$\geq$ 50 – < 100
High	$\geq$ 100 – < 150
Very High	$\geq$ 150

Source: DOE 2003

4.3.2 Landslide and Slope Failure Risk

To assess the degree of impact for landslides, various studies and surveys should be carried out such as terrain analysis, terrain classification/mapping, landslide hazard delineation/mapping, and/or land use suitability studies.

Degrees of landslide or slope failure hazard can be illustrated in slope hazard maps. Detailed geological or geotechnical studies can also be conducted to assess the stability of high hazard slopes.

The specific construction methods used for the development must also be detailed out to assess the effectiveness of slope protection.

For project areas exceeding 10 ha, landslide and slope failure risk analysis has to be carried out.

The geotechnical report and the slope failure risk analysis shall be carried out by the Geotechnical Engineer. The relevant information shall be extracted from the geotechnical report.

Impact	• Loss of life and damage to property • Sedimentation of watercourses and water bodies • Mudflow
Assessment	• Terrain analysis and classification • Landslide hazard delineation/mapping • Detailed geotechnical analysis by a qualified geotechnical engineer • Landslide/slope failure risk analysis
Output	• To identify areas of high risk or landslide and/or slope failure

4.3.3 Changes to Hydrological Regime and Flooding

The hills and highland areas form the headwaters of most streams and rivers. For large developments, land clearing at these areas may affect the hydrological regime and result in major changes downstream.

Hydrological impacts may include the following:

- Increase in water yield, high sediment load and turbidity level
- Changes in drainage pattern and channel morphology, higher storm flow volume or peak discharge, resulting in flooding downstream

Estimation of the possibilities of flash flood occurrence should be performed in accordance with the Urban Stormwater Management Manual for Malaysia (MSMA 2nd Edition) (2012) by the Drainage and Irrigation Department, Malaysia.

The Rational Method can be used to calculate stormwater flows from rainfall in small catchment areas. This method relates peak runoff to rainfall intensity through a proportionality factor.

Alternatively, hydrograph methods can be used whenever spatial and temporal variations of rainfall or flow routing/storage effects need to be considered (refer MSMA 2nd Edition).

The assessment shall be carried out by a hydrologist and the relevant information to be extracted from the hydrological report.

Impact	• Loss of life and damage to property • Sedimentation of watercourses and water bodies • Mudflow
Assessment	• Detailed hydrological analysis for flood flow using rational or unit hydrograph method in accordance with MSMA, and approved by DID
Output	• To show that the runoff during post-construction is the same or less than the runoff during pre-construction

4.3.4 Water Quality

For larger scale development (greater than 10ha), the sediment yield from soil erosion may significantly impact the watercourses. The suspended solids loading into the watercourse shall be modelled to predict the Total Suspended Solids (TSS) concentration in the watercourse and how far reaching is the effect downstream.

Impact	• Sedimentation of watercourses and water bodies • Affecting receptors downstream such as raw water supply intake, recreational activities, aquaculture, and other beneficial uses as well as the river ecology
Assessment	• TSS concentration in the river can be predicted using 1-D models such as Qual2K, or 2-D models such as MIKE11 or WASP.
Output	• To determine the TSS concentration at various locations downstream of the river, and its dispersion as it reaches sensitive receptors such as water supply intakes or aquaculture farms.

4.3.5 Geological and Seismic Analysis

For areas larger than 10 ha, seismic risk analysis will be done to assess the possibility of rock and landslides during an earthquake.

Recent events have shown that catastrophic slope failures can occur during seismic activities. With geological mapping, the areas with weak rock can be avoided for construction or a larger FoS can be applied in the geotechnical design. Areas with high seismic risk in relation to geological formation should be avoided all together.

Impact	Loss of life and damage to property
Assessment	Identification of areas of weak rock with geological mapping
Output	Map out areas of weak rock, for siting of critical structures to be avoided and increase foundation FoS if necessary

The assessment shall be carried out by a geologist, with the relevant info to be extracted from the geological report.

4.3.6 Blasting

Two main issues of concern related to blasting work are noise and vibration, and risk of flyrock.

Impact	• Noise and vibration • Damage and injury from flyrock
Assessment	• Noise and vibration modelling to determine the noise level and shockwaves (CADNA etc.) • Assessment to be carried in accordance to the DOE's guidelines for noise and vibration
Output	• To determine noise and vibration levels from blasting, and results should be within the limits set by the DOE's guidelines for noise and vibration

4.3.7 Stakeholder Consultation

New developments on hills and slope areas often affect the people living adjacent or near the project area and are a major cause of concern to these people. Therefore, consultation with affected parties has become a necessity for most projects especially ones in sensitive areas such as hills and slope areas.

Stakeholders most likely affected by projects located on highlands and slope areas will include:

- **Nearby residents**
  To focus on the disturbance from the project site, health and safety, accessibility to better facilities, and overall effect on the comfort and convenience of their daily lives

- **Nearby commercial groups**
  Commercial stakeholders will include business operators, institutions and industrialists. Issues envisaged will include benefits to their business in terms of increase in market size, compatibility with their operations, safety to their property and staff, and potential competition to their operations.

Various approaches shall be undertaken to conduct an effective consultation with all stakeholders. This will include the identification of the stakeholders and their representatives, the location of meetings, the level of detail of information to be disseminated, number and schedule of briefings, and key personnel that needs to be present.

The consultation methodology can range from stakeholder dialogues, focused group discussion, public surveys and other relevant methods. A combination of two or more of these consultation methods can be applied in the same project, depending on the needs or suitability.

Impact	Residents and other stakeholders have concerns on the impacts of the project
Assessment	• Conduct stakeholder engagements to disseminate information of the project to the stakeholders, and to record their objections and feedback • Several methods of consultation shall be used, such as stakeholder dialogues, focused group discussion, public surveys, public meetings and other suitable methods
Output	• Feedback from stakeholders on their concerns and perception, as well as the views on how the planning or measures can be improved

4.3.8 Other Impacts

Other possible impacts from project activities are also to be considered for assessment, and presented briefly in the EIA if there are sensitive receptors present.

However, if any of the impacts are considered major, a detailed assessment will have to be carried out.

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The other impacts are listed below and not limited to the following:

Noise	**Impacts** Noise from construction activities such as earthworks and piling **Assessment** - Qualitative assessment analysis for receptors located more than 500m from project - Noise modelling (CADNA etc.) from piling etc. for receptor less than 500m from project **Output** - To determine the noise levels at the boundary of the sensitive receptors to see if it is within limits recommended by DOE's guidelines for noise
Air pollution	**Impacts** Dust (TSP) generated from earthworks and movement of heavy vehicles **Assessment** - Qualitative analysis for receptors more than 500 m from project - Dust dispersion modelling (SCREEN3, AEROMOD etc.) from earthworks etc. for receptor less than 500 m from project **Output** - To determine the dust levels (TSP) at the boundary of the sensitive receptors to see if it is within limits set in the Malaysian Ambient Air Quality Guidelines (MAAQG)
Ecology	**Impacts** Flora and fauna affected by the development such as land clearing or forest fragmentation. **Assessment** - Conduct ecological assessment as detailed in the Technical Guidance for Scoping for EIA – Forestry Activities (First Schedule) **Output** - Determine the type of flora and fauna in the surrounding area and identify the endangered species if any.

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Sewage and wastewater	**Impacts** Possible pollution of river water from the discharge of treated sewage and other wastewater **Assessment** - Water quality modelling (Qual2K etc) for STP more than 1000 PE capacity for catchments with raw water supply intake downstream - Parameters: BOD **Output** - To determine the BOD concentration at various locations downstream of the river, and its dispersion as it reaches sensitive receptors such as water supply intakes
Construction waste	**Impacts** Issues from disposal of construction waste generated in hill areas **Assessment** - Qualitative assessment
Solid waste	**Impacts** Issues from disposal of domestic waste during construction stage in hill areas **Assessment** - Qualitative assessment
Scheduled waste	**Impacts** Issues from management and disposal of scheduled waste in hill areas **Assessment** - Qualitative assessment
Visual Impact	**Impacts** Loss of vista and reduced quality of life. **Assessment** - Qualitative assessment
Socio Economic	**Impacts** Potential improvement or disruption of local socio economy. **Assessment** - Qualitative assessment for projects $\geq$ 10 ha in size

SECTION 4 : ASSESSING POTENTIAL ENVIRONMENTAL IMPACTS

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SECTION 5 : POLLUTION PREVENTION AND MITIGATION MEASURES

5.1 INTRODUCTION

This section aims to describe the formulation of the mitigation and management measures for each of the significant impacts that has been identified. The mitigation measures that are proposed shall have the following characteristics:

- Focus on control at source rather than end-of-pipe solutions
- Practical, activity and site specific, and easily implemented, taking into account site conditions and implementation costs.
- Consider the use of new technology where available and applicable
- Ensure that the output from the mitigation works are measurable to enable better monitoring of their effectiveness
- Include a programme or operational procedure for the maintenance of the implemented measures

5.2 SOIL EROSION AND SEDIMENTATION

Soil erosion and sedimentation mitigation are essential especially on highlands and slopes to prevent slippage and potential landslides. A Land Disturbing Pollution Prevention and Mitigation Measures (LDP2M2) must be formulated prior to project implementation. If a detailed LDP2M2 is not available during the EIA preparation stage, a conceptual plan highlighting the type and location of mitigation measures can be prepared.

Erosion and sedimentation measures must be catered to the weather during construction. Temporary control facilities will need more supervision during the wet season while permanent measures such as turfing and any measures to reduce exposure must be a priority during the dry season.

The main aspects of soil erosion and sediment control measures are as follows:

5.2.1 Soil Erosion Control

Planning and Phasing

The timing and duration of site clearing and earthworks play a major role in reducing soil erosion. These activities should be planned to commence in periods of low rainfall and developments with areas greater than 10 ha shall be carried out in phases.

This is one of the most effective methods of soil erosion control.

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Preservation of Existing Vegetation

Existing vegetation outside the project site shall be retained as they will serve as a filter for sediment as well as act as a soil binder to retain the soil.

Temporary Slope Cover

All exposed completed slopes awaiting further construction shall be covered with plastic sheets, fibromats or equivalent material. This will prevent runoff flowing downslope causing further soil erosion. The covers have to be frequently maintained for optimal effectiveness. Where there is available biomass, the mulch can also be used as slope cover.

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Catch Drains

Catch drains shall be constructed at the top of slopes to ensure that runoff do not flow down the slope and cause soil erosion. The drains have to be frequently maintained to ensure proper drainage.

Turfing

All completed slopes shall be turfed immediately to prevent soil erosion. Closed turfing or hydroseeding shall be carried out where applicable. The grass shall be watered regularly to ensure a rapid growth and not wilting during dry periods.

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5.2.2 Sedimentation Control

Silt Traps and Sediment Basins

Silt traps and sediment basins are the main measures for sedimentation control. However at hill and slope areas, there is often space limitations to construct a proper silt trap or sediment basin to the sizes prescribed in the MASMA. Therefore some improvisation may have to be done on site during construction.

The location at the steep slopes may make it difficult for desilting or maintenance to be carried out, therefore the design of these structures has to take into account the terrain and access constraints.

Silt Fences

Silt fences shall be erected at the top of slopes or next to streams or rivers to prevent the flow of sediment downslope or into rivers. The silt fence has to be sturdy with the supports properly anchored into the ground to ensure that they do not collapse during major storms. They have to be regularly maintained to ensure that they function effectively.

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Advanced Treatment Systems

For areas with space constraints, advanced treatment systems can also be implemented as a sediment control measure. This will include the use of mobile silt traps and sediment treatment plants. The silted water from the work areas will be pumped into the mobile silt traps and sediment treatment plants before discharging to existing waterways.


Mobile silt trap

Sediment treatment plant

Other erosion and sedimentation prevention measures applicable for highlands and slopes are listed below:

- Control devices to be located next to streams or any water courses before construction
- LDP2M2 should cover all temporary and permanent measures to be applied at the site
- No clearing or grubbing to the edge of a waterway provided work will start instantly
- Grubbing and stripping to be restricted to surface areas where excavation will start within 30 days
- A buffer or untouched riparian vegetation should be maintained on the edge of streams when possible
- Slopes steeper than 2:1 should be grooved properly before seeding
- Erosion and sedimentation control measures should be checked before, during and after every storm event to ensure effectiveness
- No control measures should obstruct any live streams within the site
- Maintenance and cleaning of dirty machinery should not be conducted near waterways
- Cut material should be located far from waterways to avoid wash back
- Sediment along silt fences should be removed when it reaches 50% of the fence height. Alternatively a new line of the silt fence can be placed down slope.
- Erosion and sedimentation measures should be provided for stockpiled fill material
- Surface runoff should be diverted into temporary slope drains.

- Diversion berms should be constructed and reshaped where necessary to prevent runoff
- Streams should be diverted through a stabilized temporary diversion channel or pipe culverts before new culverts are placed
- No material should be placed or discarded in waterways
- Erosion and sedimentation control at borrow pits and waste areas should be checked weekly
- Clearing and grubbing of proposed borrow pits and waste areas should only be conducted after receiving approval of those sites

More erosion and sedimentation measures can be referred from the Guidelines Document for Addressing Soil Erosion and Sediment Control Aspects in Environmental Impact Assessment (EIA) Report, 2010 (DOE), Guidelines for Erosion and Sediment Control in Malaysia, 2010 (DID) and other relevant guidelines.

5.3 LANDSLIDES AND SLOPE FAILURE

Preliminary evaluation of slopes in the project site is required to assess the slope condition, degree of hazard and the risk of landslide. Three possible options to consider for slope treatment are listed below (adapted from EIA Guidance Document for Housing, Activity 7 in Areas Gazetted for Housing, 2007):

<u>Avoid High Risk Hazard</u>

- Avoid from developing along slopes or near the base of slopes
- Relocate roadways or other infrastructure to more stable areas

<u>Accept Failure or Landslide Hazard</u>

- Acceptance is based on an evaluation of the degree of hazard and the economics of prevention

<u>Stabilize the Slope To Eliminate Or Reduce The Hazard</u>

- Change the slope geometry to decrease the driving forces or increase the resisting forces (reduce height, reduce inclination, add weight to toe)

- Control surface water infiltration to reduce seepage forces (vegetation, seal cracks, drainage system, etc.)

- Control internal seepage to reduce the driving forces and increase material strength (deep wells, sub-horizontal drains, interceptor trench drains, blanket drains, etc.)

- Provide retention to increase the resisting forces (e.g. concrete pedestals, rock bolts, ground anchors, soil nails and retaining walls)

Provide Barriers for Rock or Debris Slide

- For project site that has houses or occupied buildings downslope, temporary barriers shall be constructed between the project site and the receptors as a shield against rock slide or falling debris, especially if there are rock blasting activities.

- The barriers shall be designed such that it can withstand rock slide and protect the buildings below.

5.4 CHANGES TO HYDROLOGICAL REGIME AND FLOODING

The measures required to mitigate the impacts of increased runoff has to be incorporated into the project design. The runoff from the new development can be reduced through the use of more porous areas and less paved areas. Provision of large retention ponds at the development may not be possible due to the lack of space.

The drainage network can be designed to be oversized and exceed flow requirements to increase storage for runoff and increase retention time.

A series of smaller ponds can be constructed cascading down the slopes and still achieving the desired retention objective.

If necessary, for very large developments generating a large runoff flow, the siting of a larger retention pond downhill in the low land should be considered.

The drainage network can be designed to be oversized and exceed flow requirements to increase storage for runoff and increase retention time.

5.5 BLASTING

Safe blasting procedures shall strictly follow the procedure outlined in the *Garis Panduan Kerja Peletupan Pembangunan (JMG.GP.11), 2008,* and include the following:

- Daily blasting is only confined from Monday to Friday and blasting schedule is from 12 noon to 1. 30 pm only. No blasting will be carried out on weekends and on any public holidays.

- Consumption of explosive is only sufficient for the day's use and there shall be no stock in store at Project site.

- The delayed detonation technique to be used to minimise peak overpressure.

- Use of suitable stemming materials such as chipping.

- Rock blasting operations to be undertaken by qualified operators only.

- Communication and dialogue with surrounding residents on blasting operations to minimise potential conflicts that may arise.

- To minimize ground vibration, these factors are considered or to be followed: (i) Usage of suitable ignition pattern with less drill holes per delay number, (ii) Reduce spacing to get less charge in each drill hole, (iii) Choosing a fitting drill hole diameter to get the right spacing and charge in each drill hole, and (iv) Limit the advance in each round.

- To minimize fly-rock occurrence, the blast hole may be covered with energy absorbing coverings, which can be placed on top of the blasting surface. This can be made applied by using soil cover and practicable due to the small blast hole diameter. The surface of the blast area to be further covered with layer of chain link, safety net, old rubber tyres rubber mat, earth or sand bags etc, or combinations of these, to prevent fly-rocks.

5.6 SLOPE MAINTENANCE

For slopes areas after the completion of construction, the maintenance of the slopes is necessary for the prevention of post construction slope failures.

Maintenance of structures can be subdivided into four categories (adapted from Guidelines on Slope Maintenance in Malaysia (Public Works Department Malaysia, 2006):

- Routine Maintenance Inspections, which can be carried out by any responsible person with no professional geotechnical knowledge,

- Engineer Inspections for Maintenance, which should be carried out by a professionally-qualified geotechnical engineer,

- Regular Check of Buried Water-carrying Services, which should be carried out by a specialist leakage detection contractor, and

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- Regular Monitoring of Special Measures, which should be carried out by a firm with special expertise in the particular type of monitoring service required. Such monitoring is only necessary where the long term stability of the slope or retaining wall relies on specific measures which are liable to become less effective with the passage of time.

The detailed monitoring programme is dependent on the findings of the geotechnical analysis and a typical monitoring programme is shown in **Table 5-1**. The typical man made items on slopes and retaining structures that require maintenance are shown in **Figure 5-1.**

Table 5-1 Typical Slope Maintenance Programme

Maintenance Type	Personnel	Frequency
Routine inspection Records of blockage, cracks, slips and chain age	Maintenance personnel	Monthly
Inspection of leakage Inspection on buried water pipes	Specialist leakage detection contractor	Monthly
Checking inspection Verify records by Maintenance/Team	Civil Engineer or Qualified/Competent Person	Yearly
Geotechnical Inspection Carry out technical assessment on existing conditions and stability of slopes	Geotechnical Engineer	Every 5 Years
Monitoring of Special Measures When recommended by Geotechnical Engineer	Specialist	When necessary

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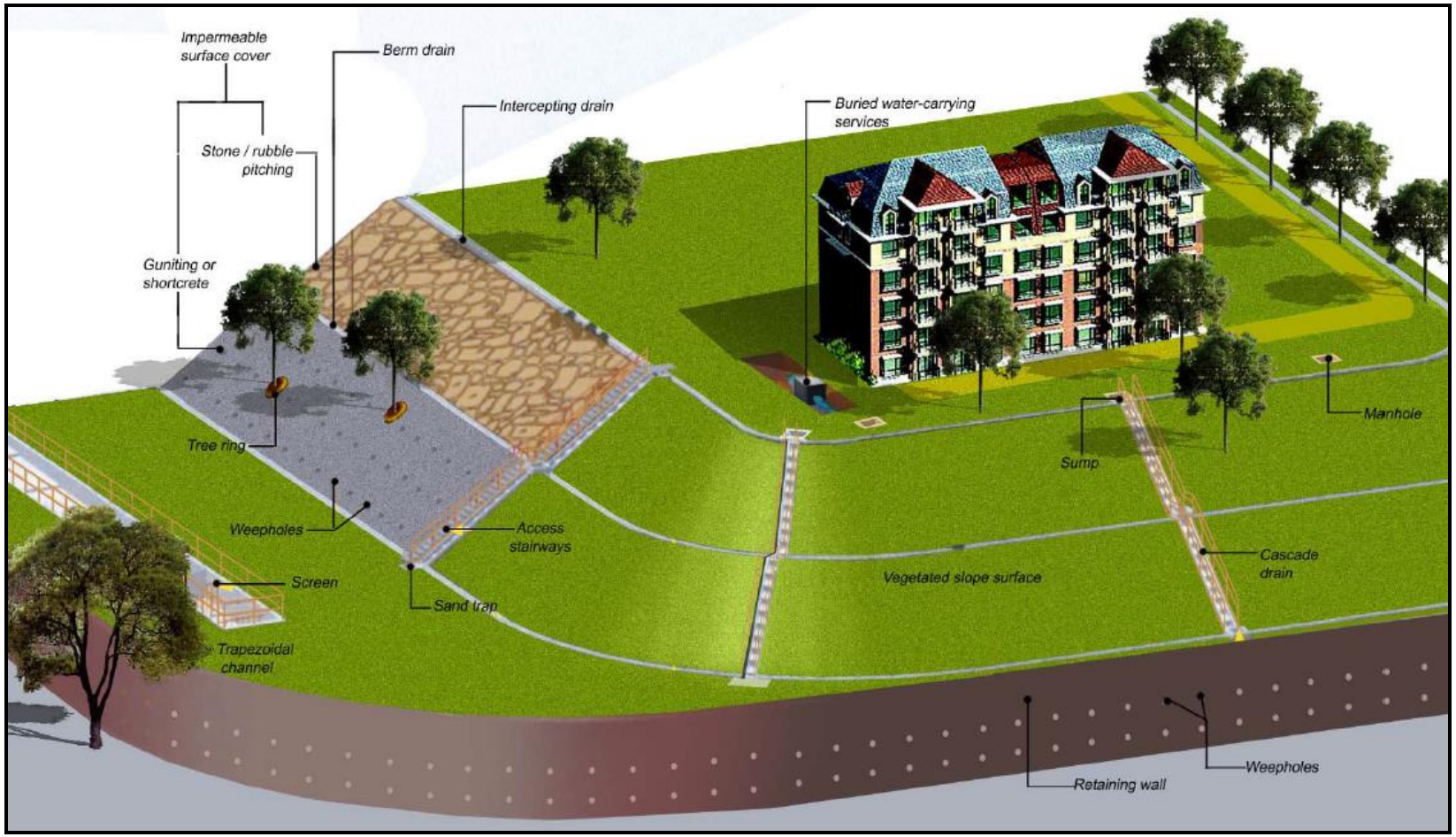
Figure 5-1 Typical Man made Items on Slopes and Retaining Structures that Require Maintenance



Source : Guidelines on Slope Maintenance in Malaysia (JKR, 2006)

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SECTION 6: POST EIA MANAGEMENT

6.1 MONITORING OBJECTIVES

This section will detail the methods and procedures to conduct Post EIA compliance monitoring of the implemented measures.

The monitoring and audit programme shall detail the status of the implementation of each of the proposed measures, issues faced, non-compliance, and state of environment in terms of measurement of water quality, air quality, and noise and vibration levels.

The parameters for the water quality, air quality and noise levels shall be specified, along with the sampling frequency and criteria for locating the sites for the measurements to be taken.

The qualification of the site personnel conducting the site audit shall also be specified.

6.2 ENVIRONMENTAL MONITORING FRAMEWORK

Environmental monitoring requirements for the construction stage shall be carried out based on the size of the project. The Director-General reserves the right to impose additional sampling requirements where it is deemed as necessary.

6.2.1 Water Quality Sampling

- To be carried out for projects of all sizes
- Sampling parameters – TSS and Turbidity
  Other parameters such as DO, BOD, COD, Oil and Grease, Ammoniacal Nitrogen, *E. coli* to be done only depending on site conditions
- Frequency: Monthly

6.2.2 Silt Trap Discharge Sampling

- To be carried out for projects of all sizes
- Sampling parameters – TSS and Turbidity
- Frequency – weekly for TSS, daily for turbidity; after every heavy rain event (12.5mm and measured by rain gauge) – in-situ sampling of TSS and turbidity

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6.2.3 Air Quality

- To be carried out for projects if there are sensitive receptors present within 500m of the Project Site
- Sampling parameters – TSP, $PM_{2.5}$,
- Frequency - Monthly

6.2.4 Noise Level

- To be carried out for projects if there are sensitive receptors present within 500m of the Project Site
- Sampling parameters – L_{90}, L_{10}, L_{max}, L_{eq},
- Frequency - Monthly