VOLUME

I

GOVERNMENT OF MALAYSIA

SECTORAL REPORT

1 : POLICY AND INSTITUTIONAL FRAMEWORK

2 : HAZARD MAPPING AND ASSESSMENTS

NATIONAL SLOPE MASTER PLAN
(PELAN INDUK CERUN NEGARA)

JKR

SEPTEMBER 2009

LIST OF ACRONYMS

Bahasa Melayu		English	
Ayat-Ayat Teknikal		Technical Terms	
		AAD	Average Annual Demages
		AAL	Average Annualized Loss
		ACEM	Association of Consulting Engineers, Malaysia
		ADD	Average Annual Damages
		ADMIT	Asian Disaster Mitigation Training Network
		ADPC	Asian Disaster Preparedness Center
		AEG	Association of Engineering Geologist
		AGS	Australian Geo Mechanical Society
		AMSA	The Australian Maritime Safety Authority
		ArcGIS	Geographic Information System Software
		AUD	Australian Dollar
	Lembaga Jurutera Malaysia	BEM	Board Of Engineers Malaysia
		BRO	Borders Road Organization
		BTE	Bureau of Transport Economic
		CATs	Catastrophe Bonds
		CBA	Cost-Benefit Analysis
		CDMRC	Carribbean Disaster Management and Resource Centre
		CEDD	Civil Engineering and Development Department
		CFA	Country Fire Authority
		CIDB	Construction Industry Development Board
		CLP	Canada landslide Project
		CPD	Continuous Professional Development

		CRISP	Centre for Remote Imaging, Sensing and Processing
		DDMRC	District Disaster Management and Relief Commitee
		DFEM	Discrete Finite Element Method
		DHS	Department of Homeland Security
JPS	Jabatan Pengairan dan Saliran	DID	Department of Irrigation and Drainage
		DLP	District Local Plans
		DMC	Disaster Management Centre
JAS	Jabatan Alam Sekitar	DOE	Department of Environment
		DPRI	Disaster Prevention Research Institute
		ECC	Emergency Control Centre
		ECLAC	Economic Commission for Latin America and the Caribbean
		ECLAC-UNDP-PIOJ	Economic Commision for Latin America and the Caribben-United Nations Development Programme-Planning Institute Of Jamica
		EDGS	Enhance Data GSM Evolution
		EMA	Emergency Management Australia
		EMERCOM	Emergencies and Elimination of Consequences of Natural Disasters
		EMP	Environmental Management Plan
		EMS	Emergency Medical Centre
		EPA	Environmental Protection Agency
		EPC	Emergency Preparedness Canada
		FEM	Finite Element Method
		FEMA	Federal Emergency Management Agency
		FHWA	Federal Highway Administration
		FIT	Flood Information Tool
		FORM	First Order Reliability Method
		FOSM	First Order Second moment Approximation

		FYMP	Five Year Malaysia Plan
		GDP	Gross Domestic Product
		GEO	Geotechnical Engineering Office (Hong Kong or Brazil)
		GSI	Geologist Survey of India
		HAZUS	Natural Hazard Loss Estimation Methodology
		HKD	Hong Kong Dollar
		HKIE	Hong Kong Institution Of Engineers
		HPC	A High Powered Committee on Disaster Management
		ICL	International Consortium Landslide
		ICS	Incident Command System
		ICSM	Inter – governmental Committee on Slope Management
		ICT	Information And Communication Technology
		IDLHZ	Inventory / Database on Landslide Hazard Zone
		IDMC	International Ministerial Committee for Disaster Management
		IEM	The Institute of Engineers Malaysia
		IMF	International Monetary Fund
		IRPA	Intensified Research In Priority Areas
		ITC	Geoinformation Science and Earth Observation
		LiDAR	Airborne Light Detection and Ranging System
		LIP	Landslide Interoperability Project
	Had Cecair	LL	Liquid Limit
		LMS	Landslide Motion Survey
		LREIS	Laboratory of Resources & Environmental Information System
	Langkah - Langkah Pengurangan Kerugian	LRM	Loss Reduction Measures
	Agensi Remote Sensing Negara	MACRES	Malaysian Centre For Remote Sensing
		MEHMS	Malaysian Engineered Hill Slope Management System

LLM	Lembaga Lebuhraya Malaysia	MHA	Malaysia Highway Authority
KEMENTAH	Kementerian Pertahanan Malaysia	MINDEF	Ministry of Defence
		MINT	Malaysian Institute for Nuclear Technology Research
		MLIT	Ministry of Infrastructure, Land and Transport
		MOSTI	Ministry of Science Technology And Innovations
		MTD - RC	Mountainous Terrain Development Research Centre
		NADII	National Disaster and Information Management
		NASA	National Aeronautics And Space Administration
		NASEC	National Soil Erosion Research Centre
	Badan Bukan Kerajaan	NGO	Non-Governmental Organisations
		NIBS	National Institute of Building Sciences
		NPV	Net Present Value
MKN	Majlis Keselamatan Negara	NSD	National Security Division
		NTES	Northern Territory Emergency Service
		PIAM	Persatuan Insurans AM Malaysia
JKR	Jabatan Kerja Raya Malaysia	PWD	Public Works Department
		QRA	Quantitative Risk Assessment
		RAM	Victorian Rapid Appraisal Method
		RCL	Research Centre on Landslide, Japan
		RM	Ringgit Malaysia
		ROs	Regional Slope Engineering Centres
		RSDM	Russian System on Disaster Management
		SAIS	Slope Asset Information System
		SAR	Search And Rescue Operation
		SDMRC	State disaster Management and Relief Committee
		SEA	Slope Engineering Agency

		SEDC	State Economic Development Corporation
		SEPU	State Planning Unit
		SIMS	Slope Information Management System
		SIS	Slope Information System
		SMART	Special Malaysia Disaster Assistance and Rescue Team
		SSO	State Secretary Office
		SSP	State Structure Plans
		TCPA	Town & Country Planning Act
		TCPD	Town & Country Planning Department
		TDMA	Time Division Multiple Access
		TEC	Total Estimated Cost
		TEMAN	Total Expressway Maintenance Management Network
		TSA	The Slope Agency
PBB	Pertubuhan Bangsa - Bangsa Bersatu	UN	United Nations
		UNDP	United Nations Development Programme
		USD	United States Dollar
		USGS	United States Geological Survey
		VPN	Virtual Private Network
		WWF	World Wildlife Fund
ATM	Angkatan Tentera Malaysia		Malaysian Armed Forces
CKC	Cawangan Kejuruteraan Cerun, JKR		Slope Engineering Branch, PWD
DBKL	Dewan Bandaraya Kuala Lumpur		Kuala Lumpur City Council
IKRAM	Kumpulan IKRAM Sdn Bhd		
JBPM	Jabatan Bomba dan Penyelamat		Fire and Rescue Department
JKM	Jabatan Kebajikan Masyarakat		Department of Social Welfare
JMG	Jabatan Mineral dan Geosains		Minerals and Geoscience Department

JMM	Jabatan Meteorologi Malaysia		Malaysia Meteorological Department
JPA3	Jabatan Pertahanan Awam		Department of Civil Defence
JUPEM	Jabatan Ukur dan Pemetaan Malaysia		Department of Survey and Mapping Malaysia
KPKT	Kementerian Perumahan dan Kerajaan Tempatan		Ministry of Housing and Local Government
MPAJ	Majlis Perbandaran Ampang Jaya		Ampang Jaya Municipal Council
PBSM	Persatuan Bulan Sabit Merah		Malaysian Red Crescent Society
PDRM	Polis Diraja Malaysia		Royal Malaysian Police
STMB	Syarikat Telekom Malaysia Berhad		
TNB	Tenaga Nasional Berhad		
UiTM	Universiti Teknologi MARA		
UM	Universiti Malaya		University of Malaya
UPM	Universiti Putra Malaysia		
USM	Universiti Sains Malaysia		
UTM	Universiti Teknologi Malaysia		
UPC	Unit Pengurusan Cerun		
RTM	Radio Television Malaysia		

1. POLICY AND INSTITUTIONAL FRAMEWORK

ANNEXES

1. POLICY AND INSTITUTIONAL FRAMEWORK

1.1 Overview

1.1.1 Introduction

Appropriate policy and institutional development of slope management are fundamental solutions for better and more effective slope management, protection of people and resources from landslide disasters.

The basic concepts in policy and institutional framework are to shift policy emphasis from post-landslide relief and rehabilitation to a more proactive approach of landslide prevention and control strategy in national planning and implementation. However, it is commonly acknowledged and accepted that landslides will continue to occur despite such preventive actions. Policies and institutions must be in place to address issues related to landslide risk reduction strategies, including disaster preparedness, mitigation and rehabilitation.

One of the objectives of institutionalising slope management will be to generate greater awareness in landslide reduction and coping with landslides.

Policy, political commitment and community participation in landslide disaster reduction at the national, state and local levels are crucial elements for good governance of slope management.

1.1.2. Objectives

The objective of this component is to develop effective policy and institutional framework for landslide risk reduction, mitigation and disaster preparedness.

1.2 Problem Statement

1.2.2. Current Situation

In past and current practices of slope management in Malaysia, the Government is considered the centre for all authority and actions, especially in dealing with slope failures.

Overall, there is a low appreciation of the economic value and cost-efficiencies in risk reduction compared to replacing lost assets, and the persistent difficulty in demonstrating the cost-efficiencies in saving lives and public property *before* disasters occur.

Among the public, there is not enough awareness of the hazards posed by landslides.

Landslide management is often misunderstood as merely providing relief to victims, aiding recovery following an event and rebuilding damaged infrastructure. Relief funds and allocations are typically made available more readily *after* a disaster rather than *before*. Few resources have been devoted to routine hazard identification or to sustained risk management strategies in areas prone to landslides. The differences in the management approaches with respect to crisis management and risk reduction strategies are shown in **Table 1.1**.

Practices in developed countries underscore the fact that slope management must be the responsibility of the government. However, its success also depends on widespread decision-making and the participation of many others. Policy direction and legal framework assure legitimacy, but success depends on available professional and human resources.

In many countries, there is a designated authority responsible for responding to crisis situations when they happen. However, there are currently few institutions engaged in or which have adequate capacities to oversee risk reduction strategies on a continuous basis, such as monitoring potential risks and motivating public and private action to minimise possible consequences.

Table 1.1: Current approach and additional needs in emergency management

Current Approach **Emergency assistance, crisis management**	**Additional Needs** **Disaster risk reduction strategies**
Emphasis	
1. Primary focus on hazards and disaster events 2. Single, event-based scenarios 3. Basic responsibility to respond to an event	1. Primary focus on vulnerability and risk issues 2. Dynamic, multiple risk issues and development scenarios 3. Fundamental need to assess, monitor and update exposure to changing conditions
Operations	
4. Often fixed, location-specific conditions 5. Responsibility in single authority or agency 6. Command and control, directed operations 7. Established hierarchical relationships 8. Often focused on hardware and equipment 9. Dependent on specialized expertise	4. Extended, changing, shared or regional, local variations 5. Involves multiple authorities, interests, actors 6. Situation-specific functions, free association 7. Shifting, fluid and tangential relationships 8. Dependent on related practices, abilities, and knowledge base 9. Specialised expertise, squared with public views, priorities
Time horizons	
10. Urgent, immediate and short time frames in outlook, planning, attention, returns	10. Comparative, moderate and long time frames in outlook, planning, values, returns
Information use and management	
11. Rapidly changing, dynamic information usage, often conflicting or sensitive 12. Primary, authorised or singular information sources, need for definitive facts 13. Directed, 'need to know' basis of information dissemination, availability 14. Operational, or public information based on use of communications 15. In-out or vertical flows of information	11. Accumulated, historical, layered, updated, or comparative use of information 12. Open or public information, multiple, diverse or changing sources, differing perspectives, points of view 13. Multiple use, shared exchange, inter-sectoral use of information 14. Matrix, nodal communication 15. Dispersed, lateral flows of information
Social, political rationale	
16. Relates to matters of public security, safety	16. Matters of public interest, investment and safety

Source: ISDR, Living with Risk, UN 2004

1.2.3. Needs

Whilst it is ideal for the Federal Government to provide central coordination and support, there is a need to decentralise landslide risk reduction efforts. Projects in risk reduction need to be implemented not only by the national government but also by the state and local authorities, private sector, academic institutions and community-based organisations.

There is a need for change or restructuring of current policy and institutional arrangements and functions, including laws that need to be made more relevant, explicit and uniform. A consensus must be developed amongst all relevant parties involved.

Government agencies, technical and academic institutions, commercial interests, communities and individuals themselves must develop their corresponding competencies and effective capabilities in risk management. Furthermore, with limited resources, coordination is important if they are to become more effective.

Restructuring national policies to widen the scope of slope management by including landslide risk awareness and management, and training programmes are necessary for the implementation of a comprehensive slope management system. Landslide risk reduction objectives need to be part of national development plans.

1.2.4. Constraints

The main constraint stems from a mindset of what commonly constitutes landslide management responsibilities. It is ingrained with concepts associated with post-disaster rescue, relief, reconstruction and rehabilitation, as well as maintaining public law and order during times of crisis. Broader concepts have begun to take hold more recently in some countries at national levels.

The National Security Council (MKN) in the Prime Minister's Department is responsible for coordinating activities related to the preparation, prevention, response and handling of disasters. This office can be instrumental in the establishment of policy statements and a mechanism for the implementation of a comprehensive slope management system.

Currently, the Public Works Department through the Slope Engineering Branch is providing technical support in handling landslide disasters in the country. This function can be widened and reconfigured to cover the above-mentioned slope management system.

There is little reference to landslide risk reduction in our national development plans. On the contrary, many developed countries and some Asian countries have made a sustained commitment in integrating slope protection in their strategic development objectives. At the same time, they have proceeded to expand their institutional capabilities and increasingly focus on disaster risk awareness and management and training programmes.

1.3 Detailed Study

1.3.2. Introduction

In 1922, the British Administration enacted the Federated Malay States Enactment No. 22 called the "The Silt (Control) Enactment". It had been recognised even then that there was a need to respond to the potential damage that may be caused by the movement of earth, mud, silt, sand or soil. This Enactment was repealed and replaced with the Land Conservation Act 1960 (the LCA) after independence.

The legislators, at the time of the formulation of the LCA, could not have foreseen the tremendous development that was to occur in the country. Construction is among the important economic activities contributing to national development. During construction, earthwork is usually carried out to obtain a more efficient landform to suit the infrastructure or building to be built. Top soils are removed, higher ground is levelled and lower ground filled up. Unsuitable soil may also be removed and replaced. Earthworks in construction may be carried out for development for housing, commercial and infrastructure purposes. Most of these activities are carried out by private developers, but the Government may also be a major player in some mega projects, particularly roads, dams, airports and ports.

Earthworks when carried out without due regard to geotechnical factors may result in negative impacts such as slope failures and settlements. Exposed surfaces are also susceptible to erosion resulting in soil particles being transported by storm runoff to lower grounds and into receiving waters. The negative impacts are landslides, slope failures, mudflows, deterioration of water quality and sedimentation of channels and drainage facilities. Various measures may be adopted to prevent and control occurrences of slope failures, erosion and sedimentation, including engineering solutions, proper maintenance and enforcement of proper practices through legislative and institutional measures.

1.3.3. Review of National Legislation

The management of landslides and slope failures boils down essentially to the conservation or development of land. It will normally involve several parties and is subject to relevant laws. The parties involved, in general, may be grouped into the following categories:

a) The Owners and/or Occupiers – normally owner or occupier of the land and/or parties in joint-ventures;

b) Professional Service Providers - architects, engineers and others who design, obtain approvals and supervise the development;

c) Developers/Contractors – developers and/or contractors who may be the prime movers of a development project, carry out the works and would have formal approvals/agreements to that effect; and

d) Regulatory Bodies which have the power to control all activities on any land. They regulate, approve, supervise and enforce the laws related to any development and all earthworks. These may include both Federal as well as state/local agencies. Federal agencies would include the Highway Authority (LLM), Department of Environment (JAS), Town and Country Planning Department (JPBD) and the Department of Drainage and Irrigation (JPS). State agencies would include the State Town and Country Planning Department, State JPS, Land Administrator/District Officer, State Economic Planning Unit and State Economic Development Corporation. At the local level, local authorities are in fully responsible for controlling all development activities in their respective jurisdictions.

Legislation is targeted to regulate and control the activities of all the groups of persons involved in the development of land. A list of the relevant laws and guidelines that may be applicable to the management of land in relation to slope failures is as follows;

A) LIST OF LEGISLATION RELEVANT TO MANAGEMENT OF LANDSLIDES

1. Waters Act, 1920
2. Geological Survey Act, 1974
3. Street, Drainage and Building Act, 1974 (as amended in 2007)
4. The National Forestry Act, 1984
5. The National Land Code, 1965
6. The Environmental Quality Act, 1974

7. Land Conservation Act, 1960
8. Town and Country Planning Act, 1976
9. Local Government Act, 1976
10. Mining Enactment, 1929
11. Civil Defence Act, 1951
12. Police Act, 1967
13. Fire Services Act, 1988
14. Building and Common Property (Maintenance and Management) Act, 2007
15. Public Order (Preservation) Act, 1958

B) MUNICIPAL RULES

1. Earthworks By-Laws
2. Uniform Building By-Laws (amended in 2007)

C) STATE ENACTMENTS

1. Selangor Waters Management Authority Enactment, 1999
2. Environment Protection Enactment, 2002, Sabah
3. Town and Country Planning Ordinance, 950, Sabah
4. Forest Enactment, 1968, Sabah
5. Land Ordinance, 1930, Sabah
6. Water Resources Enactment, 1998, Sabah
7. Minerals Ordinance, 1960, Sabah
8. Local Government Ordinance, 1961, Sabah
9. Natural Resources and Environment Ordinance, 2001, Sarawak

D) GUIDELINES

1. Urban Storm Water Management Manual, 1999, Federal JPS
2. Guidelines on the Prevention and Control of Soil Erosion and Siltation in Malaysia, 1996, JAS.
3. Environmental Impact Assessment Guidelines for Development of Resorts and Hotel Facilities in Hill Stations, 1995, JAS.
4. National Guidelines for Landscaping, JPBD
5. Guidelines on Erosion Control for Development Projects in the Coastal Zone, Federal JPS.

6. Guidelines for Development of Hilly Areas, JPBD
7. Guidelines for Development of Highlands, Ministry of Natural Resources and Environment (NRE)
8. Guidelines for Development of Environmentally Sensitive Areas, TJPBD
9. Standards for the Development of Environmentally Sensitive Areas, JPBD

A summary of the relevant laws in Peninsular Malaysia, Sabah and Sarawak is shown in **Tables 1.2**, **1.3** and **1.4** respectively.

Table 1.2: Summary of relevant legislation in Peninsular Malaysia

Title	Relevant Subsidiary legislation	Relevance to Slope Management
1. Waters Act, 1920	• Nil	• Protect and conserve rivers and water sources from degradation and pollution • Control over development in water catchment areas • Presently of not much relevance to slope management
2. Geological Survey Act, 1974	• Nil	• May be considered as a vehicle to implement better data collection on geology, hazard maps, etc • Is relevant to current activities of the Slope Management Division
3. The National Land Code, 1965	• State Land Rules	• Could be used to deal with illegal squatters. • Right of access to land when necessary • Classification of land – could introduce a new class for hilly land • To impose conditions related to slope management when there is an application for conversion of land • May impose conditions on any activity on hill land
4. Street, Drainage and Building Act, 1974 (as amended in 2007)	• Uniform Building By-Laws 1984, as amended 2007	• Authority over all developments related to building standards and design within municipal areas • Drainage issues may be regulated • Hong Kong GEO uses Building Code to regulate the development and maintenance of all buildings in the Territory. Similar standards and codes may be issued under the Malaysian Legislation.
5. The National Forestry Act, 1984	• Nil	• Not directly related but can be used to prohibit logging on hill slopes including uncontrolled/illegal activities in forest areas • Certain forests on hill slopes may be declared *Soil Erosion Forests*
6. The	• Environmental Quality	• Generally requires most activities covering more

Title	Relevant Subsidiary legislation	Relevance to Slope Management
Environmental Quality Act, 1974	(Prescribed Activities) (Environmental Impact Assessment) Order 1987	than 50 hectares for an EIA to be conducted • Guidelines on soil erosion has been issued • JAS has required project proponents to take into consideration impact on slopes and mitigating measures to be built in
7. Land Conservation Act, 1960	• Nil	• Specifically intended to regulate all activities on hill slopes • Hill slopes to be defined by Land Administrator • Allows the latter to impose controls on any development or activity on hill land • Also gives powers to Land Administrator to enter and remedy a potentially dangerous situation • Potential for this legislation to be reviewed and amended to enable better and more developed slope management practices to be implemented in accordance with the Master Plan • Cabinet directive have been issued for development on hill slopes
8. Town and Country Planning Act, 1976	• Various guidelines have been issued under the Act. Implementation of these guidelines may vary from state to state.	• Deals with spatial planning. Hill land has been developed without much rules and guidelines. • Guidelines have been issued for development of hill slopes in Sabah • Local plans and structure plans including development in hill areas are approved under this Law and the Local Government Act • Potential for better planning and standards to be imposed using this Law
9. Local Government Act, 1976	• Earthworks By-Laws • Establishment of local authorities • Parks By-Laws • Draft Structure and Local Plans are approved by the local authorities as the planning authority	• Deals with all forms of earthworks including hill cutting • MASMA Guidelines have been adopted by Cabinet for implementation by all local authorities • Local authorities also have powers: - To approve development projects with proper terms and conditions - To ensure maintenance of public/private properties - To ensure safety of public - To abate nuisance - Of entry into and access to all properties under reasonable circumstances • Slope agency will have to work very closely with all local authorities now and in the future and may have to continue to rely on the extensive powers under this legislation
10. Police Act, 1967	• Nil	• Police have general powers to take charge of any incident for public order and safety

Title	Relevant Subsidiary legislation	Relevance to Slope Management
		• Investigate, collect evidence and engage in search and rescue • Control access into and out of any disaster area • Charge, detain and investigate any person/act for criminal offences
11. Civil Defence Act, 1951	• Nil	• Act provides for the setting up of this voluntary force to act during times when the nation is faced with an hostile act • Recently they have been mobilised for natural disasters as a response team • The Act is being revised and updated – potential to use the new Act for better response mechanisms
12. Fire Services Act, 1988	• Nil	• Act provides for the Fire Services Department to act in times of natural disasters.
13. Public Order (Preservation) Act, 1958	• Nil	Minister may proclaim any area to be in danger. CPO has powers of control and regulation over the area. Includes powers of requisition of movable and immovable property.

Table 1.3: Summary of Relevant Legislation in Sabah

Title	Relevant Subsidiary legislation	Relevance to Slope Management
Environment Protection Enactment 2002 (repealed and replaced with the Conservation of Environment Enactment)	• Prescribed Activities Order	Protect and conserve natural resources and safeguard the environment
Forest Enactment Sabah No. 2 of 1968	Contains eight subsidiaries • Date of Commencement • Forest Rules, 1969 • Imposition of Fee under rule 12 (3) • Forest (Prohibition of Export) Rules, 1982 • Imposition of Cess for Export of Sawn Timber under rule 12 (3) • Imposition of Additional Charge for Debt Redemption Trust Fund under rule 12 (3) • Imposition of Special Charge under rule 12 (3) • Notice of Investment of Powers under section 4 (3)	Not directly related but can be used to prohibit illegal logging and illegal squatters
Housing (Control and Licensing of Developers) Enactment, 1978	• Housing (Control and Licensing of Developers) Rules, 1980	To control housing developers, especially those who are errant
Land Ordinance, 1930	• Land Rules • Appointments • Land (Temporary Planting Permit) Rules • Rent Revision Rules, 1958	Deals with illegal squatters preservation of rivers, seashores and hills
Local Government Ordinance, 1961	• Various rules have been made in relation to the establishment of municipal councils	Authority over all developments within municipal area including entry for safety reasons
Mining Ordinance, 1960	• Mining (Fees) Regulations, 1960 • Mining Regulations, 1969 • Mining (Inspector of Mines) Regulations, 1976	Control over mining in any area. Could be used to avoid soil erosion and mining activities on hilly areas.
Parks Enactment,1984	• Kinabalu National Park Regulations, 1971 • Tunku Abdul Rahman National Parks Regulations, 1974 • Turtle Island National Park Regulations, 1979	Prohibits environmentally degrading activities within the parks

Title	Relevant Subsidiary legislation	Relevance to Slope Management
Town and Country Planning Ordinance, 1950 Sabah Cap. 141		Deals with spatial planning. Allows hill land to be developed in accordance with rules and guidelines. Guidelines have been issued for development on hill slopes.
Water Resource Enactment, 1998		Control over development in water catchment areas
Wildlife Conservation Enactment,1997		Deals with the protection of wildlife and their habitat
LOCAL AUTHORITY LEGISLATION		
Kota Kinabalu Municipal Council, 1982	Planning By-Laws	Local plans and structure plans including development in hill areas
	Earthworks By-Laws	Deals with all forms of earthworks including hill cutting
Sandakan Municipal Council, 1981	Earthworks By-Laws	Deals with all forms of earthworks including hill cutting
Tawau Municipal Council, 1982	Earthworks By-Laws	Deals with all forms of earthworks including hill cutting

Table 1.4: Summary of relevant legislation in Sarawak

Title	Relevant Subsidiary legislation	Relevance to Slope Management
Natural Resources and Environment Ordinance., 1996	• Prescribed Activities Order	Protect and conserve natural resources and safeguard the environment
Forest Ordinance, 1958	• The Planted Forests Rules, 1997	Not directly related but can be used to prohibit illegal logging and illegal squatters
Public Park and Greens Ordinance 1993	• Nil	Establish and manage public parks and greens. Could be used to declare hilly areas as parks and greens.
Land Code	• Land Rules	Deals with all aspects of land administration including rivers, lakes and water resources. Land use approvals are given under this Ordinance. Also provides for customary land rights.
Local Authorities Ordinance, 1996	• Various rules have been made in relation to the establishment of municipal councils	Provides for the establishment of local authorities which have authority over all developments within municipal area, including action against any act of nuisance
Minerals Ordinance, 2004		Control over mining in any area. Could be used to avoid soil erosion and mining activities on hilly areas.
Building Ordinance 1994		Controls and regulates all buildings within the areas specified
LOCAL AUTHORITY LEGISLATION		
City of Kuching North Municipal Council	Earthworks By-Laws	Deals with all forms of earthworks including hill cutting

A summary of some of the main guidelines related to development in highland areas is given in **Table 1.5** below.

Table 1.5: Summary of relevant guidelines

Title	Relevant Subsidiary legislation	Relevance to Slope Management
Guidelines for Development on Highlands, Ministry of Natural Resources and Environment, 2005		• Apply to development of infrastructure, agriculture or any physical development on highlands >300metres above sea level • 1,000metres above sea level, maintained as Soil Protection Forests and Catchment Forests • Highlands Classification: - o 0-150m (Low land) o 150-300m (Hill land) o 300-1000m (Highland) o >1000m (Mountain) • Physical development subjected to Construction Suitability Map (CSM) • Four classes in the CSM:- o Class 1: Low geotechnical limitations o Class 2: Moderate geotechnical limitations o Class 3: High geotechnical limitations o Class 4: Extreme geotechnical limitations
Guidelines for Conservation of Natural Topography in Physical Planning and Development in accordance with the Town and Country Planning Act 1976 (published in 1997)	• Town and Country Planning Act 1976 • Uniform Building By-laws 1984, as amended 1996 • Land Conservation Act, 1960, as amended 1989	• Highland is land >150m above sea level and gradient >25°. • Any land development involving construction of infrastructure, any structure and acts which relates to or interrupts natural state of land. • Category of hill areas are:- o <25° - low & medium risk o >25° - high risk hill area
Guidelines for Conservation and Development of Environmentally Sensitive Area	• Under review	• Under review
Standards for Development of Sensitive Area	• Not for public circulation	• Relates to all environmentally sensitive areas. • Document not for public circulation
Guidelines on Hillside Development, A Study by Institution of Engineers Malaysia, 2003	• Nil	• Slopes for hillside development can be classified into 3 Classes: o Class 1 Development o Low risk : Existing legislation procedures can still be applied o Class 2 Development o Medium Risk: Mandatory submission of geotechnical report prepared by professional engineer

Title	Relevant Subsidiary legislation	Relevance to Slope Management
		o Class 3 Development o Higher Risk : In addition to the geotechnical report, an Accredited Checker (AC) shall be engaged by the developer
Guidelines on Hillside Development, Ministry of Natural Resources and Environment, 1997	• Town and Country Planning Act 1976 • Uniform Building By-laws 1984, as amended 1995 • Land Conservation Act, 1960 • Geological Survey Act, 1974, as amended 1996	• Category of hill areas are:- o <25° - low & medium risk o >25° - high risk hill area • Any land development involving construction of infrastructure, any structure and acts which relates to or interrupts natural state of land.
Guidelines on the Prevention and Control of Soil Erosion and Siltation in Malaysia, Department of Environment, 1996	• Street Drainage and Building Act 1974 • Environmental Quality Act 1974 • Town and Country Planning Act 1976 • Mineral Development Act 1994 • Mining Enactment 1929 • Geological Survey Act, 1974, as amended 1996	• Projects involving earthworks resulting in soil movements and erosion include- o hill slope development o forestry o housing o resort and recreational development • Any steep slopes, all cut and fill slopes, landslide prone slopes • Preliminary Site Evaluation and Erosion and Sediment Control Plan to be prepared before development • Hill slope development subject to proper irrigation, vegetation, earthwork stabilization, maintenance and monitoring
MASMA (Urban Stromwater Management Manual For Malaysia), Ministry of Natural Resources and Environment, 2000	• Town and Country Planning Act 1976 • Street Drainage and Building Act 1974 • Land Conservation Act, 1960 • Waters Act 1920	• Development of all land with natural slope of 20% (12.5º) or greater • Specific requirements for planning, design and implementation of drainage/stormwater management facilities in hillside development project • Mandatory design and planning standards set out for hillside development • Slopes in hillside development: Reduce infiltration, erosion/sedimentation and enhance slope stability

Agencies identified as retaining responsibilities related to slope management are:

- Slope Engineering Branch (CKC) of the Public Works Department (JKR)
- Town and Country Planning Department
- Department of Environment
- Mineral and Geosciences Department (JMG)

- Malaysia Meteorological Department (JMM)
- Malaysian Remote Sensing Agency (MACRES)
- Public Works Department
- Malaysia Highway Authority (LLM)
- Survey and Mapping Department (JUPEM)
- Department of Land and Mines
- National Security Division (NSD), Prime Minister Department
- Royal Malaysia Police (PDRM)
- Fire and Rescue Department
- Special Malaysia Disaster Assistance And Rescue Team (SMART)
- Emergency Medical Services
- Malaysian Armed Forces
- Civil Defence Department (JPA3)
- Department Social Welfare
- Malaysian People Voluntary Alliance (RELA)
- Local authorities

Table 1.6 summarises the main agencies involved and existing legislation that empowers them to control and regulate various aspects of slope management.

Table 1.6: List of stakeholders

Legislation	Lead Agency	Stakeholders
1. Waters Act, 1920	• District and Land Office	• Department of Irrigation and Drainage • State Secretary • DOEDepartment of Environment • Local Authority • State Water Authorities
2. Geological Survey Act, 1974	• Mineral and Geosciences Department	• Department of Environment • District & Land Office • Mines Department • Local Authority • Town & Country Planning
3. The National Land Code, 1965	• District and Land Office	• Town and Country Planning Department • Department of Environment • Department of Irrigation and Drainage

Legislation	Lead Agency	Stakeholders
		• Public Works Department • Mines Department • Survey Department
4. Street, Drainage and Building Act, 1974 (as amended in 2007)	• Local Authority	• Town & Country Planning • Department of Irrigation and Drainage • Department of Environment • Public Works Department • Sewerage Services • Department of Occupational Safety and Health • Construction Industry Development Board
5. The National Forestry Act, 1984	• Forestry Department	• Department of Environment • Department of Irrigation and Drainage • District & Land Office • Department of Wildlife and National Parks • Survey Department • Forest Research Institute of Malaysia • Malaysian Timber Industry Board
6. The Environmental Quality Act, 1974	• Department of Environment	• Fisheries Department • Forestry Department • Town and Country Planning Department • Land and Mines Department • Public Works Department • Department of Irrigation and Drainage • Marine Department • Agriculture Department • Local Authority • District and Land Office
7. Land Conservation Act, 1960	• District & Land Office	• Town and Country Planning Department • Local Authority • Department of Irrigation and Drainage • Public Works Department • JOEA
8. Town and Country Planning Act, 1976	• Town and Country Planning Department	• District & Land Office • Department of Environment • Department of Irrigation and Drainage • Public Works Department • Water Authority • Fire Services Department • Local Authority • Ministry of Local Government
9. Local Government	• Local	• All Government agencies and

Legislation	Lead Agency	Stakeholders
Act, 1976	Authority/District Councils	departments
10. Police Act, 1967	• Police Force	• Civil Defence Department • Fire Services Department • Malaysian Highway Authority • Local Authorities
11. Civil Defence Act, 1951	• Civil Defence Department	• Police Force • Ministry of Health • Fire Services Department • Public Works Department • Essential Services Departments such as water, rail, etc.
12. Fire Services Act, 1988	• Fire Services Department	• Police Force • Local Authorities
13. Public Order (Preservation) Act, 1958	• Royal Malaysian Police	• Civil Defence Department • Armed Forces • Essential Services Departments

The agencies which adopt and apply the guidelines are shown in.

Table 1.7: List of Stakeholders of the Relevant Guidelines

Guidelines	Lead Agency	Stakeholders
Guidelines for Development on Highlands	• Ministry of Natural Resources and Environment	• All government agencies
Guidelines for Conservation of Natural Topography in Physical Planning and Development in accordance with the Town and Country Planning Act 1976	• Town and Country Planning Department	• State and local authorities
Guidelines for Conservation and Development of Environmentally Sensitive Area	• Town and Country Planning Department	• Under review
Standards for	• Town and Country	• Not for public circulation

Guidelines	Lead Agency	Stakeholders
Development of Sensitive Area	Planning Department	
Guidelines on Hillside Development by IEM	• Institution of Engineers Malaysia	
Guidelines on Hillside Development	• Ministry of Housing and Local Government	• Department of Environment • Geological Survey Department • Department of Irrigation and Drainage • Agriculture Department • IKRAM • Institution of Engineers Malaysia • Town and Country Planning Department • Water Supply Branch, Public Works Department • Forestry Department
Guidelines on the Prevention and Control of Soil Erosion and Siltation in Malaysia, 1996, DOE	• Ministry of Natural Resources and Environment	• All government agencies
MASMA (Urban Stromwater Management Manual For Malaysia)	• Ministry of Natural Resources and Environment	• All government agencies • Water authorities • Developers • Engineers • Architects

The control and regulation of all issues pertaining to land in the country is legally, and almost exclusively, within the purview and jurisdiction of state governments (vide the Federal Constitution) to the exclusion of the Federal Government. This entrenched position will mean that any legislation on issues pertaining to land, with almost no exception, will be made by state authorities. An examination of legislation within the various states indicates that by and large there is no specific legislation at that level which adequately addresses the myriad aspects of slope management. There are, however, a number of laws related to land that provide specific direct powers related to the management of land such as the National Land Code and Land Conservation Act. There are other state laws which are indirectly related to slope management such as the Town and Country Planning Act, Local Government Act, Street Drainage and Building Act, Waters Act, Forestry Act, Mining Act, Selangor Waters Management Enactment, Natural Resources Environment Board (Sarawak), Sabah Water Resources Enactment and Conservation of Environment Enactment Sabah. These laws address issues of urban planning, hillside development, soil erosion and forest/water resources management.

At the federal level, despite the growing awareness of the need for action to address the issues related to slope management, there is as yet no specific legislation that empowers any federal agency to act on all these issues. This may be due to the fact that the Constitution does not empower the Federal Government to enact any legislation on issues pertaining to land. It may also be due to the fact that the proactive management of slopes at the Federal level almost certainly started only with the formation of the Slope Engineering Branch (CKC) of the Public Works Department in 2004. Prior to this, there was no specific agency exclusively tasked with the management of slopes. It can be concluded that, as far as the management of slope failures is concerned, current legislation gives the authorities a limited platform to manage the myriad issues associated with it.

1.3.4. Issues in Legislation

Land Use Planning

The Town and Country Planning Department , in compliance with the Town and Country Planning Act , has prepared the National Physical Plan for Peninsular Malaysia and Structure and Local Plans for various states. Presently, Local Plans and State Structure Plans are prepared by the Town and Country Planning Department to cover the municipality and the state levels respectively. These plans do take into account land that is sensitive to development, including hill land. Local authorities are tasked with the implementation of these various plans.

Under the Town and Country Planning Act, a project proponent has to apply for planning permission approval from the local planning authority. Among the key requirements at this stage is the Development Proposal Report under Section 21 of the Act. The approval process begins with the checking of the submission against the development local plan and seeking of comments from various technical agencies including the Department of Drainage and Irrigation Department , Department of Environment and Public Works

Department . The local authority, which is also the local planning authority, will decide on the approval.

Major projects are approved by the State Planning Committee, which is chaired by the Chief Minister. Often at this stage, environmental issues are managed through the Environmental Quality Act . Under Section 34A of this act,, the Department of Environment requires an Environmental Impact Assessment (EIA) to be submitted for a list of 19 Prescribed Development Activities. The Development Proposal Report (LCP) under Section 21 of the Town and Country Planning Act 1976 also requires a report on the current environmental status and the environmental managementmeasures that have been considered and taken by the planners and engineers in the planning of the proposed development layout. The environment-related concerns and impacts at this stage will be considered, including impact on land, soil erosion, slope failure, surface waters, groundwater, hydrologic balance, drainage regime, flooding and sedimentation. Impact on human population will also be taken into account in terms of impact on and danger to communities.

<u>Land Use Conversion and Sub-division</u>

Land conversion and sub-division are standard procedures that need to be carried out first in any land or property development. Applications for land use conversion must comply with the National Land Code and must be lodged with the District Land Office. The District Land Office will, prior to approval, seek comments from the relevant technical bodies including the Agriculture Department, Town and Country Planning Department, Department of Drainage and Irrigation, local planning authority, water authority, Public Works Department and other departments where necessary, such as the Department of Environment, Department of Civil Aviation, Department of Mineral and Geoscience. The technical inputs from these agencies are often included in the conditions of approval for the conversion of land.

<u>Control of Land Use</u>

The Land Office/District Office is the principal agency responsible for land use regulation. The primary legislation that empowers the agency is the National Land Code supported by the Town and Country Planning Act. There are other legislation that enables the agency to regulate land use such as the Land Conservation Act and the Waters Act. The State of Penang has prescribed land above 200 feet to be "hill land" under the Land Conservation Act. The Department of Environment, through the EIA Order and the Environmental Quality Act, has defined *highlands* to include areas of elevation of 1,000 feet or more above sea level including gazetted hill land under the Land Conservation Act (see the "EIA Guidelines for Development of Resorts and Hotel Facilities in Hill Stations, 1995"). The Town and Country Planning Department generally adopts land above 25 degrees as being not suitable for residential or related development. Sarawak has adopted (via the Natural Resources and Environment (Prescribed Activities) Order 1994) hills with slopes of 20 degrees or more as requiring an EIA to be conducted. Sabah has similarly adopted 20 degrees for EIAs to be conducted. It does appear that there is no generally accepted definition of "hill" land among the authorities.

Illegal settlements/activities on state and or private land are a major issue especially when it occurs on hill land. These illegal land uses have been a long-standing problem in most states, particularly in Pahang and Kelantan. Enforcement of the laws is often tempered with issues encompassing social, political and economic factors. Selangor, for one, had an official policy to achieve zero squatters status by 2005 and, though delayed, may be on the way to achieve the target. The state is also making efforts to legalize illegal industries. This is done by approving land use conversions and persuading the property owners to apply for proper building plan approval besides applying for DOE license to occupy industrial premises.

<u>Control of Construction Activities</u>

Almost the entire country is now under the jurisdiction of local authorities (city, municipal or district councils). These agencies implement various laws related to development including the Local Government Act; Street, Drainage and Building Act and Town and Country Planning Act. For development projects, during the construction stage the officers of the local authority and the pertinent technical departments monitor the implementation of the development projects to ensure that they are carried out according to the approved plans. The project proponent's consultants have to comply with various requirements under the Uniform Building By-laws and the Earthworks By-laws.

There are extensive powers under the Street, Drainage and Building Act for the authorities (and its authorized representatives) to control, regulate, investigate, enter, take action or stop any work on any land or building. They have the powers to undertake remedial measures themselves and recover costs and take punitive measures for action not in accordance with approvals given. Only works carried out by a government agency are not subject to regulation by local authorities. It is presumed that the government agency will impose and abide by construction best practices.

A relevant guideline that may be imposed is the Guidelines on the Prevention and Control of Soil Erosion and Siltation in Malaysia, DOE, 1996. Contractors undertaking construction works have to be registered with the Construction Industry Development Board (CIDB). The CIDB is a statutory body responsible for developing the construction industry in the country and promoting the adoption of best construction practices (technology, quality, environment, safety). Thus, the CIDB does play an important role in enhancing the capacity of contractors during the implementation of construction work including developing an accreditation scheme to recognise contractors with good EM practices.

Building Plan Approval

Building plans are principally regulated by the Streets, Drainage and Building Act and subsidiary by-laws, such as the Uniform Building By-law. The Local Authority has to seek comments from the relevant bodies before giving its approval including the Town and Country Planning Department, Drainage and Irrigation Department, Department of Environment, Public Works Department and other departments as deemed necessary. The controls are exercised through a number of plans which have to be submitted by the proponents at this stage including the earthwork plan, oads and drainage plan, structural plan and landscape plan.

The objective of the authorities, through implementing the above measures, is to ensure that among others, the safety and stability of every building is ensured. Upon completion of the building the authorities will issue the Certificate of Fitness for Occupation (CFO). This is now replaced with the Certificate of Completion and Compliance (CCC) effective for all building plans approved after 12th April 2007 for all states in Peninsular Malaysia under the Uniform Building By-law, 1984, as amended in 2007. The issuance of the CCC is now undertaken by the Principal Submitting Person (PSP). The CFO/CCC may be issued only after all the technical agencies listed in the building plan approval process are satisfied with the compliance of the project in accordance with the approved conditions.

The Local Authority/PSP has to ensure that the development project has been properly carried out and completed in accordance with the planning approval and conditions. In the short to medium term, the slope agency may work in cooperation with these existing institutions and legislation to give its expert advice and input for inclusion in their consideration.

The development planning process is shown in **Figure 1.1**.

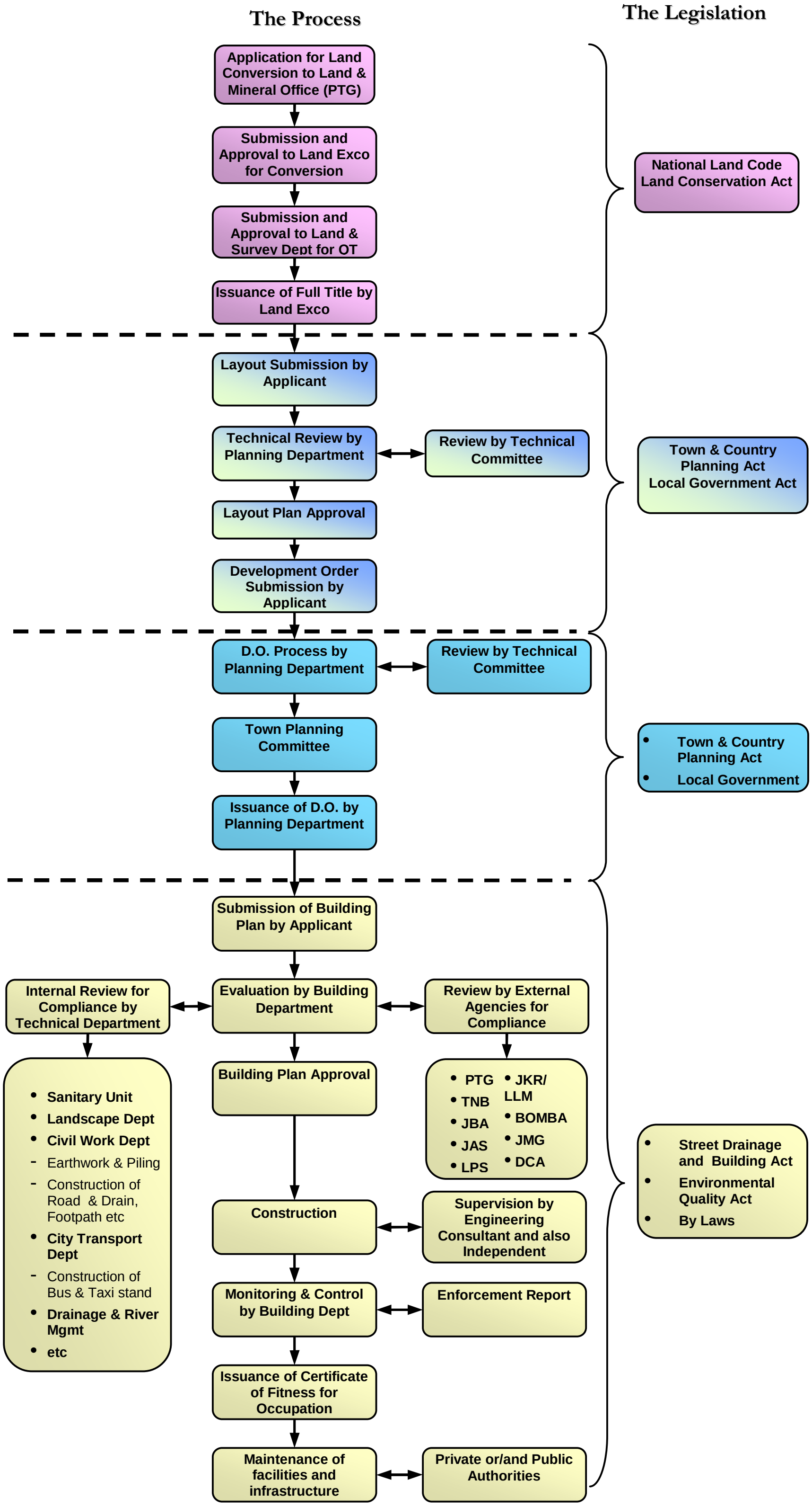

Figure 1.1: Land development stages

Property Maintenance and Management

The local authority is empowered to ensure that relevant public areas and works are properly maintained. Some of the pertinent environmental concerns at this stage include the proper maintenance of drains and the stability of surrounding hill slopes. The responsibilities and powers of each relevant party are defined in the following legislation:

- Building and Common Property (Maintenance and Management) Act, 2007 defines the powers of the developers, commissioners of buildings, joint management bodies and management corporations
- Local Government Act empowers local authorities
- Town and Country Planning Act empowers the Town and Country Planning Department and local authorities
- Street, Drainage and Building Act empowers local authorities

Management of Drainage Systems

Drainage and rivers have a major impact on hill slope conservation and maintenance. The Highland Towers incident was caused primarily by issues pertaining to poor drainage planning, implementation and maintenance. Planning for major drainage, flood mitigation and river rehabilitation are mostly carried out by the Department of Irrigation and Drainage. Local authorities are concerned with municipal level drainage systems and issues. However, some large local authorities such as Dewan Bandaraya Kuala Lumpur and Penang carry out planning of the total drainage systems within their municipalities. The Department of Irrigation and Drainage and local authorities are currently in a transitional stage in the adoption of the *Manual for Stormwater Management for Malaysia* (MASMA) which has been approved by the National Council on Local Government. The Department of Irrigation and Drainage has also produced several guidelines pertaining to rivers.

Environmental Management Plans

Issues related to management of slopes and hill land may also be addressed through an integrated Environmental Management Plan . The EIA Order 1987 prescribes various activities to be made subject to a mandatory EIA on hill station resorts or hotel development covering an area of 50 hectares or more. There are provisions in other laws which may have a similar effect. The Town and Country Planning Department requires a Strategic Environmental Impact Assessment to be included in the preparation of Statutory Plans and LCP, and to be carried out administratively. The states of Sabah, Sarawak and Selangor have state legislation that requires project proponents to undertake EIA and EMP for specific projects including those on hill land. The Selangor Waters Management Authority Enactment 1999 has substantial provisions for activities that may impact water resources. The relevant state legislation for Sabah and Sarawak has been mentioned above.

Monitoring and Enforcement

In practice, enforcement of the various laws is usually easier said than done, especially since there appears to be very little by way of coordinated planning or management effort for slope management in the country. The occurrence of several landslides in areas such as Ampang and Cameron Highlands with tragic consequences, has created national awareness.

However, with the exception of this project, there appears to be very little by way of national efforts to approach the management of slopes in a more systematic and organised manner. Such effort appears to be stymied by the overwhelming pressure to develop at any cost. Agencies may also be hampered by lack of expertise and shortage of enforcement staff. The perceived (as opposed to actual powers vested under the law) lack of legal powers within existing legislation to manage slopes could also be a hindrance to enforcement.

Private Litigation for Damages and Compensation

The principle of compensation for damages arising from negligent acts and nuisance by any person is well covered under Malaysian civil law. Malaysia follows the common law system and therefore much of its civil law is similar to that found in Commonwealth countries. The Highland Towers case (see review in Annex 2) whilst clearly reinforcing some of these common law principles on the law of negligence and nuisance also set some new precedents. Private parties are free to bring an action against any person for acts of negligence or nuisance in Malaysian courts. In the Highlands Towers case, the court found various defendants (developers, architects, draftsmen and land owners) liable to pay damages for their acts of negligence/nuisance against the plaintiffs who suffered damage to their property and loss of lives. The Supreme Court of the country however exonerated the Municipal Council (which was also a defendant sued by the plaintiffs) from having to pay compensation on the grounds of public policy – reportedly to prevent the Council from depleting its limited resources on compensation for economic loss of private parties.

1.3.5. Review of Slope Management Practices

The pro-active management of slopes at the federal level in Malaysia started only with the formation of CKC in the Public Works Department in 2004 following a Cabinet's decision for better management of slopes in the country. Prior to this, there was no specific agency exclusively tasked with the management of slopes.

Its establishment was prompted by a major rockfall at Bukit Lanjan which caused a closure of a major highway for six months. Prior to this incident, there were other landmark landslides such as the Highland Tower collapse, Genting Sempah debris flow and Hillview landslide.

Proper and systematic management of slopes in Malaysia is the responsibility of the CKC. Its tasks include slope failure investigations, repair works, landslide early warning system, slope cataloging, data digitalizing, promoting public awareness and also formulating specifications and guidelines for slopes.

This role of CKC is to ensure safer slopes through the increase in engineered slopes, reduction of risks and fatalities from landslides, provision of public education on slope safety, maintenance and prevention. It is currently provided with an annual operational budget of about RM 2.5 million and 59 staff.

CKC is made up of eight units comprising slope safety, slope management, IT and standards, research and development, forensic investigation, and quality and training. The organisation of units under the branch is shown in **Figure 1.2** below.

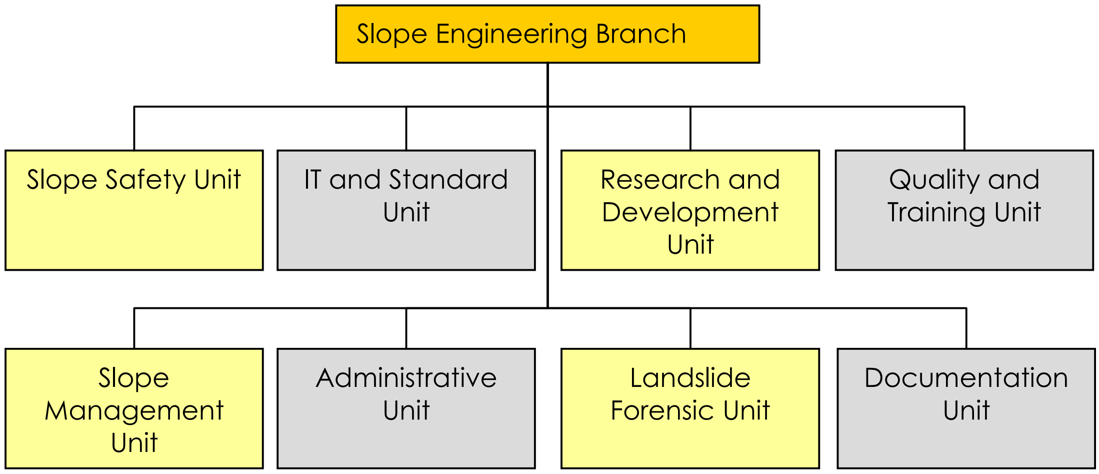

Figure 1.2: Current organisation chart of the Slope Engineering Branch

The functions of each unit are as follows:

- Slope Safety Unit

  The functions of this unit are to coordinate slope repair works, oversee slope inspection and maintenance, establish and maintain early warning system to detect impending slope failure, prepare management and development budgets for slopes, assess slope safety when requested and increase public awareness.

- Slope Management Unit

  The functions of this unit are to establish comprehensive slope management and information by using *Slope Management and Risk Tracking* (SMART),collect slope spatial and non-spatial data, produce hazard and risk maps, generate priority list of slopes that are in need of repair and ensure that slope risk is as low as practically possible.

- IT and Standards Unit

  The functions of this unit are to prepare standard specifications and guidelines for slope maintenance and inspection; utilise GPS and GIS software to generate hazard and risk maps; use GIS to produce slope hydrological models;to coordinate and maintain existing software systems while determining the standards and architecture that will be developed in the future; prepare, update and maintain the branch website; collate spatial data entry in the SMART system and perform probabilistic slope stability analysis;manage the SMART system and provide assistance in matters pertaining to information technology and computer technology to other units within the branch.

- Research and Development Unit

The functions of the Research and Development unit are to carry out research on landslides and the National Slope Master Plan study, and initiate cooperation and memorandum of understanding with universities to appraise new and existing technologies utilised by CKC.

- Landslide Forensic Unit

The responsibilities of this unit are to investigate landslides, coordinate and investigate landslides for Government agencies, prepare landslide reports and respond to the National Committee for landslides. Other functions are to check the design of new slopes, prepare standards and guidelines for slope design, improve the planning, design and construction of slopes.

- Quality and Training Unit

The functions of this unit are to execute strategic planning to train personnel based on competency and training need analysis, budget for human resource development and training, manage and oversee Quality Management System (SPK) as documented in the ISO and plan and guide personnel to augment their skills, knowledge and ability to perform duties.

- Documentation Unit

The functions of this unit are to collect, catalogue and store technical data pertaining to slopes, reports, landslide records in Malaysia, and literature on slopes. The unit also supports other units within the branch by retrieving data and reports required.

- Administrative Unit

  The functions of this unit are to manage matters pertaining to personnel services, annual budgeting, managing salary and allowances, producing monetary report, purchasing, managing assets and keeping records and updating personnel information.

Major projects undertaken by CKC are comprehensive studies and repairs of hazardous slopes along federal roads (such as along the Tamparuli–Sandakan Road in Sabah and Kuala Kubu–Gap Road in Selangor), Landslide Early Warning System and Integrated Slopes Information System (ISIS).

1.3.6. Review of Disaster Management

There is no specific law that applies specifically to disaster response and management. There are, however, various laws related to emergency services, public order and control. These include the Police Act, the Fire Services Act and Civil Defence Act. There are also provisions in the Street Drainage and Building Act which enable the local authority to declare certain public spaces and buildings as unsafe, to evacuate people and to take appropriate measures to demolish, repair, maintain and manage such areas.

MKN Directive No. 20 is perhaps the most important document related to disaster management in the country. The objective of this Directive is to establish a land disaster management and relief system that will provide a swift, coordinated and effective response to any major disaster. The directive was issued by the National Security Council, Prime Minister's Department in May 1997, prompted largely by the tragic Highland Towers incident.

The directive defines "disaster" as a sudden and complex incident which causes loss of lives, damage to property or natural environment, severely affects local activities and requires effective co-ordination of many agencies with deployment of extensive resources. Landslide is classified as a "disastrous incident" by this directive, Although it excludes minor disasters from its coverage. These are indicated as "non-disastrous incidents" which involve only "a small number of victims", has no possibility of spreading and can be handled by relevant agencies with minimal resources and facilities at the local level, e.g., small fire or mishap on a lake or river.

MKN Directive No. 20 sets up a co-ordinating mechanism for agencies to respond to a disaster. There are three levels of disaster. They are categorized under this Directive and controlled as follows:-

a) Level 1 Disaster – district level
b) Level II Disaster – state level
c) Level III Disaster – central level

MKN Directive 20 lays down the steps and measures to be taken and followed in times of disasters. These include:

a) Management at the scene of disaster based on zone
b) Role and duty of major and secondary rescue agencies in disaster management
c) Guidelines and standing order for agencies operation
d) Collaboration between Government agencies, statutory bodies and private sectors;
e) Media control centre
f) Management of disaster relief fund
g) Release of statements and messages
h) Declaration of disastrous situation
i) Enforcement

The framework for disaster management in Malaysia is shown in **Figure 1.3**.

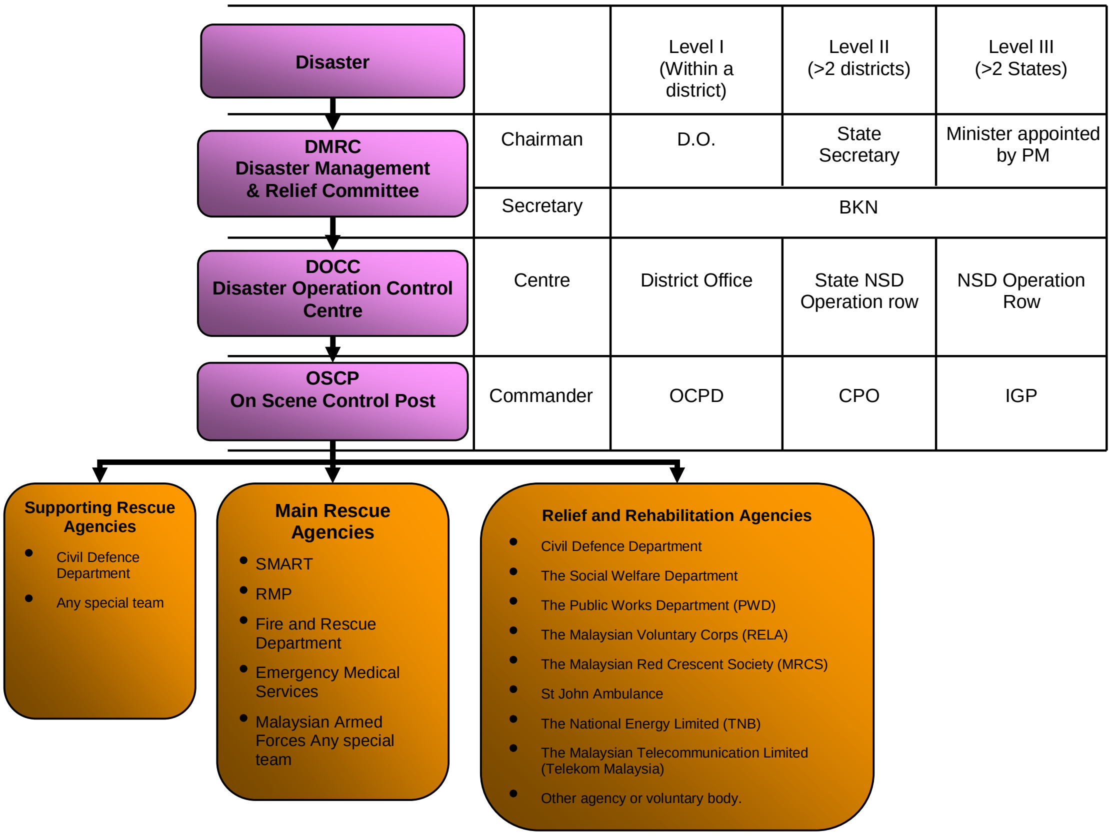

Figure 1.3: Disaster management framework

MKN Directive 20 is an administrative guideline that is normally adhered to by government agencies. It is less clear when non-governmental agencies become involved and the legal impact of this directive on them.

Given the fact that the directive was issued in 1997, it is timely that a general review of the efficacy of the whole disaster management mechanism be undertaken and appropriate changes made where relevant. In this respect it must be noted that this directive is merely a guideline for government agencies to follow but has served its purpose quite well over the years. The directive may also be become outdated with the many changes in the roles, responsibilities and capabilities of the agencies concerned. The manner and process of handling disasters have also undergone evolution with new developments and changes in many countries abroad. There is a need to re-examine the various laws to ensure that the national disaster response and management mechanisms serve their purpose.

It may be also timely for due consideration to be given to the formulation of a Disaster Relief Management Act such as that found in other countries (e.g., the United States, Japan and United Kingdom) so that sound practices may be backed by legal standing. In this respect, it is noted that there are moves to upgrade the MKN Directive No. 20 into legislation in the very near future.

1.3.7. Review of International Practices

It is appropriate that a review of legislation and practices in some countries be undertaken to allow for benchmarking and to consider the adoption of best practices appropriate to local conditions. This review covers both developing countries and developed economies.

<u>Sri Lanka</u>

Best practices that could be emulated from Sri Lanka include:

a) The setting up of appropriate training facilities in cooperation with the Asian Disaster Mitigation Training Network (ADMIT) and Asian Disaster Preparedness Centre (ADPC) shows the way for possible cooperation with Sri Lanka in this vital area;

b) The establishment of the Sri Lanka Disaster Management Act providing legislative and institutional support for disaster risk management with the establishment of the powerful National Council for Disaster Management under the President and the Disaster Management Centre (DMC) as the lead agency for disaster risk management. The proposed Disaster Counter Measures Act should be studied as it appears to be far- reaching in its intentions to regulate all aspects of disaster management.

<u>Australia</u>

Best practices that could be emulated from Australia include:

a) Each of the state and territorial governments has developed counter-disaster arrangements and emergency service agencies and coordinated related activities through emergency/disaster management committees. These emergency service agencies rely heavily on the support of trained volunteers who provide services such as search and rescue, fire fighting and medical care. States and territories have become increasingly self-sufficient in responding to disasters. The Federal Government has become more of a financial source with specialised expertise, assessment, warning and monitoring services for meteorological and geological hazards;

b) Non-governmental organisations (NGOs) are an essential component in Australian disaster response/relief arrangements and community support in the disaster recovery phase. Australia's emergency management community is expanding to further recognise the important roles played by the private sector and professional institutes in developing and implementing mitigation plans and strategies;

c) There is research undertaken by the Australian Geo Mechanical Society which produced a benchmark report called the AGS (2000). The intention was to establish uniform terminology, define a general framework, provide guidance on risk analysis methods, and provide information on acceptable and tolerable risks for loss of life. It emphasizes the pragmatic benefits of incorporating the concept of risk in the assessment of potential landslides, particularly in planning and management situations. Likewise in Malaysia, there is an urgent need to encourage and conduct similar research for localized application.

<u>Republic of Korea</u>

In 1997, the Government of the Republic of Korea created the National Institute for Disaster Prevention (NIDP) to:

a) Update its national disaster management and prevention policies

b) Research and apply the findings to develop independent design capabilities for disaster management and prevention systems

c) Collect, compile, and analyse information on disasters for improved disaster impact assessment, improved mitigation practices, better integrated disaster management policies and the promotion of wider international cooperation

d) Engage in activities including:

- Develop an online management system for areas exposed to specific hazards
- Evaluating recovery and response systems
- Developing a comprehensive management system
- Compiling a disaster impact assessment standard
- Conducting an annual International Disaster Prevention Cooperation Seminar to maintain public, policy and professional interests in disaster risk reduction

India

The Indian Government has strengthened its organisational planning to lessen disaster impacts that go far beyond effective relief services. The following lessons were drawn:

a) A more comprehensive national strategy was developed to link risks with development objectives and environmental concerns.

b) The long-standing relief commissioner system was altered, and national policies on risk reduction were revised.

c) Technical agencies, educational institutions, commercial interests, international finance and insurance investors were included in the development of a major reorientation of risk monitoring and management.

d) International and national expertise were used in the design of improved administrative legislation and building standards.

e) State governments were encouraged to update their legislation, strategic plans, disaster management codes, manuals and procedures.

f) The responsibilities were assigned to the Ministry of Home Affairs because of its:

- direct responsibility for the coordination of the operational aspects of Government
- influence which proceeds from the national direction of the civil service, through various state jurisdictions, down to local governmentimplementation of policies

- range of responsibilities, which include the integration of disaster and risk management into the national, state and local planning and administrative processes

g) A High Powered Committee on Disaster Management (HPC) was formed and its key recommendations included:

- identifying disaster management as a listed responsibility in the national constitution to be shared by national and state government authorities
- drafting a national act for calamity management and preparing and submitting a model state disaster management cct to the Government for consideration
- maintaining a sustained focus by constituting a Cabinet Committee on isaster anagement
- proposing a national council for disaster management under the Prime Minister's Department, which is chaired by the Prime Minister or his deputy, with an expanded scope to include human-induced disasters
- establishing a National Institute for Disaster Management as a national centre, with a structure as evolved as the HPC
- integrating disaster reduction strategies with development plans
- designating at least 10 percent of budgeted reserved funds at the national, state and district levels to be earmarked and apportioned for schemes that specifically address disaster prevention, and preparedness measures
- developing and providing precise Geographic Information Systems (GIS) and digital maps of all states, districts and urban centres with essential spatial and non-spatial data at appropriate scales

<u>China</u>

The Chinese Government has shown the highest levels of responsibility and political commitment towards disaster reduction.

a) The Chinese Government established an inter-ministerial coordinating institution known as the National Committee for International Disaster Reduction, in recognition that a long-term political commitment is required at the highest levels to fulfil the objective of reducing risks of disaster.

- The committee is headed by a state councillor and consists of 30 agencies that include representatives from the state council, ministries, national committees and bureaus, the military services and social groups. Its secretariat is located in the Ministry of Civil Affairs.
- The committee is responsible for designing a national disaster reduction framework. In this capacity, it develops guiding policies, coordinates relevant departments in the implementation of specific programmes and supervises disaster reduction work undertaken by local governments.
- An additional advisory group of 28 senior specialists in related fields has been formed to provide guidance to the national committee, especially in the application of science and technology in disaster reduction initiatives.

b) Progressive implementation of the National Disaster Reduction Plan of the People's Republic of China (NDRP), scheduled to run between 1998 and 2010. The objectives are to:

- integrate and link disaster reduction activities into overall national economic and social development planning for the advancement of national economic and social development
- increase the application of scientific and technical experience in disaster reduction work
- enhance public awareness about disaster risk reduction
- establish comprehensive institutional and operational structures for disaster risk management
- reduce direct economic losses associated with natural hazards
- keep abreast of international developments in trelevant areas and strive to promote international exchange and multinational cooperation
- implement the disaster reduction plan at provincial and local levels of responsibility

On May 12, 2008, a devastating 8.0 Richter earthquake struck China's Sichuan province and surrounding areas with 90to 95 percent of homes collapsed or uninhabitable. In

addition to a staggering estimated death toll of about 69,000, over 2.5 million people have been displaced from their homes.
Major earthquake events in China normally require a huge disaster relief response by the government and prompts worldwide offers of help. Politics often interjects itself into disaster relief as the handling of disaster relief, by both the government and contributing countries, has political ramifications. Foreign governments can score political points with disaster aid to a country that may be hostile or unfriendly. This is one reason why some host governments do not want foreign disaster aid to come in.

However, the Chinese Government response to the 2008 earthquake disaster relief was positive, spurred by the sheer scale of the disaster and the desire to avoid incurring unnecessary political costs. It showed a previously unheard-of openness as it dispatched massive foreign relief and aid workers to the region.

Chinese troops and rescue workers were immediately mobilised and reached the devastated areas two days after roads were cleared of debris. Three days after the disaster, Japanese search and rescue crews arrived in Beijing and were making their way to the earthquake zone. South Korea and Russia joined the Chinese search effort. Despite political tensions, China agreed to accept a cargo plane from Taiwan full of tents and medical supplies. Taiwan's Red Cross sent a 20-person emergency relief team.

Through these activities, it was clear to see that the Chinese Government has learned some hard lessons from their handling of past disasters and wisely opening itself for international assistance.

<u>Canada</u>

a) In 2001, Canada created the Office of Critical Infrastructure Protection and Emergency Preparedness (OCIPEP) under the purview of the Minister of National Defence. An all-hazards approach was taken in recognition that different hazardous events can have similar impacts. Its functions are to;

- address vulnerabilities and augment the protection of the country's infrastructure from disruption or destruction
- ensure civil emergency preparedness

- provide national leadership to enhance the capacity of individuals, communities, businesses and governments to manage risks within their environment

b) OCIPEP has gained a great deal of experience in preparedness, response and recovery activities from its predecessor, Emergency Preparedness Canada (EPC), resulting in Canada's increasingly comprehensive ability to cope with emergency situations.

c) Efforts towards the long-term goal of reducing vulnerabilities to, and losses from, disasters include:

- land-use zoning guidelines
- structural protective features
- comprehensive and more systematic National Disaster Mitigation Strategy (NDMS)

d) The development of NDMS include the involvement of all levels of governments, private sector and non-governmental stakeholders such as scientists, scholars and practitioners, in defining the framework for a new national strategy (i.e. ,about the best-suited scope, policies and mechanisms for co-ordinating and implementing a national strategy).

e) Federal mitigation activities, through an Inter-departmental Mitigation Co-ordinating Committee, include reviewing preparedness and mitigation initiatives and conducting analysis to identify areas where additional attention is needed. Participants include representatives from all relevant federal departments.

<u>South Africa</u>

a) A methodical, if protracted, effort to develop a comprehensive national strategy for disaster risk management has been pursued in South Africa by reforming organisational structures and creating new legislation concerning disaster risk management.

b) The government resolved to assess South Africa's ability to deal with disaster risk management. This initially involved;

- A complete review of disaster management structures and policies, and recommendation of a formal structure for disaster management. [An initial

National Disaster Management Committee was formed in 1996 with the intended function of co-ordinating and managing national disaster management policy. As that body never came into being, in mid-1997 the Government approved the formation of an alternative Inter-Ministerial Committee for Disaster Management (IMC).]

- A reen Paper on disaster management, which was produced as the first tangible step towards establishing a formal disaster management policy for the country. It was tabled in February 1998 and provided an important conceptual framework for public dialogue about disaster management and risk reduction at local, provincial and national levels.
- A year later, a policy White Paper was developed by South Africa within the framework of the IDNDR.

c) Key policy proposals include:

- Integration of risk reduction strategies into development initiatives
- Development of a strategy to reduce community vulnerability
- Legal establishment of a national disaster management centre
- Introduction of a new disaster management funding strategy
- Introduction and implementation of a new disaster management act
- Establishment of a framework to enable communities to be informed, alert and self reliant
- Establishment of a framework to coordinate training and community awareness initiatives
- Contribution to joint standards and common practices along the same lines with neighbouring and other countries

d) To address South Africa's immediate needs, an interim disaster management authority was composed with representatives from ten national departments. This was later converted into a National Disaster Management Centre (NDMC). It has yet to become a statutory institution.

e) An Inter-Departmental Disaster Management Committee (IDMC) was also established in the same year to ensure better co-ordination among government departments at national level. This, however, was intended as an interim measure until such time when the planned statutory structures became functional under a Disaster Management Act.

f) The Disaster Management Bill was enacted in January 2003. It focused more attention on intra-governmental institutional relationships and related operational arrangements. The rationale behind the bill was to ensure that unambiguous guidelines could be given once the legislation was promulgated.

<u>Switzerland</u>

a) In Switzerland, a long-standing Federal Forest Law recognised the importance of forests to reduce water runoff and protect against avalanches. The country has proceeded from the earlier conventional protection from hazards to developing more integrated risk management based on a balanced equilibrium of disaster prevention, response and reconstruction measures. Residual risk based on social, economic and ecological criteria was starting to be considered in under this new plan.

b) Hazard and risk management in Switzerland follow the principle that distribute responsibility between federal, state and communal authorities as well as among individual property owners and other public institutions and organisations. It emphasizes the inviolable rights of the lower hierarchies of official authority and public responsibility, and allows the upper hierarchical levels to exert only a limited degree of political power and take over administrative duties that the lower levels of responsibility are not able to cope with or accept.

c) The Swiss disaster management strategies aim to achieve sustainable development in all aspects of natural disaster reduction and place great importance on prevention, response and reconstruction (in a somewhat reverse subsidiary relationship to each other). Great emphasis is placed on prevention. Response must be efficient and smooth in the face of catastrophic events. Reconstruction has to take place subsequently, and to a degree that is necessary, feasible and compatible with far-reaching considerations about the environment.

d) The Swiss disaster management strategies include:

- Creating an extra-Parliamentary Commission (the National Platform for Natural Hazards, 1997) made up of representatives of the Federal

Government, the states, research and professional associations and the economic and insurance sectors. Its activities are to:

- Develop a national strategy for dealing effectively with natural hazards
- Coordinate all parties involved in disaster reduction
- Create more awareness about natural hazards and replace the conventional approach to protection with an enlarged understanding of risk management
- Promote through public relations
- Initiate and support projects which further integrate risk management
- Support third party projects that share similar aims
- Utilise the synergies among various sectors

▪ Maintaining and promoting the exchange of experience with other countries with regard to disaster reduction, sustainable development and humanitarian assistance

▪ Setting up a virtual campus (the Centre of Competence on Natural Disaster Reduction) where students, researchers and other practitioners who are working with natural hazards can access courses and risk-related information on the website. This is part of building awareness about risk reduction through information exchange and education.

▪ Upgrading the Swiss National Alarm Centre, recognizing that communications are important for the routine exchange of information in times of calm as well as during times of crisis

▪ Allocating financial resources to ensure their most effective use to:
  - Give preference to non-structural preventive measures, such as maintenance rather than engineering
  - Shift resources from reconstruction to preventive measures
  - Reallocate resources to increase inter-state collaboration and avoid duplication;
  - Improve the coordinated use of Ggovernment subsidies and similar incentives for local authorities and communities

<u>Russia</u>

a) Russia has a comparatively long history of disaster reduction and emergency response with a set of institutional initiatives introduced during the past decade.

- During 1992-1993, the national Unified State System of Early Warning and Disaster Mitigation, which subsequently became the Russian System on Disaster Management (RSDM), was established.
- In 1994 the status of the State Committee on Emergencies and Natural Disasters was elevated and became a the Ministry of the Russian Federation for Civil Defence, Emergencies and Elimination of Consequences of Natural Disasters (EMERCOM). The institutional co-ordination of efforts in disaster reduction was provided through an inter-agency commission for disaster reduction organised in 1995.

b) The national institutional framework for natural disaster reduction developed and installed in Russia encompassed a diversified institutional framework. This included legislation, administrative structures at the national level, coordination and implementation mechanisms, and national programmes that focuses on emergency prevention and mitigation, response capabilities, and specific practices in the mitigation of hazards.

c) The mitigation of natural hazards or prevention of potential disasters became an integral part of Russia's national policies for enhancing environmental and human security.

d) Current national disaster reduction policies emphasize:

- Monitoring, forecasting and risk assessment of natural hazards
- Measuring to manage associated risk of natural hazards
- Implementing disaster risk management practices that can mitigate or alleviate eventual damage

e) Major commitments of national policy include:

- Compiling an inventory and related databanks on territorial vulnerability to natural risks
- Monitoring and forecasting potential disaster occurrence. This requires co-ordination and close cooperation amongst existing national hydro-meteorological, seismological, agricultural, environmental and space monitoring networks. However, crucial, monitoring and the related aspects of forecasting have remained weak elements in the national strategy.

f) Major problems remain to be tackled, which are to:

- Fully synthesise a variety of earlier monitoring networks and
- Improve the quality, quantity and regularity of data measurement.

g) Important actions being pursued under the national prevention and mitigation policies are:

- Protective measures
- Reinforced stability of buildings
- The expanded application of zoning measures
- Improved early warning practices
- Increased public awareness
- More direct public participation in risk reduction

h) Shifts in national disaster reduction policies have taken place from the historical priority of emergency response towards the potential risk identification, assessment and reduction of risks by management and operational practices that can alleviate the severity of potential disaster impacts. There is a growing understanding that it is more economical to prepare properly for the inevitable hazards.

i) EMERCOM is a federal body of the executive governmental authority responsible for the:

- Implementation of official policy in disaster prevention and mitigation
- Operational management and coordination of government actions in case of emergency

<u>New Zealand</u>

In New Zealand, local authorities plays a major role in disaster risk reduction management. For example, the Wellington City Council, led by the mayor and supported by the city's business community, had taken the followings actions:

a) Reviewed the existing disaster risk reduction strategy by:

- Engaging in a series of local and international consultations to update both the extent and methods for an improved approach to manage exposure to seismic risks;

- Consulting and working closely with the fire service, and reachingout to many different professional and commercial interests not previously involved in the traditional measures of emergency management
- Focuing on reducing exposure to a variety of possible urban risks, considering the growth and economic foundations of the city
- Analysing existing practices which revealed that:
  - The prevailing disaster management regime focused almost exclusively on emergency response and short-term preparedness measures
  - Emergency managers were ill-equiped to contribute to important and more far-reaching policy decisions regarding comprehensive disaster risk management programmes
  - A noticeable lack of connection existed between the operational abilities of emergency services and the understanding necessary for planning and implementing advance protection for critical economic and social assets of a growing capital city.

b) Embarked on the revision and implementation of legislative reforms in disaster risk management encompassing an all-hazards approach to risk and to appeal to all segments of society. The following accomplishments have been achieved over recent years:

- Broadened responsibilities for local authority emergency managers, with increased roles in training and developing community capacities for risk identification, vulnerability reduction and disaster resilience
- Decentralised emergency management groups, with membership including neighbouring local authorities, emergency services and utility companies in order to ensure that whilst the national emergency management strategy is focused at the local level, there is improved co-ordination of human and technical resources across the country

- Adopted a comprehensive risk management strategy that integrates disaster management into environmental and community management practices at national and local levels

c) Established a hazard liaison group consisting predominantly of planners and policy analysts drawn from the city, district and regional councils with the following tasks to:

- Enhance communication amongst local authorities on hazard management issues
- Eacilitate intra-council communication
- Link hazard mitigation with land-use planning
- Develop tools to manage risk and improve communication amongst people working in sustainable development and environmental management

At the national level, the government established an Earthquake Commission (EQC) to provide natural disaster insurance to residential property owners in New Zealand. One of the functions of the EQC is to assess and settle claims in the event of a major disaster. It insures against damage from disasters such as earthquakes, natural landslips, volcanic eruptions, hydrothermal activities, tsunamis, storms, floods or fires caused by the disaster. Since 1945, this government-owned entity has been collecting premiums from insured people and a substantial fund has built up in form of a Natural Disaster Fund. It is backed up by a government guarantee, which ensures that EQC will always be able to meet its obligations, regardless of the circumstances.

EQC has also formulated a Catastrophe Response Programme (CRP) to cope severely damaged community infrastructure and heavy demands on nationally limited resources during a major disaster. This includes alternative operations sites, provision of additional staff and equipment, and effective post disaster operations.

The EQC also encourages and funds research on matters relevant to natural disaster damage as well as educate people on what can be done to prevent and mitigate damage caused by natural disasters. On the international front, EQC participates in and supports close collaboration with other disaster management organisations around the world in the area of disaster preparedness and response.

1.3.8. Questionnaire Responses

Questionnaires were sent to almost all federal, state and district agencies, as well as private sector and non-governmental organisations. The feedback is summarised as follows:

a) More than half of the respondents (56 percent) said that there are no existing policies or any regulations for the prevention and control of soil erosion or specifically for slope management.

b) However those who acknowledged the existence of policies and regulations (47 percent) said that in general, the enforcement of existing policies was very much state responsibilities.

c) Sixty percent of the respondents said that the majority of policies were adopted and approved mainly by the Cabinet after 1993, a year which marked the awareness of the severity of landslide problems, due to the Highland Towers incident.

d) Implementation of existing policies was only limited to development planning and practices.

e) The respondents also agreed (88 percent) that all authorities at all levels should be involved with slope control and management.

f) Majority of respondents (64 percent) were of the opinion that new policies are required to ensure better control and regulation of slopes in Malaysia. However, they did not see the need to change the existing organisational framework and responsibilities for slope control and management.

g) Most of them (93 percent) felt that there was a need to change the level of public participation in slope control and management.

h) The majority of the respondents were aware of the laws for regulation and control of soil erosion, such as the Environmental Quality Act and the3 Street, Drainage and Building Act as well as the Town and Country Planning Act. However, half of the respondents (50 percent) were not involved in implementing or enforcing those laws.

i) Respondents also said that the present laws are not sufficient for effective regulation and control. This is mainly due to inadequate/insufficient deterrents and absence of specific regulations, guidelines and standards pertaining to slope control and management.

j) Majority of the respondents were not aware of any new laws, regulations, standards or guidelines that are being considered or proposed.

k) Majority of the respondents said that the main agencies responsible for slope control and management should be the Public Works Department, Local Authorities and Department of Environment. The involvement of these agencies is basically at the policy direction level.

l) Majority of respondents (56%) said they are not involved in the discussion and decision making processes related to slope management.

m) Opportunities were given to the private sector to participate or give their views on matters pertaining to the management of slopes in Malaysia. Majority of respondents would like to see more participation of the Institution of Engineers Malaysia, Real Estate and Housing Developers Association and Malaysia Institute of Planner in consultation dialogues.

1.3.9. Responses from Road Shows

Two roadshows to the states were conducted to brief agencies and organisations about the slope management study and source their opinion and feedback. In December 2006 and March 2007, the project team was in Sabah and Pulau Pinang respectively. The following feedback was obtained:

<u>Sabah</u>

a) There was common consensus on the need for clear and additional legislation and guidelines pertaining to management of hill slopes and highland development and landslides. Better cooperation amongst all relevant agencies at all levels was necessary.

b) Local authorities are not directly related to slope management, but they form part of the secretariat of the Disaster Committee. They are responsible for matters pertaining to property development where federal laws are referred to in most instances. As far as they were concerned, legislation related to their functions are clear enough for their implementation. However, the setting up of a special committee within JKR would be beneficial to specifically look into matters on slopes and landslides.

c) In Sandakan, the local authority is involved in the "Team Operasi Gerakan" in the event of disasters, including landslides. Their involvement as lead agency in the said Team is well-received by other local stakeholder agencies.

d) In Sabah, the MKN Directive20 is applied and implemented. In the area of rescue, this directive, which is complemented by other guidelines and ordinances, is deemed sufficient. However, specific legislation on the aspect of early warning and prevention is required.

<u>Pulau Pinang</u>

a) Participants at this forum felt the need to educate and create awareness amongst politicians. The local authorities usually have to surrender to the demands of politicians when making decisions. If the politicians are well aware of the dangers related to their demands, perhaps they will abide by the decisions of the professionals.

b) The current practice does not give the local authority enough power to strictly enforce rules and requirements. The problem is compounded by interference of politicians in decision making.

c) The state has a Hillside Committee (Jawatankuasa Tanah Bukit), which is chaired by the tate Executive Council. However, the recommendations by the Committee can be superseded by politicians.

d) Participants said that the current penalty, which is RM10,000, is too low as a deterrent. They felt that jail sentences will be a better penalty, hence the need for new laws (Acts).

e) Participants also recommended that all hillside development plans be accompanied by an Emergency Preparedness Report. This condition can be put under the responsibility of the management corporation of the development. It was also recommended that the Emergency Response Plan be part of the requirement for the approval of layout plans.

f) Local authorities have the power to approve or reject applications. If they do not succumb to pressure by politicians, the present empowerment is adequate.

g) It is necessary to inculcate a better understanding of the needs and jurisdiction of all relevant agencies. If not, a more powerful agency equipped with the correct legal backing is needed.

1.3.10. Technical Visits

<u>Hong Kong</u>

A technical visit was made to Hong Kong in December 2006 with the intention of learning their experiences and aspirations. On average, about 300 incidents affecting man-made slopes, walls and natural hillsides are reported in Hong Kong each year. The Government of Hong Kong has been proactive in the management of slopes. A total of 57,000 slopes have been cataloged by the authorities in Hong Kong. Through concerted actions, landslide risk has been greatly reduced.

The Hong Kong Government's overall policy objective is to maintain the highest standards of slope safety. It has managed to meet this objective and vision through a comprehensive Slope Safety System. The system commenced with the formation of a specialised section, namely the Geotechnical Engineering Office (GEO) of the Civil Engineering and Development Department (CEDD) in 1977.

The Slope Safety System comprises seven key strategies:

- Improve slope safety standards, technology, and the administrative and regulatory framework
- Ensure safety standards of new slopes
- Rectify substandard government slopes
- Maintain all Government man-made slopes;
- Ensure that private owners take responsibility for slope safety
- Promote public awareness and response in slope safety through public education, publicity, information services and public warnings

- Enhance the appearance and aesthetics of slopes

The agency that focuses on slope management in Hong Kong is GEO. It is remarkable that GEO itself does not have in-house legislation to support its actions. It relies to a great extent on the following legislation which is under the ambit of other agencies as indicated below:

- Buildings Ordinance - Buildings Department
- Planning Ordinance - Planning Board
- Lands Administration Ordinance – Lands Department

The main legislation in operation in Hong Kong that manages all development on land is the Buildings Ordinance. The main objective of this legislation is to ensure that the construction of all buildings is undertaken in a safe manner without prejudicing the safety, security and convenience of the public.

GEO exercises control at all stages of development through a system of auditing, orders, practice notes, guidelines and registration. All contractors, engineers, architects, and consultants are registered and bound by a duty to perform professionally.

The maintenance of government slopes is handled through administrative means with GEO's technical input. The departments that are responsible for the maintenance of slopes are under GEO's control. However, with private slopes, it is the responsibility of private owners to maintain their hill slopes. They have to engage professional engineers and ensure that appropriate designs, measures and works are carried out . In this case, GEO merely audits and approves.

Hong Kong appears to be very successful and has a rational approach in the management of slopes. Best practices that could be emulated from Hong Kong include:

a) Organisational change from a closed, reactive culture to a more, proactive one that is well-perceived by the media and the public.

b) The creation of a specialised agency focused on geotechnical control of all major works that lays the basic foundation for the system. The fact that it was part of the Public Works Department does not appear to deter its effectiveness. There appears to be, so far, little or no conflict of interest nor hindrance to its performance.

c) The adoption of an integrated and systematic approach to the landslide problem was another major factor in its success. An assessment of the problem was first carried out in the form of identifying, cataloging and registering all the slopes. A priority programme was then drawn up for remedial works. At the same time all new works were made subject to geotechnical design audits. Regular maintenance of slopes was not ignored.

d) The system is supported by appropriate regulatory controls, which are both formal and informal. It is remarkable that the key agency did not go out on a limb to have its own legislation. The reason that the system has worked so well is partly due to the comprehensive (one-stop) approach taken by one agency (the Buildings Department) to ensure that all technical inputs are obtained from all agencies before a project is approved. There has been no instances where the input of GEO has been rejected or overlooked by the Buildings Department. The role of GEO is respected and accepted by the development industry and the lack of legal authority does not appear to be an issue. However, all orders and legal notices are issued by the Buildings Ordinance. The Ordinance itself does recognise the role of departments such as GEO in the enforcement of the law.

e) The concerted effort to ensure and encourage stakeholder participation in the management of the problem is a key factor in the success of the programme. Thus, the industry is encouraged to selfregulate. Registration of engineers and their professionalism is left to its peers. Almost all information is freely available to the industry. Investigation of accidents is contracted out to consultants. Active and effective public participation is encouraged throughout the planning process.

f) There is sufficient budgetary funding allocated for new capital works, maintenance works and public education and awareness campaigns.

g) There is a great deal of transparency of all actions undertaken by GEO and other agencies. Public access to information is undeniably better than in almost all agencies in Malaysia. This translates into better accountability for monies spent and more effective agencies.

h) Public education and campaigns are an important part of the overall strategy to reduce injuries and fatalities. It is considered as money well spent (on par with monies spent for physical works) as the occurrence of landslides cannot be totally eliminated. It is tan ongoing programme targeted at a wide spectrum of the public.

i) However, it must be kept in mind that Hong Kong has a relatively simple, unitary administrative structure with clear lines of authority and responsibility. It is therefore far easier to implement actions when there is no blurring of powers, authority and responsibility between various stakeholders.

<u>United States of America</u>

The United States Geological Survey (USGS) was established in 1879 with the passing of a bill in Congress. As the country's largest water, earth, and biological science and civilian mapping agency, the USGS collects, monitors, analyses and provides scientific understanding about natural resource conditions, issues, and problems. Its diversity of scientific expertise enables it to carry out large-scale, multi-disciplinary investigations and provide impartial scientific information to resource managers, planners and other endusers.

USGS is organised with a headquarters and Eastern Region facility in Reston, Virginia. Central Region and Western Region offices are located in Denver, Colorado, and Menlo Park, California, respectively. Thousands of USGS employees are working in every state throughout the country.

One of the major USGS programmes is the National Landslide Hazards Programme (LHP), which aims to reduce long-term losses from landslide hazards by improving understanding of the causes of ground failure and suggesting mitigation strategies. The scope of works of the LHP are to:

- Conduct landslide hazard assessments
- Pursue landslide investigations and forecasts
- Provide technical assistance to respond to landslide emergencies
- Engage in outreach activities
- Monitor and model active landslides
- Provide landslide hazard information and studies of landslide hazard mitigation

The technical staff for LHP comprises scientists, geographers, public education and outreach officers, GIS specialists and researchers. The LHP works closely with other federal and state agencies to reduce landslide losses and obtains funding directly from Congress. The LHP is also involved in developing information, scientific understanding and capabilities needed to issue accurate warnings, advisories and notifications of landslide hazards.

USGS has three types of information centres: for earthquakes, geomagnetics and landslides. The National Landslide Information Centre (NLIC) disseminates information through:

- Publications and free educational materials
- Public talks and presentations
- Exhibits at conferences, schools and civic organisations
- Tours of landslide centres
- Toll-free phone line
- Research and field reports, and publications on subjects such as economic losses
- Press releases
- Landslide videos

Resources available at the NLIC include:

- Hazard studies
- Fact sheets, books, pamphlets, and posters
- Case studies
- Landslide research papers
- Emergency management information
- On-line bibliographic database
- Photographic images
- Video tape collection of landslide events and information

A visit was made to the Colorado Geological Survey (CGS), a state government agency involved in slope management. It was created in 1967 with the enactment of a house bill. The objectives of the CGS are to:

- Assist, consult and advise existing state and local governmental agencies on geologic problems

- Determine areas of natural geologic hazards that could affect public safety or cause economic loss to Colorado residents
- Conduct studies, collect geologic information, and publish maps, reports and bulletins

There is a statute in Colorado that defines a "professional geologist" as a person with accredited academic qualification, training and work experience in the field of geology.

The lessons learnt from the technical visit to the United States are as follows:

- USGS is a research and investigative federal government agency that acts as an advisory agency and has no regulatory power. However, its recommendations are highly valued.
- For hazardous slopes on private lands, the government, through the Federal Emergency Management Agency (FEMA), can buy out land and properties affected by landslides and the owners are relocated at their own costs. However, landowners can refuse government help and repair dangerous or failed slopes themselves.
- Landowners can sue developers for not disclosing information on slope stability at the time purchases were made. This normally ends with out-of-court settlements.
- One of the most successful hazard mappings is for shallow landslides where maps with polygons and not points are used. Geologic, soil and slope maps and rainfall and soil saturation data are required. Deterministic models are used for landslide analysis. Relative safety maps based on static factor of safety are then generated.
- Geologic hazard maps, generated from a forensic examination of past geologic events, can be used to predict future events and also as a planning tool. Multiple methods of investigation are necessary to produce better geologic hazard maps.
- Main problems and issues in information collection are that the USGS is still experiencing inconsistencies in information collection and archiving, and competition for limited resources between various types of hazards. There are also variations between states with regard to information collection practices.

- There is still ongoing expansion and improvement of landslide inventory and loss studies amongst all the states in the United States and collaboration with other professional practices, such as the American Planning Association.
- Sub-division of land requires submission of reports concerning geologic characteristics, hazards, soil suitability and any soil or topographic conditions that present hazards or require special precautions.
- All development in areas designated by the authority as geological hazard areas shall be engineered and administered in a manner that will minimise significant hazards to public heath and property.
- Local government agencies are required to submit reports regarding geologic suitability for land purchases, new infrastructure plans, and improvements to existing infrastructure for review.
- Developers or builders of new residential areas are required to provide the purchaser with a summary of soil and hazard analyses and site recommendations.

1.3.11. Summary

The management of landslides and slopes boils down essentially to the conservation or development of land. Legislation is used to regulate and control the development activities. Relevant laws and guidelines are applicable, and there are agencies empowered to control and regulate the management of land in relation to slope failures.

However, the control and regulation of all issues pertaining to land in the country is legally, and almost exclusively, within the purview and jurisdiction of the state governments (vide the Federal Constitution) to the exclusion of the federal Government. At the Federal level, despite the growing awareness of the need for action to address the issues related to slope management, there is as yet no specific legislation that empowers any federal agency to act on all these issues.

Laws that provide specific powers related to the management of land include the National Land Code, the Forestry Act and the Mining Act. Other state laws that are related to slope management are the Land Conservation Act; Town and Country Planning Act; Local Government Act; Street, Drainage and Building Act; Waters Act; Selangor Waters Management Enactment; Sabah Water Resources Enactment and

Environment Protection Enactment Sabah. These laws address issues of urban planning, hill development, soil erosion and water resources management.

Local authorities monitor the implementation of the development projects to ensure that they are carried out according to the approved plans. In practice, enforcement of the various laws is usually easier said than done, as there is little coordinated planning or management effort for slope management in the country. The local authorities are also empowered to ensure that relevant public areas and works, such as drains and surrounding hill slopes, are properly maintained.

There is no specific law that applies specifically to disaster response and management. There are, however, various laws related to emergency services, public order and control. These include the Police Act, the Fire Services Act and Civil Defence Act. There are also provisions in the Street Drainage and Building Act which enable the local authority to declare certain public spaces and buildings as unsafe, to evacuate people and to take appropriate measures to demolish, repair, maintain and manage such areas. MKN Directive 20 is perhaps the most important document related to disaster management in the country.

The principle of compensation for damages arising from the negligent acts and nuisance by any person is well covered in Malaysian civil law.

A review of legislation and practices in some developing and developed countries was undertaken for benchmarking and possible adoption as best practices for local conditions. Best practices that could be emulated are:

- Sri Lanka - the setting up of training facilities with international cooperation
- Australia - counter-disaster arrangements and emergency services, roles of non-governmental organisations roles, and research
- South Korea – roles of the National Institute for Disaster Prevention
- India – strengthening of organisational planning to lessen disaster impacts
- China – high government levels of responsibility and political commitment towards disaster reduction
- Canada – emergency preparedness
- South Africa – development of a comprehensive national strategy for disaster risk management

- Switzerland – shift from conventional protection from hazards to more integrated risk management
- Russia – institutional initiatives to disaster reduction and emergency response
- New Zealand – roles of local authorities in disaster risk management

Feedback from questionnaires and road shows indicated that the present laws are not sufficient for effective regulation and control. This is mainly due to insufficient deterrents. Implementation of existing policies are only limited to incorporation into development planning. Awareness of slope control and management and relevant regulations, guidelines and standards among public and decision makers are low. Hence, there is a common consensus on the need for clear and additional legislation and guidelines pertaining to management of hill slopes, highland development and landslides, and for better cooperation amongst all relevant agencies at all levels.

Technical visits were made to Hong Kong and the United States of America with the intention of learning their experiences and aspirations. Hong Kong appears to be very successful in the management of slopes. This may be due to its small territorial size,

The Government of Hong Kong is very proactive in the management of slopes and is able to maintain the highest standards of slope safety with almost all slopes catalogued. GEO exercises control at all stages of development through a system of auditing, orders, practice notes, guidelines and registration. Departments responsible for the maintenance of government slopes are under GEO supervision and oversee the safety of private slopes.

USGS is a research and investigative federal government agency that assumes an advisory role and has no regulatory power. However, its recommendations are highly valued. The USGS collects, monitors, analyses, and provides scientific understanding about natural resource conditions, issues, and problems. Its range of scientific expertise enables it to carry out large-scale, multi-disciplinary investigations and provide impartial scientific information to resource managers, planners, and other endusers. A similar government agency at the state level, the Colorado Geological Survey, assists and advises state and local governmental agencies on geologic problems by conducting studies, collecting geologic information, and publishing maps, reports and bulletins.

1.4 Recommended Strategies

1.4.1. Introduction

The aim of this proposal is to establish necessary systems, structures, programmes, resources, capabilities and guiding principles for managing slopes, reducing landslide risks and preparing for and responding to landslides and threats of landslides in the country. This will save lives and property, avoid disruption to the economy and environment, and ensure sustainability of development.

The policy framework proposal will cover the following phases of slope management:

- Pre-landslide Phase (Prevention, mitigation, and preparedness measures);
- Landslide Impact Phase (Emergency relief measures); and
- Post-landslide Phase (Loss assessment, Reconstruction & Rehabilitation measures).

Figure 1.4 shows that slope management is a continuum of activities, not a series of events that start and stop with each disaster occurrence.

In order to carry out the policy proposal, it is necessary to define a framework of operation for a set of agencies and stakeholders that play key roles in slope management. The study team envisages the following entities playing significant roles:

- Federal, state and local authorities
- Government departments
- Voluntary agencies, including NGOs
- Professional bodies
- Private sector
- Community

The key element of the policy and institutional framework is to strengthen the resources and capability of existing entities and build new capabilities, wherever necessary. The Federal Government provides the overall direction and guidance that keeps the focus of various entities on slope and disaster management. Local authorities and government departments at the state and district levels are the implementation agencies.

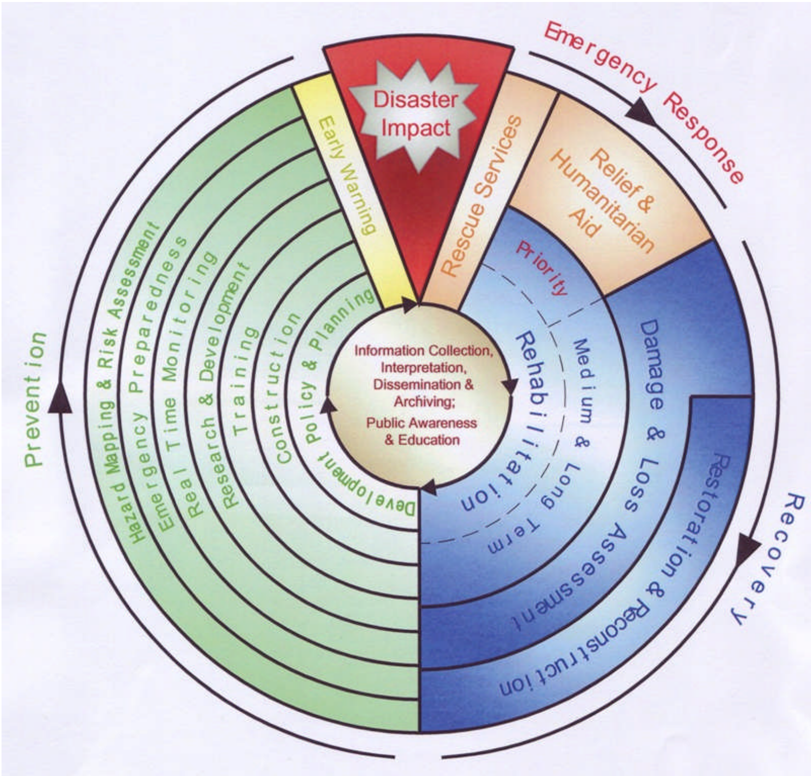

Figure 1.4: Slope management cycle

Pre-landslide Phase

The pre-disaster phase includes prevention, mitigation, and preparedness activities. These activities involve collecting extensive data, maintaining directories of resources, developing action plans, capacity building, training and community awareness activities, amongst others. The capabilities developed in this phase will play a critical role in all subsequent phases.

Landslide Impact Phase

This phase includes all measures that are taken immediately in the aftermath of a disaster. Speedy decision making, efficient response, fast deployment of trained personnel and proper flow of information are crucial in this phase. The ability of institutions to respond to a disaster is developed during the pre-disaster phase, and their capabilities will be put to test in this phase.

Post-landslide Phase

The post-landslide phase mainly comprises reconstruction and rehabilitation activities. The thrust of this phase is to ensure fast recovery and alleviate long-term economic and social impact from the landslide.

1.4.2. Strategic Thrust

The strategic thrust and strategies of the policy and institutional part of the National Slope Master Plan are listed in **Table 1.8**.

Table 1.8: Strategic thrusts

Strategic Thrust	Strategies
Develop effective policy and institutional framework for landslide risk reduction, mitigation and disaster preparedness	Strategy 1.1: Propose multi-sectoral and integrated slope management and landslide risk reduction mechanisms Strategy 1.2: Integrate landslide risk reduction into development policies and planning Strategy 1.3: Adopt or/and modify necessary legislation to support and promote landslide risk reduction Strategy 1.4: Demonstrate strong government support to promote and finance landslide risk reduction Strategy 1.5: Build strong capabilities, expertise and networking in slope management

1.4.3. Strategies

Strategy 1.1	Propose multi-sectoral and integrated slope management and landslide risk reduction mechanisms

The objective of this strategy is to ensure an integrated and uniform approach to slope and landslide management through the application of the principles of cooperative governance.

Multi-sectoral and integrated slope management and landslide risk reduction mechanisms, with designated responsibilities from national to the local levels, will ensure clear and transparent decision-making through collaboration, cooperation and communication.

Slope management is a shared responsibility fostered through partnerships between the various stakeholders and cooperative relationships between the different government agencies, the private sector and the community. Furthermore, slope management is an inter-governmental process, with each level of government playing a unique role and shouldering specific responsibilities in the process. It is important that the slope management functions normally performed by various sectors and disciplines in the national, state and district levels are not duplicated.

The main purpose of the institutional arrangements is to create an enabling environment for implementation of integrated risk reduction measures and development of institutional capacity to provide improved emergency preparedness, and response and recovery services.

Institutional arrangements must enable cooperation and co-ordination, with emphasis on facilitating co-ordination among existing structures, organisations and institutions wherever possible as well as harnessing existing skills and expertise.

The following activities would be carried out under this strategy:

Action 1.1.1: Establish coordinating committees on slope management at the national, state and local authority levels.

An inter-governmental Committee on Slope Management (ICSM) must be established at the national level and must consist of members involved in slope management.

The primary purpose of the ICSM is to provide a mechanism for the active participation of all stakeholders, including technical experts and communities, in slope management planning and operations, where relevant role players consult one another and coordinate their activities on slope management issues.

The ICSM is to be established by the Minister of Works, responsible for administering slope management and must be chaired by the head of the national Slope Engineering Agency (SEA). The committee is accountable to the Minister for:

- Ensuring that appropriate mechanisms and institutional arrangements are in place to give effect to the principles of cooperative governance
- Coordinating slope management by establishing joint standards of practice amongst the government agencies

The ICSM must comprise a central nucleus of senior representatives of the relevant national departments related to slope management works, together with the heads of the SEA Regional Offices and representatives of each state government. Technical experts and other role players in slope management as designated by the Minister should supplement membership of the committee. The committee membership should remain fluid to accommodate changing needs in respect of technical inputs and specific expertise requirements. Such representation may include relevant NGOs, international relief agencies, community-based organisations (CBOs), institutions of higher education and the private sector.

The ICSM must advise and make recommendations to the Minister on issues relating to slope management and the establishment of the national disaster management framework.

The ICSM should also play a role in:

- Acting in an advisory capacity on matters pertaining to slope management
- Supporting the programmes of SEA
- Promoting joint standards of practice
- Developing the slope management information system
- Contributing critical information to the directory of institutional role players
- Assisting in establishing effective communication links
- Advising and making recommendations on training and public awareness
- Participating in the review of slope programmes and policies.

Recommendations on issues relating to slope management policy must be submitted to SEA for consideration before being submitted to the ICSM.

Meetings of the ICSM must take place at least quarterly, unless circumstances dictate that meetings be convened more frequently.

The primary responsibility for the coordination and management of landslide risk reduction rests with the state and local authority. It is difficult to apply the principles of cooperative governance, integrated and coordinated slope management and stakeholder participation at the state and locals level in the absence of appropriate structures and without the participation of key personnel from various state departments. It is equally difficult to effect landslide risk management planning and co-ordination without the appropriate institutional arrangements. For the purposes of effective implementation of the National Slope Master Plan (NSMP) and consistency in the requirements of the national slope management framework, it is necessary to establish inter-Governmental committee at the state level. However, in the event that a state elects not to do so, appropriate existing alternative structures must be identified.

Action 1.1.2: Identify the roles and responsibilities of all relevant entities in the integrated management of slopes and establish a clear chain of command for all slope management activities and coordination mechanisms

Government agencies must assess any national legislation applicable to their functions with respect to slope management and must advise the SEAon the state of such legislation.

Slope management responsibilities must be integrated into the routine activities of the various sectors and disciplines within the Government agencies and their substructures. These responsibilities must be reflected in the job descriptions of the relevant role players and appropriate key performance indicators must be provided.

In the NSMP, each government agency must determine its roles and responsibilities in relation to slope management and assess its capacity to adhere to the requirements of the NSMP, particularly with reference to setting priorities for risk reduction initiatives, emergency preparedness, response and recovery. Such capacity must be supplemented, where necessary, by collateral support and the sharing of resources between government agencies, and by harnessing the capacity of the private sector and NGOs. The parameters of such assistance must be clearly defined.

Each government agency must appoint an individual who will act as its focal or nodal point for disaster management and who will also be its representative on the ICSM. This individual will be responsible for:

- Facilitating and coordinating the relevant department's slope management arrangements and planning for risk reduction
- Ensuring that such arrangements and plans are consistent with the NSMP
- Facilitating the alignment of the arrangements and plans with those of other government agencies and other institutional role players
- Integrating the slope management planning process with the integrated development planning process
- Regularly reviewing and updating slope management plans
- Ensuring response to requests for information from SEA

These responsibilities must be included in the job description of the relevant appointee and appropriate key performance indicators must be included.

Agencies identified as retaining responsibilities related to slope management are:

- The proposed Slope Engineering Agency
- Town and Country Planning Department
- Department of Environment
- Mineral and Geosciences Department
- Malaysia Meteorological Department
- Malaysian Remote Sensing Agency
- Public Works Department
- Malaysia Highway Authority
- Survey and Mapping Department
- Department of Land and Mines
- National Security Division, Prime Minister Department
- Royal Malaysia Police
- Fire Rescue Department
- Special Malaysia Disaster Assistance and Rescue Team
- Emergency Medical Services
- Malaysian Armed Forces
- Civil Defence Department

- Social Welfare Department
- Malaysian People Voluntary Alliance (RELA)

Strategy 1.2	**Integrate landslide risk assessment and risk reduction planning into development policies and planning at all levels of government and industry**

Sound practice in landslide risk management for government policymakers, urban managers, planners and slope management professionals can only take place when it is integrated within government functions. It stems from coherent policies that are based on a comprehensive understanding of landslide risk, preparedness and mitigation, and community participation.

The following activities would be carried out under this strategy:

Action 1.2.1: Ensure that the planning activities of federal, state and local authorities take into account slope protection and landslide risk reduction and provide suitable preventive and mitigation measures

Planning for slope management is a participative process involving a multitude of role players and stakeholders from across government sectors, disciplines and spheres, the private sector, NGOs, CBOs and communities. It will therefore be necessary to cluster stakeholders into planning groups relevant to the various activities associated with slope management, that is, development of landslide risk reduction strategies, landslide hazard warning and assessment, and guidelines for landslide response and recovery activities.

Primary responsibility must then be allocated to the lead government agency for each of the activities listed above. This entity is the custodian of the relevant slope management plans and accordingly is responsible for the submission of such plans to SEA. The entity is also responsible for ensuring that plans stay relevant with changes and new developments.

Responsibilities must also be allocated to those entities that play a secondary or supporting role in the various activities identified during the planning process. Thus, it is the explicit responsibility of government agencies (including those at the state and local levels) and other institutional role players to implement slope management plans.

SEA is primarily responsible for ensuring that slope management plans are developed and implemented in a uniform and integrated manner. It may convene ad hoc meetings of planning groups, task teams and key personnel from the relevant government agencies for the purposes of integrated and coordinated planning.

Action 1.2.2: Establish and employ a consistent approach for assessing landslide risks that will provide uniform information for planning of effective risk reduction programmes.

Landslide risk refers to the likelihood of harm or loss due to landslides in vulnerable areas, which include elements such as structures, services and households. Its assessment is the first step in planning an effective risk reduction programme. It examines the likelihood and outcomes of expected landslide events, including the vulnerability conditions that increase the chances of loss.

Risk assessments are essential for effective slope management and risk reduction planning and help to shape risk reduction programmes for specific threats. It identifies potential threats that can undermine an area or community, making it possible for appropriate risk reduction measures to be incorporated into the project design prior to implementation. However, they need to be supported with good monitoring systems,

Relevant agencies must carry out risk assessments for priority disaster risks relevant to their functional areas. Where possible, these should be undertaken inter-departmentally to avoid duplication of efforts and to ensure uniformity of findings.

Risk assessment planning requires identification of key stakeholders, as well as consultation with them about the assessment and the interpretation of the findings.

Risk assessments must be executed systematically in the following ways:

- Prior to the implementation of any landslide risk reduction, preparedness or recovery programmes
- As an integral component of the planning phase for large-scale housing, infrastructure or commercial/industrial developments, or those that affect the natural environment

- When social, economic, infrastructural, environmental, climatic or other indicators suggest changing patterns of risk that increase the likelihood of significant landslide impacts.

All proposed risk assessments and related studies planned by national, state and local agencies must be reviewed by SEA prior to implementation to ensure consistency in approach.

Action 1.2.3: Set the level of acceptable risk in slope management where the probability of occurrence of a slope failure is small or where consequences are so slight that society is willing to take or be subjected to the risk

The concept of acceptable risk evolved partly from the realisation that absolute safety is generally an unachievable goal, and that even very low exposures to slope failures may confer some level of risk. The acceptable level of risk becomes a risk management objective because such exposures could not be completely or cost effectively eliminated. It is useful for determining design requirements in structures or for taking certain actions.

However, application of the concept of acceptable risk is difficult as it involves consideration of social values. Inequitable distribution of risks and benefits across society further complicate the determination of an acceptable level of risk.

Two methods can been used to determine acceptable risk levels. Firstly, the revealed preference approach assumes that society, through trial and error, has achieved a nearly optimal and thus acceptable balance of risks and benefits. Essentially, this means that the acceptable level of risk of the society can be revealed by studying their characteristics. Secondly, the stated preference approach uses opinion surveys and public consultations of hypothetical scenarios to obtain information about risk levels that the society is willing to take before warranting mitigation action.

Strategy 1.3	Adopt necessary legislation to support landslide risk reduction at all levels of government and industry

The following activities would be carried out under this strategy:

Action 1.3.1: Formulate/modify appropriate legislation and guidelines for better slope and landslide disaster management in the country

Short-Term Proposals/Recommendations

It is envisaged that in the short term (defined as five years commencing from 2009 and assuming the Agency is set up within this term), the Slope Management Division of JKR will be upgraded to be a full fledged department (the Agency) within the Ministry of Works. Within this period, it is expected that the Agency will be largely focused on institutional issues related to its formation and establishing linkages for cooperation with other agencies.

In line with this focus the Agency should engage into a cooperative framework to enable smooth implementation of its duties. Such a framework will also require assistance from other agencies to "lean" on their legal powers and implement its duties similar to what is being done by GEO in Hong Kong. It may require the agencies to appoint officers of the Agency as authorized representatives under the relevant legislation. This will then enable the Agency to immediately carry out investigations, surveys and monitoring on any site.

Some of the tasks that may be implemented in the short term include the following:

a) Draw up a framework for cooperation with key agencies such as the Town and Country Planning Department, relevant local authorities, land offices, geological agencies and Department of Environment for support to implement some specific tasks such as hazard mapping, forensic investigations, site investigations, training, research and monitoring and early warning systems.

b) Inform and make available the specialist services and expertise of the Agnecy to these agencies

c) Review existing and develop new guidelines, codes and standards for adoption by all agencies as their prescribed requirements for development on hill slopes

d) Together with the agencies, commence work to identify and agree on critical areas and priorities where the new Department's expertise could be put to use. In this respect the new Department could immediately provide expert advice and input to the one stop centres in relevant local authorities for the issuance development planning considerations and approval

e) Commence work on amendments to existing legislation to strengthen powers related to improved slope management. Such legislation includes the Earthworks By-Laws; Land Conservation Act (currently being actively reviewed by a team of Government agencies); Street Drainage and Building Act (including the Uniform Building By-Laws) and Civil Defence Act. Proposals for amendments to the Land Conservation Act are included herein as Annex 12. It is understood that the Civil Defence Act is being actively reviewed by the agency concerned and it may be worthwhile for the Slope agency to offer its comments. It has also been suggested that MKN is considering converting the Directive 20 circular into legislation. Legislation would rightfully address issues pertaining to the management of disasters arising from slope failures. The Agency should also ensure that all local authorities adopt the Earthworks By-Laws as amended to enable issues related to slope management to be effectively implemented nationwide.

Medium Term Proposals/Recommendations

In the medium term (defined as 6-10 years) it is expected that the Agency would have matured into a well-established specialist agency in management of slopes in the country. It would have gained valuable experience in working with other agencies and publicly acknowledged as the lead agency for slope management in the country. It would have identified various shortcomings in the legislative area which would need to be rectified with appropriate amendments to key legislation such as the Land Conservation Act; Local Government Act; Street Drainage and Building Act and the Town and Country Planning Act. Amending such legislation is but one option available to the Agency but it will be more difficult as these laws are well established and empower other well established agencies. The Agency may well have to consider establishing a completely new law for better management of slopes in the country. **Table 1.11** identifies the actions in the medium term which the Agency will have to implement. Some of the tasks that may be implemented in the medium term include the following:

a) Refine and further enhance procedures, guidelines and cooperative framework for working with other agencies particularly in terms of legal empowerment

b) Adopt amendments to existing legislation, particularly relevant by-laws, to enable better implementation of slope management practices in the country including delegation of powers to the Agency

c) Commence work on identifying separate and new legislation to comprehensively address and manage all issues related to the management of slopes in the country

d) Consider the formulation of a Disaster Relief Management Act along the lines of similar legislation existing in countries such as India and Australia. In this respect the move to upgrade the MKN Directive 20 into legislation may tie in with this proposal

e) Amendments to the Land Conservation Act and Civil Defence Act may have to come into force. Assess the impact of these amendments on improvements in the efficacy of slope management in the country

Long-Term Proposals/Recommendations

In the long term, the Agency may have matured into a full-fledged independent body. It should be in a position where issues related to conflict of interest with its parent organisation no longer arise. Consistent with its independent nature, the Agency should be supported by its own dedicated law on the management of slopes in the country. This law should be unified and applicable throughout the country. However, implementation of this proposal to have a new law will face immense hurdles due to the constitutional position of *land* being largely a matter within the domain of State Governments. The formulation of such a law will require extensive prior consultation with the State Governments. It will require approvals from the National Land Council, National Council on Local Government and even the National Planning Council (under the Town and Country Planning Act Amendments). A constitutional amendment may even be necessary if it is deemed appropriate that slopes would be better managed under federal jurisdiction. In its final form it may be a model law providing uniformity of actions on management of slopes throughout the country. It will be up to state governments to consider and adopt the law for implementation in a particular state and then make it a state law. Such a law may well require the Agency to adapt itself to perform functions as a state authority vested with powers to initiate action on its own. Even with a dedicated law, the Agency will necessarily have to continue to work with other government agencies on common issues related to better management of land.

Table 1.9 summarises the main agencies involved and existing legislation that empowers them to control and regulate various aspects of slope management. It identifies the main activities related to slope management and includes recommendations for legislative reform in the short, medium and long term.

Table 1.9: Proposal for legislative reform in slope management

Activity	Agency involved	Applicable Laws	Remarks	Recommendations on legislation
1. Overall policy and institutional framework	1. Public Works Department, Slope Management Division which has a comprehensive approach to the problem 2. Some local authorities do have policies related to development on slopes. 3. TCPA and DOE have adopted some guidelines on development of hill areas and environmentally sensitive areas.	1. Town and Country Planning Act 2. Local Government Act 3. Street, Drainage and Building Act 4. National Land Code 5. Geological Survey Act 6. Police Act 7. MKN Directive 20	No specific law on management of slopes is available. Some legislation contain provisions related to overall duties of the agencies	1. Short term – set up procedures with existing legislation/agencies to carry out required functions. Obtain authorization under existing legislation. Identify and commence work on amendments to critical legislation. 2. Medium term – make amendments to critical legislation such as the Earthworks By-Laws and Building By-Laws to enable greater emphasis to be given to geotechnical considerations 3. Long term – should consider the possibility of having specific legislation for the integrated management of slopes and to empower the dedicated Agency
2. Hazard Mapping andAssessment	1. Slope Management Division 2. Some local authorities may have implemented this for specific areas 3. DOE may have carried out work related to development on specific slopes.	1. Town and Country Planning Act; 2. Local Government Act; 3. Street, Drainage and Building Act. 4. National Land Code. 5. Geological Survey Act	Largely administrative task but may need legislation to ensure that private parties undertake this activity as part of their obligations. Also need for agency to determine the standards and methodology for adoption by all parties. May need to enter into private property to carry out investigations, survey and install monitoring equipment.	1. Short term – consider administrative arrangements to enable the systems to be installed. Obtain authorization under existing legislation. Identify and commence work on amendments to critical legislation. 2. Medium term – make amendments to guidelines, Earthworks By-Laws, UBBL to require this task to be implemented by developers. Also includes the right to enter and carry out activities by the Agency related to investigation/assessment/mapping. 3. Long term – may consider incorporating this requirement in the new legislation
3. Early Warning and Real Time	1. Slope Management Division	1. Town and Country Planning Act	This being relatively new to	1. Short term – consider administrative arrangements to enable the systems to be

Activity	Agency involved	Applicable Laws	Remarks	Recommendations on legislation
Monitoring	2. Possibly PLUS may be monitoring the Highways 3. DID/DOE may be monitoring aspects related to water quantity and quality 4. Meteorology Department issuing warnings of rain/storm	2. Local Government Act 3. Street, Drainage and Building Act 4. National Land Code 5. Geological Survey Act 6. Highway Authority Act	management of slopes there is as yet no concerted efforts in this area.	installed. Obtain authorization under existing legislation. 2. Medium term - amend the Earthworks By-Laws/Land Conservation Act. Require this task to be implemented by developers/operators for critical areas as a condition of development. Include also the right of Agency to enter and carry out related activities. 3. Long term – may consider incorporating this requirement in the new legislation
4. Loss Assessment	1. Slope Management Division 2. Local authorities	1. Town and Country Planning Act 2. Local Government Act 3. Street, Drainage and Building Act 4. National Land Code 5. Geological Survey Act 6. Police Act 7. MKN Directive 20	There appears to be limited effort presently in this area. What little taking place is not properly documented or collated.	1. Need to develop and adopt methodologies/guidelines and standards in the short term. Consider administrative arrangements to enable systems to be installed. Obtain authorization under existing legislation. 2. Medium term - make amendments to Guidelines, Earthworks By-Laws, UBBL to enable this task to be implemented. Also include the right to enter and carry out activities by the Agency related to investigation, assessment, forensic work. 3. In the long term, will have to consider the possibility of having legal powers to enter sites to carry out assessment and investigations.
5. Collection of Information	1. Slope Management Division 2. Private parties such as PLUS monitoring the Highways 3. DID/DOE on aspects related to water quantity and quality 4. Meteorology Department 5. Local authorities	1. Town and Country Planning Act 2. Local Government Act 3. Street, Drainage and Building Act 4. National Land Code 5. Geological Survey Act 6. Police Act 7. MKN Directive 20	There appears to be no systematic collection, collation and documentation of information on slope failures.	1. Need to develop and adopt systems, methodologies, guidelines and standards in the short term. Also work with other agencies to request them to submit the required information. Obtain authorization under existing legislation. 2. Medium term - may consider amending the Earth Works By-Laws/UBBL to require information to be submitted by private parties and to enable investigations to be carried out. 3. In the long term, will have to consider the possibility of having legal powers to enter sites to carry out assessment and investigations.

Activity	Agency involved	Applicable Laws	Remarks	Recommendations on legislation
6. Training	A new activity to be undertaken by the Slope Management Department	1. MKN Directive 20	No legislation will be required. MKN Directive 20 should be modified for Emergency Drills related to landslide	No legislation will be required. Coperative agreements will have to be considered with other agencies to obtain cooperation for training.
7. Public Awareness	A new activity to be undertaken by the Slope Management Department in cooperation with the local authorities	1. MKN Directive 20	No legislation will be required. MKN Directive 20 should be modified for matters related to landslides and slope management.	No legislation will be required. Cooperative agreements/guidelines will have to be considered with local authorities, Ministry of Information and other agencies to obtain cooperation for joint activities.
8. Loss reduction measures	1. Slope Management Division 2. Private parties such as PLUS, developers in critical areas 3. Local authorities 4. DOE	1. Town and Country Planning Act 2. Local Government Act 3. Street, Drainage and Building Act 4. National Land Code 5. Geological Survey Act 6. Land Conservation Act	Need to review and or develop regulations, guidelines and design codes	1. In the short term, these guidelines may be implemented administratively through the approval processes under the Local Government Act and or Street, Drainage and Building Act. Obtain authorization under existing legislation for Agency to act. 2. In the medium term, appropriate amendments may be introduced in some of the legislation and their related subsidiary legislation . 3. In the long term, new legislation will have to be considered to enable the regulations, guidelines and or design codes to be implemented.
9. Emergency preparedness, response and recovery	1. Fire and Rescue Services Dept. 2. Police Department 3. Prime Minister's Department 4. Civil Defence Department 5. Slope Management Division 6. Local authorities	1. Police Act 2. Civil Defence Act 3. Local Government Act 4. Fire Services Act 5. Public Order (Preservation) Act 6. Street Drainage and Building Act 7. MKN Directive 20	Need to revise and update MKN Directive 20. Proposals to amend the Civil Defence Act are being considered.	1. In the short term, the SlopeDepartment will have to play a bigger role in providing technical assistance to the emergencies first responder agencies. 2. In the medium term, it may have to take an active role in emergency preparedness for slope failures. 3. In the long term, appropriate legislation may be considered to enable effective response and recovery in critical situations.
10. Research and	Slope Management	Nil	The newly created	1. Short term administrative arrangements will have to be

Activity	Agency involved	Applicable Laws	Remarks	Recommendations on legislation
Development	Division		agency will have to play a critical role in establishment standards, guidelines and design codes for which localized research will be essential.	made with local authorities and other private bodies (such as PLUS) for research to be undertaken. 2. In the medium to long term, appropriate legislation may be considered to access information to and from disaster sites for forensic investigations to be carried out and data to be obtained.

Action 1.3.2: Consider formulation / modification of appropriate legislation to improve the professionalism of geologists, especially in the assessment of slope hazards

The challenges of landslide hazards and risk reduction in Malaysia have resulted in significant changes in the way engineering geologists and geotechnical engineers work. Engineering geologists belong to the profession of ground engineering that practices engineering with, on or in geological materials. The practice is of considerable economic importance and benefits society in providing the means of efficient designs and structures and the sustainable use of resources and space.

There is an increasing need for professional geologists to set, measure and demonstrate attainment of acceptable standards. The competency and responsibility of geologists in the description of soils and rocks and in field and laboratory testing require professionally recognised qualifications similar to the engineering profession.

Legislation on this national recognition that was underwritten by the Mineral and Geosciences Department of Malaysia has been passed through Parliament. The development and maintenance of the necessary levels of competence and responsibilities are enshrined in this legislation.

Strategy 1.4	**Demonstrate strong government support to promote and finance slope management and landslide risk reduction**

Landslide disasters and activities relating to mitigation, preparedness, relief, reconstruction and rehabilitation require funds and can cause extensive strain on financial resources.

Assessment of risks and potential impacts of slope hazards before disasters occur is useful in the evaluation of the government's post-disaster financing options. There is a 'financing gap' or mismatch between the funds needed to repair damages and to provide relief, and the funds available through traditional financing. The financing options in the form of insurance or other risk-financing instruments should be based on the size of this financing gap and on the costs and benefits of filling that gap.

The following activities would be carried out under this strategy:

Action 1.4.1: Identify funding sources and provide budgetary allocation for slope and landslide disaster management.

The provision of funding for slope management is likely to constitute the single most important factor contributing to the successful implementation of the NSMP by national, state and local levels of government.

SEA must establish a comprehensive funding arrangement for the implementation of the different categories of slope management as outlined in the key performance areas of the NSMP, including:

- Identifying sources of funding (both public and private sectors) for the implementation of the key performance areas of the NSMP
- Identifying the government agencies responsible for budgeting
- Identifying the government agencies responsible for administering the funding
- Identifying the mechanisms whereby stakeholders can access the funding
- Identifying and establishing criteria for the release and allocation of national funding

A document providing a framework and/or guidelines for funding mechanisms must be distributed to all stakeholders. SEA is responsible for ensuring continuously revised funding mechanisms to give effect to the NSMP.

SEA must act as a facilitator between government agencies and the Treasury to ensure that suitable funding for slope management purposes is made available, and SEA should monitor these funds so that money is correctly spent. This can be done through monitoring programmes that also provide technical assistance to government agencies.

Whilst funds will be derived from nationally collected revenue, it will also be necessary to leverage resources from the private sector and the international donor community. Possible sources of funding for slope management functions and responsibilities include:

- Own revenue in each level of government
- Regular budget processes of national departments, states and local entities
- Conditional grants (including funding streams for infrastructure, capacity building and restructuring)
- Federal loans
- Insurance
- Special provision made by the Federal Government for post-disaster response and recovery, such as the Disaster Relief Fund
- Income from development contributions and fees
- Private sector investment
- Local and international donors

Start-up costs

The Federal Government must provide funding for the establishment of slope management department and regional centres, including the appointment of staff. The SEA must negotiate with the Treasury for the provision of one-off grants for start-up costs.

Operational costs

SEA must make provisions for the development of a formula to calculate the amount of funding that the Federal Government will need for operational costs of slope management centres, at least for the initial period of two years, during the phasing in of the NSMP, after which the situation must be reassessed.

Maintenance of infrastructure is one of the most effective means of slope management. The type of expenditure that is required to reduce landslide risk must be identified, and where possible, conditional grants and the local government funding linked to incentives and requirements aimed at ensuring that relevant agencies maintain infrastructure at a suitable level. Most of this expenditure should be part of the day-to-day maintenance and operational expenditure of the relevant agencies and must be budgeted.

Landslide risk reduction projects

The NSMP recognises that landslide risk reduction, including prevention and mitigation, is a key to effective slope management. It specifies that the NSMP must 'place emphasis on measures that reduce the vulnerability of landslide-prone areas, communities and households'.

As incentives for engaging in risk reduction efforts, state and local requests to the Federal Government for financial assistance will be assessed against the extent to which the state and local authorities institute landslide risk reduction measures and to the extent to which landslide could have been avoided had risk reduction measures been taken.

Although the NSMP places great emphasis on the prevention or reduction of landslide risks, there is currently no monitoring of risk reduction efforts nor have specific provisions been made for the funding of risk reduction programmes and projects. To address this, SEA must:

- Investigate and identify appropriate funding sources and mechanisms to support mitigation efforts for priority landslide risks
- Establish mechanisms for nationally assessing, prioritising and approving proposed risk reduction programmes and projects
- Directly provide or facilitate access to appropriate financial and other technical support to allow implementation of approved projects and programmes.

State or local authorities must apply to the Federal Government for funding of specific projects. If SEA identifies significant risks in their jurisdiction, they should be advised to apply. These applications must be assessed against the Hazard Mapping and Risk Assessment Profile. Funding for approved projects must be obtained through SEA.

Where long-term planning for risk reduction is possible, funding for risk reduction programmes and projects should be included in the budgets of the national departments administering the landslide risk.

Disaster response, recovery and rehabilitation

Emergency response includes measures taken during or immediately after a landslide in order to bring relief to people and communities affected by the event or disaster. A contingency reserve should set aside funding for immediate response to emergencies.

Funding for immediate response to landslides must be based upon expenditure incurred. SEA must estimate the required amount based upon past expenditures and must budget for these amounts. Once this amount is exceeded, SEA must apply for release of these funds through the Ministry of Finance.

Post-disaster recovery and rehabilitation include the repair or replacement of critical infrastructure that has been damaged or destroyed during a landslide, as well as planning and reconstruction efforts to reduce the risk of a similar landslide occurring.

The cost of recovery and rehabilitation can be very high, and frequently exceeds the resources of the state or local agencies affected. The NSMP specifies that the costs of repairing or replacing infrastructure that has been damaged or destroyed during a landslide, should be borne by those responsible for its maintenance. These agencies must submit requests for infrastructure rehabilitation funding to the Federal Government. A budget appropriation must then be requested based upon the sum of the approved claims.

Training, capacity building and public awareness funding

Training, capacity building and public awareness are essential keys to the successful implementation and continued sustainability of slope management, and funding should be provided by the Federal Government.

SEA must approach Treasury for allocation of funding for slope management training and capacity building. Training, capacity building and public awareness programmes must be developed in consultation with other relevant stakeholders.

Monitoring, evaluation and improvement

Landslide risk reduction evaluation and monitoring are essential components of slope management. All aovernment agencies at the national, state and local levels must provide for resources to perform self-assessments and reviews within their normal budgetary processes.

SEA must provide for resources to perform a national evaluation of slope management programmes, official investigations and reviews of landslide disasters, as well as national preparedness.

Action 1.4.2: Explore innovative methods of sharing and transferring the costs associated with landslide risk reduction and disasters to alleviate the burden on the state

Insurance, with respect to landslides in Malaysia, currently involves life and property. Life insurance covers loss of life or personal injury due to landslide. Property insurance covers property loss and damages where landslide coverage is normally extended under the fire or motor insurance clauses.

The additional premium for landslide coverage is at a fixed rate 0.081% of the property value. However, landslide insurance is not compulsory in Malaysia, and most homeowners opt to omit this sub-coverage. In cases where the risk is very high, insurance companies often opt not to cover landslide. The government also does not take up any insurance for government properties to cover any losses.

The government must encourage citizens and its agencies to proactively enhance their capacity to deal with risk reductions. It is not possible for the government to bear all the costs of risk reductions on a sustainable basis, or provide rehabilitation on a long-term basis. The long-term approach is to move towards spreading the risks through various risk transfer mechanisms and providing incentives to individuals and other entities to protect their interests through insurance. However, in doing so, the interests of poorer communities must still be protected by the government through appropriate mechanisms.

The risk transfer mechanisms include:

- Constituting a working group involving the insurance sector.

- Reviewing and analysing the existing risk transfer and insurance mechanisms. Although property insurance do exist, compensation of valuable properties lost due to disaster must be made mandatory through insurance schemes.
- Establish a government-backed insurance pool to cover uninsurable risks. A new legislation, which makes slope insurance policies compulsory, is needed. It also requires the enforcement of building codes and standards that reduce risk of landslides.

Compulsory landslide insurance would involve comprehensive enforcement and is a long-term solution. In the meantime, a public awareness drive on the availability of landslide insurance and the consequences of not having such insurance is an option to be highly promoted.

Strategy 1.5	**Build strong capabilities, expertise and networking in slope management**

When setting up a national slope management system, it is important to note that there is no single model that is appropriate for all countries and that institutional structures and legislation have to be designed by taking into account the specific circumstancesas well as the historical and cultural characteristics of the given country. At the same time, there are some general guidelines that should be followed for the slope management system to function effectively. These include the existence of a clearly defined national slope strategy, integration of key players into the slope management process and provision of resources for key players to carry out their responsibilities.

The following actions would be carried out under this strategy:

Action 1.5.1: Set up a central entity, a Slope Engineering Agency including strategic regional centres, with adequate support, capabilities, expertise and power in developing and streamlining slope management activities

This NSMP calls for the establishment of SEA to achieve the objective of promoting an integrated and coordinated system of slope management. The NSMP also requires the setting up of slope management centres in various regions around the country.

SEA (as well as its regional centres) must have the authority, backed by government will, to fulfil its objectives and responsibilities in the improvement of slope management and landslide risk reduction planning, implementation and monitoring across the various spheres of government agencies. For example, various government agencies and other sectoral players need to make relevant information available to SEA as and when required.

SEA must be close to the highest level of decision-making and ve able to cut across departments with individual responsibilities for slope management. Given that the coordination of the functions of government departments and administration fall within the ambit of the Prime Minister's executive authority, the best location for SEA is in the Prime Minister's Office. This will not only demonstrate the level of the government's commitment to landslide risk reduction and its integration into developmental initiatives, but also facilitate the fast-tracking of decision making and improve slope management planning, implementation and monitoring.

In the first two years of Phase 1 (2009 – 2012), the Slope Management Branch of JKR will be upgraded to become a full fledged department within the Ministry of Works. SEA is expected to mature into a well-established lead agency in management of slopes in the country within Phase 2 (2013-2017). In the long term, SEA needs to be an independent body supported by its own dedicated law and under the Prime Minister's Office. Its research and development unit has the potential to be converted into an instituteon its own.

SEA must exercise its powers and perform its duties:

- Within the NSMP
- Subject to the direction of the Minister, who is responsible for the administration of the NSMP
- In accordance with the instructions of the Director General of the Department responsible for the administration of the Plan

Key responsibilities of SEA

SEA is responsible for guiding and developing a framework for slope management policies and legislation, facilitating and monitoring their implementation, and facilitating and guiding cross-functional and multi-disciplinary landslide risk reduction activities amongst the various government agencies.

SEA acts in an advisory capacity to the ICSM and provides the secretarial support.

The NSMP requires SEA to:

- Establish and maintain institutional arrangements that will enable implementation of the NSMP
- Implement measures that will result in the development of progressive landslide risk profiles for the planning and implementation of risk reduction strategies
- Ensure the development, implementation and maintenance of risk reduction strategies, which will result in resilient communities
- Guide the development of a comprehensive communication and information management system
- Facilitate the development of response and recovery plans to ensure rapid and effective response to landslide disasters that have occurred or are threatening to occur, and to mitigate the effects of disasters that could not have been prevented or predicted
- Assist in the establishment of mechanisms for creating public awareness to inculcate a culture of risk avoidance
- Make provisions for training, education and research
- Develop, implement and maintain dynamic slope management monitoring, evaluation and improvement programmes
- Make recommendations regarding the funding of slope management and initiate and facilitate efforts to make such funding available

Direction and operational capacity of SEA

The minimum criteria for the establishment and optimal performance of SEA are outlined below.

<u>Director -General of SEA</u>

The Director -General, as head of SEA, is appointed by the Minister and is responsible for the execution of the NSMP, the performance of the duties of SEA, and makes all decisions with regard to the department. Sound managerial, technical and financial acumen are required for the post of Director-General.

The performance of the responsibilities of the Director-General will require excellent judgement and problem-solving and strategic decision-making skills. Inevitably, when a landslide occurs or is threatening to occur, independent decisions will have to be made under extremely stressful conditions. Critical decisions that are made on the spur of the moment could have far-reaching effects on the economy, the lives of people, critical national infrastructure and the environment.

The diverse and complex nature of the slope management function requires wide consultation and cooperation not only within the government spheres, but also nationally and internationally but also good communication skills and diplomacy. Accordingly, the new qualifications and experience of the post of director-general must commensurate with the existing requirements.

<u>Minimum infrastructural requirements</u>

The establishment of a slope management infrastructure must be in accordance with the national guidelines, which are to be developed by SEA. The minimum infrastructural requirements necessary to enable SEA and its regional centres to operate optimally are:

- An operation centre for the facilitation of slope management planning, implementation, monitoring and multi-disciplinary strategic management of landslide disaster operations
- An information management system
- A central communications centre, including the establishment and maintenance of a central 24-hour communications facility for reporting purposes as well as for managing the dissemination of early warnings and coordinating response to significant events and disasters
- A media and public information service that makes provisions for two-way communication within communities and among individuals by providing information on landslide risk reduction and all other aspects of slope management. It must also provide communities with the mechanisms for obtaining access to assistance in the event of an emergency and for reporting important local information to the relevant slope management centre.

- A training, education and research facility
- Adequate office accommodation and facilities for operational personnel

The proposed organisational set-up for the SEA is shown in **Figure 1.5**. **Table 1.10** presents a summary of the tasks for the major divisions of SEA.

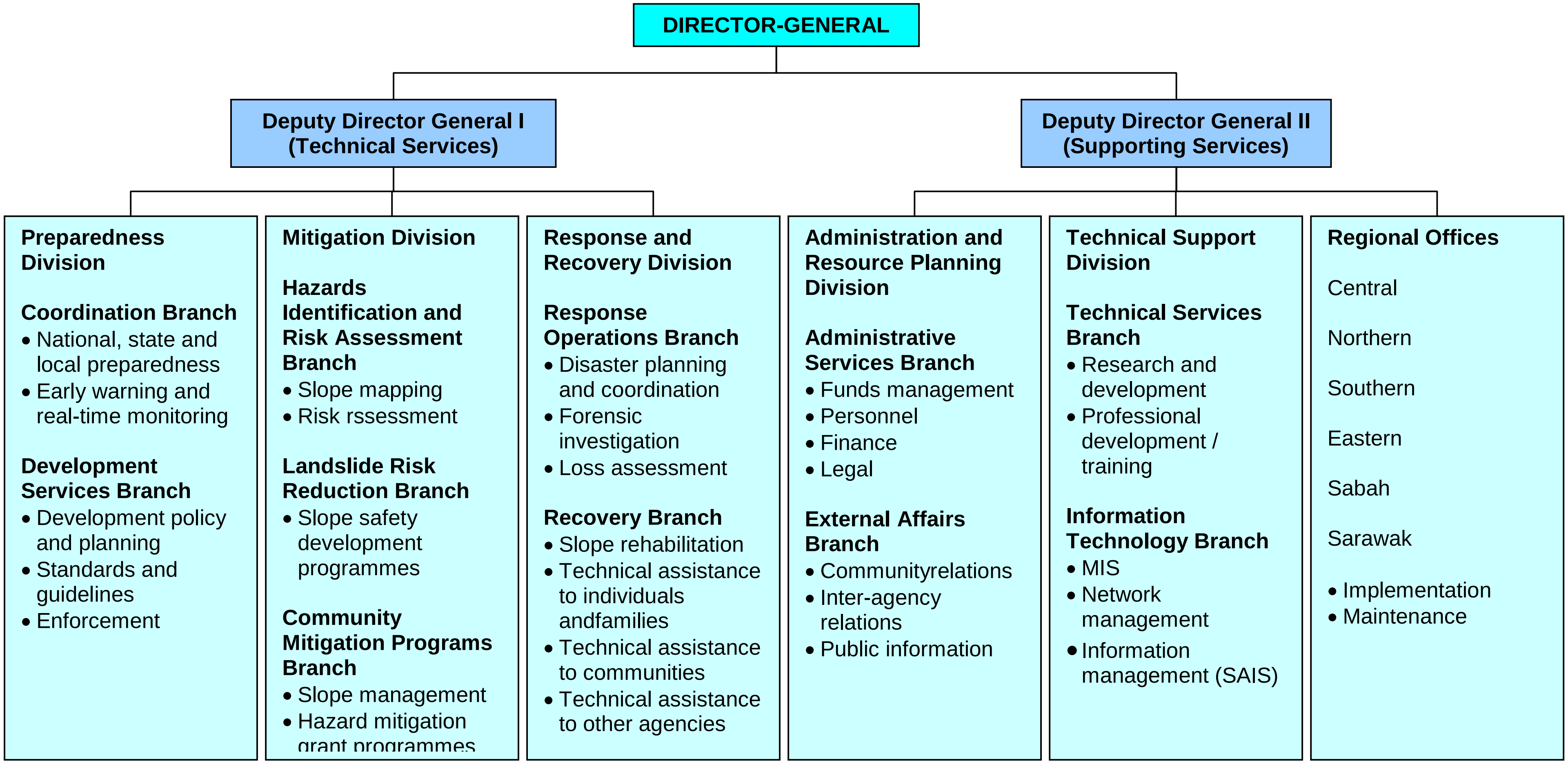

Figure 1.5: Proposed organisation chart for the SEA

Table 1.10: Summary of responsibilities of divisions within SEA

DIVISIONS	PRIMARY RESPONSIBILITIES
Preparedness	• Enhance SEA's preparedness capabilities to respond to landslide incidents • Assess and support landslide preparedness, drills and exercises capabilities of federal, state and local authorities, other agencies and community to prepare for, respond to and recover from landslide disasters • Provide early warning and real-time monitoring of hazardous slopes • Maintain and refine the NSMP • Manage and facilitate policy development, strategic planning, performance standards and assessment, innovation, and organisational development to achieve SEA's overall mission • Develop guidelines and standards for slope management activities • Develop and implement monitoring and enforcement systems for slope programmes and activities to ensure compliance with SEA's guidelines and standards • Monitor implementation of policies and strategies and considers need for policy changes
Mitigation	• Identify and assess the risks posed by landslide hazards • Develop and update landslide hazard and risk maps • Develop mitigation measures to reduce or eliminate loss of life and property from landslides • Administer risk mitigation programmes to reduce or eliminate loss of life and property from landslides • Work and coordinate with state and local government agencies to reduce the risks of hazards from future landslide disasters • Assess new technologies, equipment, strategies and methods in landslide risk reduction • Provide technical assistance to build mitigation capabilities of the communities and promote mitigation activities
Response and recovery	• Deploy immediately response and support teams and cooperate with other federal agencies, State and local governments, volunteer organisations, and the private sector in the event of landslide disasters • Assess damage and make recommendations to the government on declaration of disasters or emergencies from landslides under the MKN Directive 20 • Investigate and determine causes of landslide disasters and propose response and recovery initiatives • Develop catastrophic landslide response plans in high-risk communities • Develop and implement plans to expedite aid after landslides • Improve site safety during response and recovery efforts by coordinating debris removal and critical service restoration • Assess new technologies, equipment, strategies and methods in emergency preparedness, mitigation, response, and recovery
Administration and Resources Planning	• Set up a workforce capable of carrying out SEA's mission • Facilitate institutional change and innovation • Promote sound financial management and accountability throughout the Agency by providing financial guidance, information, and services

	• Render legal opinions and advice with respect to the duties, powers, and responsibilities of SEA and the applications of statutes, rules and regulations, other administrative issues • Educate the public on risks posed by landslide hazards and risk reduction measures that can be taken to minimise losses in the event of landslides • Disseminate information on landslide hazard and risk reduction measures as well as mitigation, response and recovery programmes and activities to other Federal, State and local Government agencies, and the public • Coordinate distribution of information to external entities. • Liaise with authorities, public and private agencies and communities on matters relating to coordination and slope safety
Technical Supports	• Support training of relevant personnel in federal, state and local authorities and agencies in landslide risk reduction, preparedness, mitigation, response and recovery • Provide research and development support and services to SEA's programmes in mitigation, preparedness, response and recovery • Establish and manage the Agency's information and data management systems
Regional Offices	• Implement and coordinate SEA's policies and programmes at the state and local levels • Ensure that local implementation is consistent with the national goals • Provide technical assistance to state and local government agencies, non-governmental organisations and local communities regarding landslide risk reductions, preparedness, mitigation, response and recovery • Liaise with other Federal agencies, State and local governments, voluntary and other private organisations and the public

Staffing

The Director-General of SEA must have suitably qualified slope management and technical and non-technical staff, including geologists, geotechnical engineers, risk reduction specialists, risk analysts, planners, information technologists, and legal and communication specialists, to perform the duties relevant to the requirements of the national slope management objective and programmes.

The Director-General will be of JUSA A grade and assisted by two deputies of JUSA B grade. The head of each division will of JUSA C grade, whereas all branches and regional centres will be headed by J54 professionals. The rest of the manpower required is shown in **Table 1.11**.

Table 1.11: Manpower requirement

	Head Office	Regional centres
Technical Staff		
Geotechnical Engineer	34	12
Civil Engineer	17	6
Geologist	6	-
IT Specialist	3	-
Geophysicist	1	-
Meteorologist	1	-
Supporting technical staff	72	30
Non-technical staff		
Administrative Officer	3	-
Legal Advisor	3	-
Accountant	3	-
Economist	3	-
Public Relation Officer	2	-
Mass Communication Officer	1	-
Supporting administrative staff	97	24

SEA will require a staff of about 344 personnel from various disciplines in order to carry out its function as a full-fledged agency specialising in slope management. The expected yearly emolument, based on the financial records of the existing Slope Engineering Branch, is about RM12 million and RM3.3 million for the Head Office and the six regional centres respectively. The corresponding office overheads are estimated at RM9.0 million and RM2.5 million. Office rental is about RM5.0 million for the head office and RM50,000 for each regional centre.

SEA Regional Offices

The SEA regional centres or offices (ROs) are the primary functional units for slope management and must build sufficient institutional capacity for slope management in the area. A key responsibility of the RO is to provide support to SEA and the states in the region. It must provide the link between national objectives and local slope management activities and priorities. Such arrangements must be consistent with national arrangements and must provide appropriate mechanisms for cooperative governance and inter-governmental relations for the purpose of slope management.

In the event of a landslide or one that is threatening to occur, the RO must provide support and guidance to the relevant agencies. In addition, it must mobilise regional infrastructure and resources to support those for local disaster management.

<u>Key responsibilities of the RO</u>

The RO must maintain a strategic overview of slope management projects and programmes in the region. Key responsibilities in this regard include:

- Risk reduction
    - Submit a landslide risk assessment for the region and slope management plans to SEA
    - Identify regional priorities for landslide risk reduction
    - Facilitate the development and preparation of local plans for landslide risk reduction
    - Establish mechanisms to monitor and manage landslide risk reduction works
    - Institute standards of practice for slope management in the region which are consistent with national standards

- Integrated development planning
    - Ensure that development planning processes include slope management plans
    - Ensure that development planning budgets make provision for slope management

- Capacity building, training, education and research
    - Initiate and coordinate slope and landslide management capacity building, education and training in the province, placing particular emphasis on the development of community awareness programmes and promoting the incorporation of such programmes into the school curriculum

- Communication and information management
    - Establish a strategic regional communication system that is compatible with systems used nationallyto enable communication between essential slope management services as well as incident command and operations
    - Establish a system (including emergency communication mechanisms) for reporting, evaluating and disseminating early warnings on a 24-hour basis such that threatened communities are able to respond appropriately and take risk-avoidance measures when a disaster occurs or is threatening to occur in their area
    - Act as a local reporting centre where information obtained from communities can be incorporated into slope management plans and programmes

- Monitoring and evaluation
    - SEA must establish standard mechanisms to enable the RO to monitor and measure performance on the ground. The RO must evaluate all slope management plans and initiatives by state and local agencies.

<u>Operational capacity and infrastructure requirements of the RO</u>

Arrangements for establishing the operational capacity of ROs to implement of the NSMP at the local level must be consistent with those of SEA. Their infrastructure requirements must concur with the national standard guidelines, which shall be developed by SEA.

It is recommended that all departments within state and local authorities identify appropriately qualified staff in their employment to serve as their slope management focal or nodal points. Slope management responsibilities must be included in the job descriptions of all key personnel identified in the local slope management framework.

Enabling SEA

There is scope for the SEA to provide expert advice and input to government agencies in mainstreaming development processes such as:

- Land use planning
- Land use conversion and sub-division
- Control of land use
- Control of construction activities
- Building plan approval
- Environmental management plans

For example, SEA may impose various geotechnical conditions to be fulfilled before development can proceed. It could also provide a hazard map and rating to the relevant planning authority to take into consideration for implementation purposes.

Again there is scope for SEA to establish set procedures and provide expert advice and input for inclusion for development considerations.

SEA should also review all the relevant guidelines and streamline them with best management practices for better management of slopes in the country.

In the short to medium term, SEA shall provide critical information and expertise to existing institutions to support them in monitoring and enforcement. SEA will conduct investigations, carry out surveys and set up monitoring stations. It may need to access private property in the course of carrying out its duties. In the long term, it is expected that SEA will have its own monitoring mechanism and early warning system for more effective monitoring and warning.

In the short to medium term, SEA will have to rely on the powers of various state agencies to carry out the functions mentioned earlier. During normal times, such agencies would consist of local authorities and district/land offices. Cooperation may extend to other agencies such as DOE, JPBD and JMG. In an emergency situation, SEA can rely on first responder agencies (under the MKN Directive 20) such as the police, fire services and civil defence.

In the medium term, relevant legislation, in particular the Street, Drainage and Building Act (Uniform Building By-Laws) and the Earth Works By-laws, could be amended to give better powers over ongoing development. Appropriate procedures should be established with various departments, particularly the local authorities for SEA to carry out its various functions.

There are powers under almost all existing legislation for SEA to act as an authorized representative (e.g., the Local Government Act, National Land Code, Street Drainage and Building Act and Geological Survey Act) or even to be delegated powers (the Environmental Quality Act). With such authorization, SEA should be able to carry out almost all its functions including investigations, surveys and monitoring activities. Most of the laws also afford legal protection from liability for authorized persons who act as public servants.

Table 1.12 summarises existing legislation that empowers SEA to control and regulate the various aspects of slope management.

Table 1.12: Legal empowerment

Legislation	Lead Agency / Stakeholders	Relevant Provisions

1. Waters Act, 1920	• Lead: District and Land Office
	• Other Stakeholders:
	  • Department of Irrigation and Drainage
	  • State Secretary
	  • Department of Environment
	  • Local Authority
	  • State Water Authorities
	  • Public Works Department
		• Sec. 2 – river banks shall be restored to their original condition
		• Sec. 3 – rivers are under the control of state and where lands are held by the government, such control exercised by head of such department under the direction of state authority
		• Sec. 6 – presumption of interference by owner adjoining the bank of river
		• Sec. 7 – no diversion of water from any river except with a licence granted by the district officer with state authority approval
		• Sec. 14 – no revetment, structure or building to be constructed within 50 feet of river bank or within flood channel

2. Geological Survey Act, 1974	• Lead: Mineral and Geosciences Department
	• Other Stakeholders:
	  • Department of Environment
	  • District & Land Office
	  • Mines Department
	  • Local Authority
	  • Town & Country Planning
	  • Public Works Department
		• Sec. 3 – Director General of Geological Survey, Deputy Director General and other officers be appointed to implement provisions under this Act. The Director General may authorize in writing any person to conduct geological survey in his behalf.
		• Sec. 4 – the Minister may from time to time, give directions to the Director General
		• Sec. 5 – Director General may authorize any gelogical survey officer to undertake consultation, analysis or other service for anyone upon obtaining approval of land proprietor/occupier
		• Sec. 6 – designate areas for geological survey
		• Sec. 7& 8 – power to enter land with 14-day notice to land proprietor, occupier, leasee and carry out necessary works to conduct geological survey
		• Sec. 11-14 – require any person prospecting, developing wells and excavating land to notify the DG of the activities carried out and anyfossiliferous material found

Legislation	Lead Agency / Stakeholders	Relevant Provisions

3. The National Land Code, 1965	• Lead: District and Land Office
	• Other Stakeholders:
	  • Town and Country Planning Department
	  • Department of Environment
	  • Department of Irrigation and Drainage
	  • Public Works Department
	  • Mines Department
	  • Survey Department
		• Sec. 6 – the Director General of Lands and Mines is appointed under the Federal Lands Commissioner Ordinance 1957 to carry out functions under this Act. The Yang di-Pertuan Agong appoints the Deputy Director General, Assistant Director Generals and other officers deemed necessary.
		• Sec. 7 – Minister may by gazette delegate to the Director General powers under this Act, subject to conditions and restrictions, but excluding power to make orders
		• Sec. 12 – state authority may appoint a State Director of Lands and Mines, Registrar of Titles and Director of Survey for the State. Other appointments include Deputy Directors, Assistant Directors, Deputy Registrars, Deputy Directors of Survey, District Land Administrators, Survey Officers and other officers deemed necessary.
		• Sec. 13 – state authority may by gazette delegate powers to ahe State Director, Registrar, Land Administrator, other officer appointed under Section 12, except the power to make rules and dispose land stipulated therein
		• Sec. 62 – land areas may be gazetted for public purpose and restrictions imposed
		• Sec. 57 & 58 – authority has right of access and use over alienated land to inspect, use and maintain drainage system
		• Sec. 122 – allows authority to impose conditions on land alienated for "buildings or industry" including area or proportion to be built on and type, design, height and structure of building.

4. Street, Drainage and Building Act, 1974 (as amended in 2007)	• Lead: Local Authority
	• Other Stakeholders:
	  • Town and Country Planning Department
	  • Department of Environment
	  • Department of Irrigation and Drainage
	  • Public Works Department
	  • Sewerage Services
	  • Department of Occupational Safety and Health
	  • Construction Industry Development Board
		• Sec. 4 - the local authority is responsible for maintaining and repairing public streets
		• Sec. 50 – local authority to construct and maintain drains and water courses
		• Sec. 70 – no new building shall be erected without written permission of the local authority
		• Sec. 70A – controls earthworks to prevent soil erosion and sedimentation
		• Sec 70A(1) – no earthworks without approval of plans and specifications by the local authority

Legislation	Lead Agency / Stakeholders	Relevant Provisions
		• Sec 70A(3) – conditions may be imposed • Sec 70A(4) – stop work order may be issued • Sec. 70A(6)&(11) – may implement corrective works and costs borne by owner of land • Sec 70A(8) – The local authority or authorized person may enter any land, building or premises, day or night, without notice, to execute work under this section • Sec. 70A(13) – provisions under this Section does not apply to earthworks carried out by or on behalf of the Federal or State Government • Sec. 70B – 70D – relates to safety and stability of buildings under construction. Review to be conducted if defect, deformation or deterioration in structure of building under erection is detected. Local authority may require submission of amended plans on stabilisation of slope. If not complied with, may order cessation of works, direct remedial work for safety and stability of building and surrounding areas or, in the extreme, take any other measure or demolish the building. Local authority or any person authorised by it or on its behalf may enter site of a building at any time without notice to the owner. • Sec. 83 &84 – declare dangerous buildings and to be repaired, shut down or demolished • Sec 86 – 90 –any premise that is a nuisance, injurious or danger to health.Local authorities may take actions to deal with such nuisance including requiring abatement of the nuisance by the owner. • Sec 97, 98 & 99 – any local authority, by its officers, employees, agents or contractors, may enter during the daytime into any building or land for the purpose of making any survey or inspection to execute any work with certain provisions for occupied buildings and night inspections. • Sec 100 – offence for obstruction of any local authority or its officers, agents or contractors in the performance of their duties.
5. Uniform Building By-Laws 1984	• Lead: Local Authority • Other Stakeholders:	• Sec. 3 – all plans to be submitted to local authority for approval.

Legislation	Lead Agency / Stakeholders	Relevant Provisions
	• Town and Country Planning Department • Department of Environment • Department of Irrigation and Drainage • Public Works Department • Sewerage Services • Department of Occupational Safety and Health • Construction Industry Development Board	• Sec 25 – issuance of certificate of completion and compliance by competent person. Local authority or any officer authorized by it may inspect construction at any time.
6. The National Forestry Act, 1984	• Lead: Forestry Department • Other Stakeholders: • Department of Environment • Department of Irrigation and Drainage • District & Land Office • Department of Wildlife and National Parks • Survey Department • Forest Research Institute of Malaysia • Malaysian Timber Industry Board • Marine Parks Department Malaysia • Public Works Department	• Sec. 3 – the State Director of Forestry, Deputy Directors, District Forest Officers and Assistants, and other officers are appointed by the State Authority • Sec 5 – the Director may delegate his powers and duties to any forest officer not below the rank of Assistant District Forest Officer • Sec.6 – state authority may delegate to the Director its powers conferred under the Act • Sec. 10 – State Director of Forestry Dept may, with the state authority's approval, declare areas as protected forest reserves for protection and conservation against soil erosion and catchment areas
7. The Environmental Quality Act, 1974	• Lead: Department of Environment • Other Stakeholders: • Fisheries Department • Forestry Department • Town and Country Planning Department • Land and Mines Department • Public Works Department • Department of Irrigation and Drainage • Marine Department • Marine Parks Department • Agriculture Department • Local Authority • District and Land Office • FRIM	• Sec.3 – the Director General is appointed by the Minister and conferred with administrative powers under the Act to control pollution. Deputy Director Generals and other officers may further be appointed to exercise any powers, duties and functions of the Director General under this Act. • Sec. 34A – require Environment Impact Analyses (EIA) to be conducted during the development planning stage and reports to be submitted for approval of the DOE State Officers. Prescribed activities requiring EIAs are stipulated in the Order. • EQA(PA)(EIA) Order – hillside development is prescribed activity • Preliminary EIA is to assess the impactof prescribed activities whilst a Detailed EIA is undertaken for projects with major impact to the environment. The Preliminary EIA process is headed by the State Director and the Detailed EIA Process is headed by the Director

Legislation	Lead Agency / Stakeholders	Relevant Provisions
		General of Environmental Quality. • Sec. 31&37 – to ensure compliance by project proponents to conditions in the EIA approval letter. Penalty is imposed for non-compliance.

8. Land Conservation Act, 1960	• Lead: District and Land Office
	• Other Stakeholders:
	  • Town and Country Planning Department
	  • Local Authority
	  • Department of Irrigation and Drainage
	  • Public Works Department
	  • JOEA
		• Sec. 3 – the Ruler in Council or the Yang di-Pertua Negeri may declare any area or land as hill land.
		• the Land Administrator is responsible for ensuring implementation and compliance of the provisions under this Act
		• Sec. 5 - controls planting of short-term crops on hill land.
		• Sec. 6 - no clearing of trees, plants, undergrowth without permit and subject to conditions imposed
		• Sec. 8 - power to acquire any hill land pursuant to the Land Acquisition Act for public purpose to prevent soil erosion
		• Sec. 11 - may take appropriate action with the sanction of the State Secretary, where damage has occurred due to erosion, displacement of earth, mud, silt, gravel and stone
		• Sec. 12-18 - issue a show cause notice, prohibition order, take measures and recover cost from defaulting person
		• Sec. 19 – owner/occupier to maintain drains, dams, water courses, walls and other works pursuant to an order

9. Town and Country Planning Act, 1976	• Lead: Town and Country Planning Department
	• Other Stakeholders:
	  • District & Land Office
	  • Department of Environment
	  • Department of Irrigation and Drainage
	  • Public Works Department
	  • Water Authority
	  • Fire Services Department
	  • Local Authority
	  • Ministry of Local Government
		• Sec. 3 – the state authority is responsible for the planning and development of land and building within thearea of the local authority of the state
		• Sec. 4 – the State Planning Committee shall be established and may direct local planning authority
		• Sec 18 – no body other than the local authority shall undertake development unless planning permission is granted
		• Sec. 21A – impose requirements on project proponentsfor compliance
		• Sec. 22 – local authorities regulate hillside developments by imposing conditions for sustainable, environmentally friendly and safe development

10. Local Government Act, 1976	• Lead: Local Authority/District Councils • Other Stakeholders:	• Sec. 8 – every local authority area is administered by a local authority • Sec. 9 - the state authority may give

Legislation	Lead Agency / Stakeholders	Relevant Provisions
	• All government agencies and departments	directions to the local authority • Sec. 81,82 & 84 – may control erosion and sedimentation if they pose a nuisance within as well as outside the local authority area • Sec 101 (v) – to do all things necessary for or conducive to public safety and health

11. Police Act, 1967	• Lead: Royal Malaysian Police
	• Other Stakeholders:
	  • Civil Defence Department
	  • Fire Services Department
	  • Malaysian Highway Authority
	  • Public Works Department
	  • Local Authorities
		• Sec. 3 – responsible for maintaining law and orderand preserving public peace and national security
		• Sec. 4 – the Royal Malaysian Police established under Section 3 shall be headed by the Inspector-General who shall be responsible to the Minister. He shall have all the powers conferred to a Commissioner or Chief Police Officer. The Deputy Inspector-General shall have similar powers.
		• Sec. 7 – may serve during war or other emergencies with local forces
		• Sec. 20(3)(j) –take lawful and necessary measures to protect life and property
		• Sec. 21 – regulate and control traffic and maintain order on public roads
		• Sec. 26 – authorized to place road barriers on public roads and streets to preserve law and order

12. Civil Defence Act, 1951	• Lead: Civil Defence Department
	• Other Stakeholders:
	  • Police Force
	  • Fire Services Department
	  • Public Works Department
	  • Essential services departments such as water and rail
		• Sec. 4 – the Director-General for Civil Defence and Assistant Director-Generals may be appointed by the Yang di-Pertuan Agong
		• Sec. 7 – provide services under the direction of the Yang di-Pertuan Agong
		• Sec. 8 – the Director-General may, with the Minister's consent, order relief and rehabilitation services for safety of life and property in the event of impending or occurring disasters
		• provide emergency services for landslides under National Security Council Directive No. 20 (MKN Directive 20) such as saving lives and properties, managing evacuation centres and providing food and first aid services

13. Fire Services Act, 1988	• Lead: Fire and Rescue Services Department
	• Other Stakeholders:
	  • Police Force
	  • Local Authorities
		• Sec. 2 –authorised officer for the purposes of this Act means the Director-General and any Fire Officer or Auxiliary Fire Officer authorised by the Director-General
		• Sec. 3 – each sttate shall have a

Legislation	Lead Agency / Stakeholders	Relevant Provisions
		director of Fire Services • Sec. 7 – the Director-General may, by gazette, delegate his powers under this Act to any fire officer • Sec. 5(1) – perform humanitarian services such as protecting life and property in any calamity. Definition of calamity under Sec. 2 may include landslides. • Sec. 5(2) – provide services imposed by law or the Minister • Sec. 19 – exercise of powers (similar to powers under Sec. 18) to protect life and property on occasion of emergencies not involving fire

14. Public Order (Preservation) Act, 1958	• Lead: Royal Malaysian Police
	• Other Stakeholders:
	  • Civil Defence Department
	  • Armed Forces
	  • Essential Services Departments
		• Sec. 2 –the Chief Police Officer includes a Commissioner of Police authorised to exercise powers and perform duties under this Act
		• Sec. 4 – regulate, restrict, control or prohibit use of public roads or places to maintain public order
		• Sec. 6 – may place barriers on roads or public place

<u>Action 1.5.2</u>: Set up a network of government departments, local authorities, disaster management agencies, research institutions, disaster management specialists, NGOs, community groups and other stakeholders to augment their capabilities and encourage best practices

Political commitment, legal foundation and institutional processes are not enough to ensure success of slope management in the country. An effective and comprehensive slope management strategy can only be be achieved by involving a wide range of role players. Leading policy direction is crucial, as is legitimacy, but it is ultimately the commitment of resources to the individuals, households and communities that are most at risk that will ensure success.

Slope management is a shared responsibility, which must be fostered through partnerships between the various stakeholders and cooperative relationship between the different levels of government, the private sector and the community. Furthermore, slope management is an inter-governmental process, with each level of government playing a unique role and applying a specific set of responsibilities in the process. This inter-dependence also implies that weaknesses or ineffectiveness in one level will result in the failure of the entire system.

Institutional arrangements must create the environment for cooperation and coordination. The emphasis must be on facilitating coordination among existing structures, organisations and institutions wherever possible and on harnessing existing skills and expertise.

However, slope management functions normally performed by the various sectors and disciplines in the national, state and local levels should not be duplicated. Slope management should not be construed as a line function. Instead, it is a management facility, to create an enabling environment for the promotion and implementation of integrated risk reduction measures and improved slope management practices.

Inter-agency cooperation

The mechanism for cooperative governance is through bringing together representatives from various agencies and levels of government. This is to provide a forum for input, including technological and specialist input, by a wide range of stakeholders from, among others, the community and the private sector.

SEA must establish mechanisms to enable the sharing of expertise at national and regional levels. They should also consider the development of working groups composed of professional and technical experts to assist in slope management activities.

To streamline coordination, a meeting between the head of SEA, the heads of regional centres and representatives of the working groups must precede meetings of the IICSM, as highlighted in Action 1.1.1.

Issues that are fundamental to interdependence and inter-governmental relations between the three levels of government include:

- Information sharing
- Establishment of standards to ensure that the technology required for communication and information systems is compatible across all levels
- Compilation and sharing of directories of institutional role players at all levels
- Submission of slope management plans and annual reports to other levels

National departments as well as state and local authorities must augment their level of capacity to deal with landslide risk reduction. Where necessary, they may enter into mutual assistance agreements with the private sector, academia and professional institutions. Such agreements must include details of financial arrangements, reimbursements and liability, and must be in accordance with the standard guidelines on mutual assistance agreements to be developed by SEA.

Research cooperation

There are many existing and ongoing research initiatives on slope management and landslide risk reduction taking place in the country. SEA, through a process of consultation, must develop a strategic research agenda in order to create additional applied knowledge and information on slope management and landslide risk reduction. SEA must facilitate:

- Consultation and engagement between the communities of scientists and professionals to identify priorities for collaborative research and development, as well as mechanisms for implementing such initiatives
- A process for auditing existing research initiatives and programmes to identify those that add value to an understanding of slope management processes and trends, and provide insights into effective landslide risk reduction strategies and measures
- Consultation with appropriate national and international agencies and foundations that support research, including the private sector, to profile the importance of focused and coordinated funding support for slope management research
- The development of an integrated slope management research agenda and programme, along with mechanisms for publishing and disseminating research results

Action 1.5.3: Cooperate with international agencies in knowledge sharing and dissemination and for assistance of expertise and resource in slope and disaster management

Regional cooperation

Regional cooperation for the purposes of landslide risk reduction is essential, and the appropriate mechanisms must be initiated to establish a forum in which such cooperation can be achieved. Accordingly, it is proposed that a consultative process be undertaken to establish a forum or working within the existing Association of South East Asian countries (ASEAN) Area of Cooperation on Environment for the purposes of landslide risk reduction cooperation in the region. The forum should have the following objectives:

- Sharing information on landslide disasters and important risk reduction issues
- Creating opportunities for conducting research
- Establishing strategic communication links and emergency telecommunication procedures and protocols
- Concluding bilateral and multi-lateral agreements with clearly defined protocols to provide for sharing of expertise in risk reduction intervention, emergency preparedness and cross-border landslide disaster response and recovery operations
- Ensuring the clear definition of responsibilities between the various regional and international role players in cross-border disaster response
- Promoting and facilitating the establishment of joint standards for landslide risk reduction practices across the region

International cooperation

Increasingly, climate change and landslide disasters originating from natural phenomena, environmental degradation and technological developments are becoming global problems, requiring global strategies and solutions. In order for Malaysia to remain at the cutting edge of development, to learn from international best practice and to be in a position to contribute to global thinking on slope management, Malaysia must support and actively participate in the strategies and efforts of the international community to reduce landslide risk, such as the United Nation and Asian programmes on disaster reduction. It must associate itself with selected international development protocols, agendas and commitments.

A further aspect of Malaysia's involvement in the international slope management arena is that of humanitarian assistance. Many international relief donor agencies and groups operate in the wake of disasters including landslides. There is a need for Malaysia to strengthen its engagement with these international organisations with the fundamental objective of tapping into the extensive expertise and resources of these agencies. At the same time, it must establish appropriate protocols to clarify procedures for requesting external assistance and to discourage ad hoc and unso1icited appeals for relief.

1.4.4. Summary

Table 1.13 summarises the proposed strategies and their respective actions under the Policy and Institutional Framework of the NSMP.

Table 1.13: Action Plans

Strategy	Action Plans
Strategy 1.1: Propose multi-sectoral and integrated slope management and landslide risk reduction mechanisms	Action 1.1.1. Establish coordinating committees on slope management at the national, state and local authority levels Action 1.1.2. Identify the roles and responsibilities of all relevant entities in the integrated management of slopes and establish a clear chain of command for all slope management activities and coordination mechanisms
Strategy 1.2: Integrate landslide risk assessment and risk reduction planning into development policies and planning at all levels of government and industry	Action 1.2.1: Ensure that the planning activities of federal, state and local authorities take into account slope protection and landslide risk reduction and provide suitable preventive and mitigation measures Action 1.2.2: Establish and employ a consistent approach for assessing landslide risks that will provide uniform information for planning of effective risk reduction programmes Action 1.2.3: Set the level of "acceptable risk" in slope management where the probability of occurrence of a slope failure is small or where consequences are so slight that society is willing to take or be subjected to the incomplete
Strategy 1.3: Adopt necessary legislation to support and promote landslide risk reduction	Action 1.3.1: Formulate/modify appropriate legislation and guidelines for better slope and landslide disaster management in the country Action 1.3.2: Formulate/modify appropriate legislation to improve the professionalism of geologists, especially in the assessment of slope hazards
Strategy 1.4: Demonstrate strong government support to promote and finance	Action 1.4.1: Identify funding sources and provide budgetary allocation for slope and landslide disaster management Action 1.4.2: Explore innovative methods of sharing and transferring the costs associated with landslide risk reduction

Strategy	Action Plans
landslide risk reductions	and disasters to alleviate the burden on the state
Strategy 1.5: Build strong capabilities, expertise and networking in slope management	Action 1.5.1: Set up a central entity, a Slope Engineering Agency including strategic regional centres, with adequate support, capabilities, expertise and power in developing and streamlining slope management activities Action 1.5.2: Set up a network of government departments, local authorities, disaster management agencies, research institutions, disaster management specialists, NGOs, community groups and other stakeholders to augment their capabilities and encourage best practices Action 1.5.3: Cooperate with international agencies in knowledge sharing and dissemination and for assistance of expertise and resource in slope and disaster management

1.5 Implementation Framework and Plan

1.5.2. Introduction

Strategies and timeframes for the implementation of the NSMP must be established well as setting up implementation budgets and identifying and allocating responsibilities in slope management.

1.5.3. Strategy Implementation Framework

The strategies will be implemented in phases as shown in **Table 1.14.** Covering a 15-year period from 2009 to 2023, this framework takes into account the setting up and growth of SEA and its regional centres.

Table 1.14: Strategy Implementation Framework

	2009	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2023
	Phase 1					Phase 2					Phase 3				
1.1 Propose multi-sectoral and integrated slope management and landslide risk reduction mechanisms															
1.2 Integrate landslide risk assessment and risk reduction planning into development policies and planning at all levels of government and industry															
1.3 Adopt necessary legislation to support and promote landslide risk reduction															
1.4 Demonstrate strong government support to promote and finance landslide slope management and landslide risk reduction															
1.5 Build strong capabilities, expertise and networking in slope management															

1.5.4. Implementation of Action Plan

Implementation of the proposed actions is shown in **Table 1.15** below.

Table 1.15: Implementation of Action Plan

No.	Action Plan	Who	When/Cost (RM Million)			
			Phase 1		Phase 2	Phase 3
			(2009 – 2010)	(2011 – 2013)	(2014 – 2018)	(2019 – 2023)
1.1	**Propose multi-sectoral and integrated slope management and landslide risk reduction mechanisms**					
1.1.1	Establish coordinating committees on slope management at the national, state and local authority levels	CKC/SEA				
1.1.2	Identify roles and responsibilities of all relevant entities in the integrated management of slopes and establish a clear chain of command for slope management and coordination mechanisms	CKC/SEA				
1.2	**Integrate landslide risk assessment and risk reduction planning into development policies and planning at all levels of government and industry**					
1.2.1	Ensure that the planning activities of federal, state and local authorities take into account slope protection and landslide risk reduction	CKC/SEA, All planning agencies				
1.2.2	Establish and carry out a consistent approach for assessing landslide risks that will provide uniform information	CKC/SEA				
1.2.3	Set the level of acceptable risk in slope management	CKC/SEA				

No.	Action Plan	Who	When/Cost (RM Million)			
			Phase 1		Phase 2	Phase 3
			(2009 – 2010)	(2011 – 2013)	(2014 – 2018)	(2019 – 2023)
1.3	**Adopt necessary legislation to support and promote landslide risk reduction**					
1.3.1	Formulate/modify appropriate legislation and guidelines for better slope and landslide disaster management	CKC/SEA NRE/JMG				
1.3.2	Formulate/modify appropriate legislation to improve the professionalism of geologists, especially in the assessment of slope hazards	JMG				
1.4	**Demonstrate strong government support to promote and finance landslide slope management and landslide risk reduction**					
1.4.1	Identify funding sources and provide budgetary allocation for slope and disaster management	CKC/SEA, Ministry of Finance				
1.4.2	Explore innovative methods of sharing and transferring the costs associated with landslide risk reduction and disasters to alleviate the burden on the state	CKC/SEA				
1.5	**Build strong capabilities, expertise and networking in slope management**					
1.5.1	Set up a central entity, including strategic regional centres, with adequate support, capabilities, expertise and power in developing and streamlining slope management activities	CKC/SEA				
1.5.2	Set up a network of government departments, local authorities, disaster management agencies, research	CKC/SEA				

No.	Action Plan	Who	When/Cost (RM Million)			
			Phase 1		Phase 2	Phase 3
			(2009 – 2010)	(2011 – 2013)	(2014 – 2018)	(2019 – 2023)
	institutions, disaster management specialists, NGOs, community groups, and other stakeholders to augment their capabilities and encourage best practices					
1.5.3	Cooperate with international agencies for the sharing and dissemination of knowledge in slope and disaster management and for assistance of expertise and resources in slope and disaster management	CKC/SEA				
		Sub-Total	**12.80**	**67.50**	**177.00**	**201.00**
		Total	**458.30**			

1.5.5. Critical Success Factors

Critical success factors are actions that must be performed well in key areas to achieve the strategic thrust of the policy and institutional framework (**Table 1.16**). They create a common point of reference to help stakeholders direct and measure the success of the strategy.

Whereas the goal of a strategy focuses on what is to be achieved, critical success factors focus on that are critical to the achievement of the goal.

Table 1.16: Critical Success Factors

Critical Success Factors	Description
Resources Secure sufficient number of competent and knowledgeable workforce, and funding	SEA needs to build up a pool of capable, multi-disciplined staff in order to discharge its functions as a centre of excellence in slope management and effectively contribute to the international landslide risk reduction effort
Engagement Create sustainable inter-stakeholder cooperation	Close and active cooperation between various stakeholders is absolutely essential to ensure successful implementation of the NSMP.

1.5.6. Key Performance Indicators

Key performance indicators (KPIs) are used to define and measure progress toward strategic thrusts. The proposed KPIs to be used for gauging the success of the strategic thrusts for the policy and institutional framework are listed in **Table 1.17**.

Table 1.17: Key performance indicators

Critical Success Factors	Key Performance Indicators	Target		
		Phase 1	Phase 2	Phase 3
Resources Secure sufficient number of competent and knowledgeable and funding	Existing key legislation for management of slopes are amended		60%	80%
	Enactment of dedicated law for management of slopes			Enacted
	Enactment of legislation on professional recognition of geologists	Enacted		
	SEA and its regional centres have been established and	CKC/SEA and 2 regional	4 centres are established	

Critical Success Factors	Key Performance Indicators	Target		
		Phase 1	Phase 2	Phase 3
	operates effectively	centres are established		
Engagement Create sustainable inter-stakeholder cooperation	ICSM has been established and meets annually	Established	2 meetings a year	2 meetings a year
	Slope management plans are formulated and implemented by local authorities and submitted to SEA	50% of Local Authorities (LAs) have SMPs	75% of LAs have SMPs 50% of formulated SMPs are revised	95% of LAs have SMPs 75% of formulated SMPs are revised
	Levels of acceptable risk in slope management have been established and are revised periodically	Established	1st update	2nd update

1.5.7. Expected Outcomes

Table 1.18 identifies the expected outcomes and desired results from each of the above strategies and actions.

Table 1.18: Expected outcomes and results

Expected Outcomes	Identified Results
Outcome 1: Multi-sectoral and integrated approach in slope management and landslide risk reduction	• Coordinating committees on slope management are established at the national, state and local levels • Slope management responsibilities are integrated and coordinated within the routine activities of all government agencies
Outcome 2: Landslide risk reduction is well-integrated into development policies and planning	• Federal, state and local authorities include slope protection and landslide risk reduction measures in their development planning • There is a uniform approach to assessing landslide risks and in provision of information by government agencies and other stakeholders • Levels of "acceptable risk" in slope management across the society and regions in the country are determined
Outcome 3: Legislation that support and promote landslide risk reduction	• Legislation and guidelines for better slope management and controls are available • Legislation and guidelines for better relief management, response and provisions are in place

Expected Outcomes	Identified Results
	• Legislation to improve the professionalism of geologists is enacted
Outcome 4: Strong Government support in promoting and financing landslide risk reductions	• Sufficient budgetary allocations for slope and disaster management are available • The costs of landslide risk reduction and disaster management is shared or transferred to individual entities to reduce the burden on the state
Outcome 5: Slope management practice with strong capabilities, high expertise and close networking	• SEA and its six regional centres with adequate supports, capabilities, expertise and power are established • A network of public and private agencies, research institutions, specialists, NGOs and other stakeholders is in place • Close cooperation with international agencies in slope and disaster management is established

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ANNEXES

ANNEX:

REVIEW OF LEGISLATION

1. INTRODUCTION

1.1 In 1922, the British Administration enacted the Federated Malay States Enactment No. 22 called the "The Silt (Control) Enactment". It was recognised even then that there was a need to respond to the potential damage that may be caused by the movement of earth, mud, silt, sand or soil. This Enactment was repealed and replaced with the Land Conservation Act 1960 (LCA) after independence.

1.2 The legislators, at the time of the formulation of the Act, could not have foreseen the tremendous development that was to occur in the country. Construction is among the important economic activities contributing to national development. During construction, earthwork is usually carried out to obtain a more efficient landform to suit the infrastructure or building to be built. Top soils are removed, higher ground is levelled and lower ground filled up. Unsuitable soil may also be removed and replaced. Earthwork in construction may be carried out for development for housing, commercial and infrastructure purposes. Most of the activities are carried out by private developers but the Government may also be a major player in some mega projects and particularly in infrastructure projects such as roads, dams, airports and ports.

1.3 Earthwork, when carried out without due regard to geotechnical factors, may result in negative impact such as slope failure and settlements. Exposed surfaces are also susceptible to erosion, resulting in soil particles being transported by storm runoff to lower grounds and into the receiving waters. The negative impacts are landslides, slope failure, mudflows, deterioration of water quality and sedimentation of channels and drainage facilities. Various measures may be adopted to prevent and control occurrences of slope failure, erosion and sedimentation, including engineering solutions, proper maintenance and enforcement of proper practices through legislative and institutional measures.

2. REVIEW OF NATIONAL LEGISLATION

2.1 INTRODUCTION

2.1.1 The management of landslides and slope failure is attributed essentially to the conservation or development of any land. It normally involves several parties and is subject to relevant laws. The parties involved, in general, may be grouped into the following categories:

a) The Owners and/or Occupiers – normally the owner or occupier of the land and/or parties in joint venture;
b) Professional Service Providers - Architects, engineers and others who design, obtain approvals and supervise the development;
c) Developers/Contractors – developers and/or contractors who may be the prime movers of a development project, carry out the works and would have formal approvals/agreements to that effect; and
d) Regulatory Bodies -that have the power to control all activities on any land. They regulate, approve, supervise and enforce laws related to any development and earthwork. These may include both federal as well as state/local agencies. Federal agencies may include the Highway Authority, Department of Environment, Town and Country Planning Department and the Department of of Irrigation and Drainage. State agencies would include the state Town and Country Planning Department, local authorities, state Department of Irrigation and Drainage, Land Administrator/District Officer, State Economic Planning Unit and State Economic Development Corporation.

2.1.2 Legislation will be targeted to regulate and control the activities of the groups of persons involved in the development and use of land. A list of relevant laws and guidelines that may be applicable to the management of land in relation to slope failure is enclosed as Annex 1. A detailed review of all the relevant laws is contained in Annexes 2 and 3. A review of the laws in Sabah and Sarawak is enclosed in Annexes 4 and 5. A summary of the relevant laws (in table form) is included in Annex 6 (Peninsular Malaysia) and Annexes 7 (Sabah) and 8 (Sarawak).

2.1.3 The control and regulation of all issues pertaining to land in the country is legally, and almost exclusively, within the purview and jurisdiction of state governments (vide the Federal Constitution) to the exclusion of the Federal Government. This entrenched position will mean that any legislation on issues pertaining to land, with almost no exception, will be made by state authorities. An examination of legislation within the various states indicates that by and large there is no specific legislation at that level that adequately addresses the myriad aspects of slope management. However, there are a number of laws related to land that provide specific direct powers related to the management of land such as the National Land Code and Land Conservation Act. There are other state laws that are indirectly related to slope management such as the Town and Country Planning Act; Local Government Act; Street, Drainage and Building Act; Waters Act; Forestry Act; Mining Act; Selangor Waters Management Enactment; Natural Resources Environment Board (Sarawak); Sabah Water Resources Enactment and Conservation of Environment Enactment Sabah. These laws address issues of urban planning, hill development, soil erosion and forest/water resources management.

2.1.2 At the federal level, despite the growing awareness of the need for action to address the issues related to slope management, there is as of yet no specific legislation that empowers any federal agency to act on all these issues. This may be due to the fact that the Constitution does not empower the Federal Government to enact any legislation on issues pertaining to and. It may also be due to the fact that the proactive management of slopes at the federal level almost certainly started only with the formation of the Slope Engineering Branch of the Public Works Department in 2004. Prior to this, there was no specific agency exclusively tasked with the management of slopes. It can be concluded that, as far as the management of slope failure is concerned, the current legislation gives the relevant bodies a limited platform to manage the myriad issues associated with it.

3. ISSUES IN LEGISLATION

3.1 Some observations on the legal aspects of slope management are given below for Peninsular Malaysia (information on Sabah and Sarawak are located in Annexes 4 and 5):

A. Land Use Planning

The Town and Country Planning Department (TCPD), in compliance with the Town and Country Planning Act (TCPA), has prepared the National Physical Plan for Peninsular Malaysia and various Structure and Local Plans for various states. Presently, Local Plans (DLP) and State Structure Plans (SSP) are prepared by the department to cover the municipality and the state levels respectively. These plans do take into account land that is sensitive to development, including hill land. Local authorities are tasked with the implementation of these various plans. Under the Town and Country Planning Act, a project proponent has to apply for planning permission approval to the local planning authority. Among the key requirements at this stage is the Development Proposal Report (LCP) under Section 21 of the Act. The approval process begins with the checking of the submission against the development local plan and seeking of comments from various technical agencies including the Drainage and Irrigation Department (DID), Department of Environment (DOE) and Public Works Department (PWD). The local authority, which is also the local planning authority, will decide on the approval. Major projects are approved by the state planning committee chaired by the Chief Minister. Often at this stage, environmental issues are managed through the

Environmental Quality Act (EQA). Under Section 34A of the EQA, the Department of Environment requires an Environmental Impact Assessment (EIA) to be submitted for its approval for a list of 19 Prescribed Development Activities. The Development Proposal Report (LCP) under Section 21 of the Town and Country Planning Act 1976 also requires a report on the current environmental status and the EM measures that have been considered and taken by the planners and engineers in the planning of the proposed development layout. The environmental-related concerns and impact at this stage will be considered, including impact on land, soil erosion, slope failure, surface waters, groundwater, hydrologic balance, drainage regime, flooding and sedimentation. Impact on human population will also be taken into account in terms of impact on and danger to communities. There is scope for the new Slope Engineering Agency (SEA) to use these existing institutions and legislation to give its expert advice and input for inclusion in their consideration. For example, SEA may impose various geotechnical conditions to be fulfilled before the development can proceed. It could also provide a hazard map and rating to the relevant planning authority to take into consideration for implementation purposes.

B. Land Use Conversion and Sub-division

Land conversion and subdivision is a standard procedure that needs to be carried out first in any land or property development. Applications for land use conversion must comply with the National Land Code and must be lodged with the District Land Office. The District Land Office will, prior to approval, seek comments from the relevant technical bodies including the Agriculture Department, Town and Country Planning Department, Drainage and Irrigation Department, Local Planning Authority, Water Authority, Public Works Department and other departments where necessary, such as Department of Environment, Department of Civil Aviation and Department of Mineral and Geoscience. The technical inputs from these agencies are often included in the conditions of approval for the conversion of land. Again, there is scope for SEA to use these existing institutions and legislation to establish set procedures and provide expert advice and input for inclusion in their consideration.

C. Control of Land Use

The Land Office/District Office is the principal agency responsible to regulate land use. The primary legislation that empowers the agency is the National Land Code supported by the Town and Country Planning Act. There are other legislation that enables the agency to regulate land use such as the Land Conservation Act and the Waters Act. The state of Penang has prescribed land above 200 feet to be “hill land” under the Land Conservation Act. The Department of Environment, through the EIA Order, Environmental Quality Act, has defined ‘highlands’ to include areas of elevation of 1,000 feet or more above sea level including gazetted hill land under the Land Conservation Act (see the “EIA Guidelines for Development of Resorts and Hotel Facilities in Hill Stations, 1995”). The Town and Country Planning Department generally adopts land above 25 degrees as being not suitable for residential or related development. Sarawak has adopted [via the Natural Resources and Environment (Prescribed Activities) Order 1994] hills with slopes of 20 degrees or more as requiring an EIA to be conducted. Sabah has similarly adopted 20 degrees for EIAs to be conducted. It does appear that there is no generally accepted definition of “hill” land among the authorities. Illegal settlements/activities on state and or private land are a major issue especially when it occurs on hill land. These illegal land uses have been a long-standing problem in most states and particularly in Pahang and Kelantan. Enforcement of the laws is often tempered with issues encompassing social, political and economic factors. Selangor, for one, had an official policy to achieve zero squatters status by 2005 and, though delayed, may be on the way to achieve the same. The state is also making efforts to legalise illegal industries. This is done by approving land use conversions and persuading the property owners to apply for proper building plan approval besides applying for Department of Environment license to occupy industrial premises. In the short to medium term SEA will have to work in cooperationcooperation with these existing institutions and support the existing legislation with its expert advice and input for inclusion in their consideration. The Agency should also review all the relevant Guidelines and streamline them with best management practices for the better management of slopes in the country.

D. Control of Construction Activities

Almost the entire country is now under the jurisdiction of local authorities (city, municipal or district councils). These agencies implement various laws related to development including the Local Government Act, Street, Drainage and Building Act (SDBA) and Town and Country Planning Act. For development projects, during the construction stage the officers of the local authority and the pertinent technical departments monitor the implementation of the development projects to ensure that they are carried out according to the approved plans. The project proponent's consultants have to comply with various requirements under the Uniform Building By-laws (UBBL) and the Earthwork By-laws. There are extensive powers under the SDBA for the authorities (and its authorised representatives) to control, regulate, investigate, enter into, require action to be taken or stop any work on any land or building. They have the powers to undertake remedial measures themselves and recover costs and take punitive action for action not in accordance with approvals given. Only works carried out by a Government agency are not subject to regulation by local authorities. It is presumed that the Government agency will impose and abide by construction best practices. A relevant guideline that may be imposed is the Guidelines on the Prevention and Control of Soil Erosion and Siltation in Malaysia, DOE, 1996. Contractors undertaking construction works have to be registered with the Construction Industry Development Board (CIDB). The CIDB is a statutory body responsible for developing the construction industry in the country and to promote the adoption of best construction practices (technology, quality, environment, safety) among all contractors in the country. Thus, the CIDB does play an important role in enhancing the capacity of contractors during the implementation of construction work including developing an accreditation scheme to recognise contractors with good EM practices. In the short to medium term, SEA should work in cooperation with these existing institutions and legislation to give its expert advice and input for inclusion in their consideration.

E. Building Plan Approval

The building plan is principally regulated by the Street, Drainage and Building Act and the subsidiary By-laws, like the Uniform Building By-law. The local authority has to seek comments from the relevant bodies before giving its approval including the Town and Country Planning Department, Drainage and Irrigation Department, Department of Environment, Public Works Department and other departments as deemed necessary. The controls are exercised through a number of plans which have to be submitted by the proponents at this stage including the Earthwork plan, Roads & Drainage plan, Structural plan and Landscape plan. The objective of the authorities, through implementing the above measures, is to ensure that among others, the safety and stability of every building is ensured. Upon completion of the building the authorities will issue the Certificate of Fitness for Occupation (CFO). This is now replaced with the Certificate of Completion and Compliance (CCC) effective for all building plans approved after 12 April 2007 for all states in West Malaysia under the Uniform Building By-law, 1984 as amended in 2007. The issuance of the CCC is now undertaken by the Principal Submitting Person (PSP). The CFO/CCC may be issued only after all the technical agencies listed in the building plan approval process are satisfied with the compliance of the project in accordance with the approved conditions. The Local Authority/PSP has to ensure that the development project has been properly carried out and completed in accordance with the planning approval and conditions. In the short to medium term, SEA may work in cooperationcooperation with these existing institutions and legislation to give its expert advice and input for inclusion in their consideration.

F. Property Maintenance And Management

The local authority is empowered to ensure that relevant public areas and works are properly maintained. Some of the pertinent environmental concerns at this stage include the proper maintenance of drains and the stability of surrounding hill slopes. The responsibilities and powers of each relevant party are defined in the following legislation:

- Building and Common Property (Maintenance and Management) Act, 2007 defines the powers of the Developers, Commissioner of Buildings, Joint Management Body and the Management Corporation;
- Local Government Act empowers the local authority;
- Town & Country Planning Act empowers the Town and Country Planning Department and the local authority;
- Street, Drainage & Building Act empowers the local authority.

G. Management of Drainage Systems

Drainage and rivers have a major impact on hill slope conservation and maintenance. The Highland Towers incident was caused primarily by issues pertaining to poor drainage planning, implementation and maintenance. Planning for major drainage, flood mitigation and river rehabilitation are mostly carried out by Department of Irrigation and Drainage. Local authorities are concerned with municipal level drainage systems and issues. However some large Local Authorities such as DBKL and Penang carry out planning of the total drainage systems within their municipalities. The Department of Irrigation and Drainage and local authorities are currently in a transitional stage in the adoption of the Manual for Stormwater Management for Malaysia (MSMA) which has been approved by the National Council on Local Government. The Department of Irrigation and Drainage has also produced several guidelines pertaining to rivers.

H. Environmental Management Plans

Issues related to management of slopes and hill land may also be addressed through an integrated Environmental Management Plan (EMP). The EIA Order 1987 prescribes various activities to be made subject to a mandatory EiA to be carried out including hill station resorts or hotel development covering an area of 50 hectares or more. There are provisions in other laws which may have a similar effect. The Town and Country Planning Department requires a Strategic EIA to be included in the preparation of Statutory Plans and LCP to be carried out administratively. The States of Sabah, Sarawak and Selangor have state legislation that requires project proponents to undertake EIA and EMP for specific projects including projects on hill land. The Selangor Waters Management Authority Enactment 1999 has substantial provisions for activities that may impact on water resources. The relevant state legislation for Sabah and Sarawak has been mentioned above. In the short to medium term, SEA may work in cooperationcooperation with the Department of Environment and JPBD to give its expert advice and input for inclusion in their consideration.

I. Disaster Response and Management

There is no specific law that applies specifically to disaster response and management. There are, however, various laws related to emergency services, public order and control. These include the Police Act, Public Order (Preservation) Act, Fire Services Act and Civil Defence Act. There are also provisions in the Street Drainage and Building Act which enables the local authority to declare certain public spaces and buildings as unsafe, to evacuate people and to take appropriate measures to demolish, repair, maintain and manage such areas. The National Security Council Directive No. 20 set up a co-ordinating mechanism for agencies to respond to a disaster. This is an Administrative Guideline that is normally adhered to by Government agencies. It is less clear when non-Governmental agencies become involved and the legal impact of this Directive on them. The Directive may also have become outdated what with the many changes in the roles, responsibilities and capabilities of the agencies concerned. The manner and process of handling disasters has also undergone evolution with many new developments and changes in many countries abroad. There is a need to re-examine the various laws and Directive to ensure that the national disaster response and management mechanism serves the purpose for which it is set up. In this respect it is noted that there are moves to upgrade the MKN 20 into legislation in the very near future.

J. Monitoring and Enforcement

There appears to be very little data made available through answers to the Questionnaire sent out to almost all agencies. In practice, enforcement of the various laws is usually easier said than done especially since there appears to be very little by way of co-ordinated planning or management efforts for slope management in the country. The occurrences of several land slide incidences in areas such as Ampang and Cameron Highlands with tragic consequences has created national awareness. However, with the exception of this Project, there appears to be very little by way of national efforts to approach the management of slopes in a more systematic and organised manner. Such efforts including enforcement appear to be stymied by the overwhelming pressure to "develop" at any cost. Agencies may also be hampered by lack of expertise and shortage of enforcement staff. The perceived (as opposed to actual powers vested under the law) lack of legal powers within existing legislation to manage slopes could also be a hindrance to enforcement. In the short to medium term, SEA may need to provide critical information and expertise to existing institutions to support them in monitoring and enforcement. The Agency needs to conduct investigations, carry out surveys and set up monitoring stations. It has to access private property in the course of carrying out its duties. In the long term, it is expected that SEA will have its own monitoring mechanism and early warning system to assist in this matter. In the short to medium term, SEA will have to rely on the powers of various state agencies to carry the functions mentioned earlier. During normal times, these would largely include local authorities and district/land officers. The Agency may extend this cooperation to other agencies such as Department of Environment, Town and Country Planning and Minerals and Geoscience Officers. In an emergency situation SEA can rely on relief agencies (under the MKN 20 Directive) such as the Police, Fire Services and Civil Defence officers. In the medium term, relevant legislation and in particular the SDBA (Uniform Building By Laws) and the Earth Works By-Laws could be amended to give better powers over ongoing development. Appropriate procedures may be sought and established with various departments and particularly the local authorities for SEA to carry out its various functions. There are powers under almost all the legislation for SEA to act as an authorised representative (eg. the Local Government Act, National Land Code, Street Drainage and Building Act, Geological Survey Act) or even to be delegated powers (the Environmental Quality Act). With such authorisation SEA should be able to carry out almost all of its functions including investigations, surveys and monitoring activities. Most of the laws also afford legal protection from liability for authorised persons who act as public servants.

K. Private Litigation For Damages and Compensation

The principle of compensation for damages arising from the negligent acts and nuisance by any person is well settled in Malaysian civil law. Malaysia follows the common law system and therefore much of its civil law is similar to that found in Commonwealth countries. The Highland Towers case (see review in **Annex 2)** whilst clearly reinforcing some of these common law principles on the law of negligence and nuisance also set some new precedents in Malaysian law. Private parties are free to bring an action against any person for acts of negligence or nuisance in Malaysian courts. In the Highland Towers case, the court found various defendants (developers, architects, draftsman and land owners) liable to pay damages for their acts of negligence/nuisance against the plaintiffs who suffered damage to their property and loss of lives. The Supreme Court of the country however exonerated the Municipal Council (which was also a defendant sued by the Plaintiffs) from having to pay compensation on the grounds of public policy – reportedly to prevent the Councils from depleting its limited resources on compensation for economic loss of private parties even when negligent in carrying out its duties.

4. REVIEW OF INTERNATIONAL PRACTICES IN LEGISLATION

4.1 Introduction

It is appropriate that a review of legislation and practices in some countries be undertaken so as to allow for benchmarking and to consider the adoption of best practices appropriate to local conditions. The Review covered both developing countries (India and Sri Lanka) and developed economies (Hong Kong, Japan and Australia). A detailed review is enclosed in **Annex 9.**

4.2 Hong Kong

4.2.1 Of the countries reviewed the most impressive appears to be Hong Kong with a very successful and rational approach to management of slopes. Hong Kong is extremely constrained by scarcity of land with immense pressure to use every bit of land irrespective of terrain. Some major disasters occurred before the government acted with some decisive measures. Best practices that could be emulated from Hong Kong include:

a. The change in public perception to fatalities and their refusal to accept any tragic events was perhaps the prime mover of change in Hong Kong. It is with such backing that subsequent actions of the Executive became easier and more palatable to the legislature.

b. The creation of a specialised agency focussed on geotechnical control of all major works laid the basic foundation for the system. The fact that it was part of the Public Works Department does not appear to deter its effectiveness. There appears to be, so far, little or no conflict of interest nor hindrance to its performance;

c. The adoption of an integrated and systematic approach to the problem was another major factor in its success. An assessment of the problem was first carried out in the form of identifying, cataloguing and registering all the slopes. A priority programme was then drawn up for remedial works. At the same time all new works were made subject to geotechnical design audits. Regular maintenance of slopes was not ignored;

d. The system is supported by appropriate regulatory controls – both formal and informal. It is remarkable that the key agency did not go out on a limb to have its own legislation. That the system has worked so well is partly due to the comprehensive (one stop) approach taken by one agency (the Buildings Department) to ensure that all technical inputs are obtained from all agencies before a project is approved. It is moot point that there has been no instance where the input of the Geo has been rejected or overlooked by the Buildings Department. The role of the GEO is accepted/respected by the industry and the lack of legal authority does not appear to be an issue. However all orders, legal notices are issued by and under the Buildings Ordinance. The latter Ordinance itself does recognise the role of Departments such as GEO in the enforcement of the law;

e. The deliberate efforts made to ensure and encourage stakeholder participation in the management of the problem is a key factor in the success of the programme. Thus the industry is encouraged to self regulate itself. Registration of engineers and their professionalism is left to its peers. Almost all information is freely available to the industry. Investigation of accidents is contracted out to consultants. Active and effective public participation is encouraged throughout the planning process.

f. There is sufficient budgetary funding being allocated for both new capital works, maintenance works and public education and awareness campaigns;

g. There is a great deal of transparency of all actions being taken by the GEO and other agencies too. Public access to information is undeniably better than in almost all agencies in Malaysia. This translates into better accountability for monies spent and more effective agencies; and

h. Public education and campaigns is an important part of the overall strategy to reduce injuries and fatalities. It is considered as money well spent (on par with monies spent for physical works) as the occurrence of landslides cannot be totally eliminated. It is to be an ongoing programme targeted at a wide spectrum of the public.

It must however be kept in mind that Hong Kong has a relatively simple unitary administrative structure with clear lines of authority and responsibility. It is therefore far easier to implement actions in the state where there is no blurring of powers, authority and responsibility between various stakeholders.

4.3 Sri Lanka

4.3.1 Best practices that could be emulated from Sri Lanka include:

a. The setting up of appropriate training facilities in cooperation with the Asian Disaster Mitigation Training Network (ADMIT) and Asian Disaster Preparedness Centre (ADPC) shows the way for possibility of cooperation with Sri Lanka in this vital area;

b. The establishment of the Sri Lanka Disaster Management Act provides legislative and institutional support for disaster risk management with the establishment of the powerful National Council for Disaster Management under the President and the Disaster Management Centre (DMC) as the lead agency for disaster risk management. The proposed Disaster Counter Measures Act should be further studied as it appears to be far-reaching in its intentions to regulate all aspects of disaster management.

4.4 Australia

4.4.1 Best practices that could be emulated from Australia include:

a. Each of the state and territorial governments has developed counter-disaster arrangements and emergency service agencies and coordinates related activities through emergency/disaster management committees. These emergency service agencies rely heavily on the support of trained volunteers who provide services such as search and rescue, fire-fighting and medical care. States and territories have become increasingly self-sufficient in responding to disasters. The Federal Government has become more of a financial source with specialised expertise, assessment, warning and monitoring services for meteorological and geological hazards;

b. Non-Governmental organisations (NGOs) are an essential component in Australian disaster response/relief arrangements and in supporting communities in the disaster recovery phase. Australia's emergency management family is expanding to further recognise the important roles played by private sector and professional institutes in developing and implementing mitigation plans and strategies;

c. There is research undertaken by the Australian Geo Mechanical Society, which produced the benchmark report called the AGS (2000). The intention was to establish uniform terminology, define a general framework, provide guidance on risk analysis methods and provide information on acceptable and tolerable risks for loss of life. It represents a continued recognition by AGS of the pragmatic benefits of incorporation of the concept of risk in the assessment of potential landslides, particularly in planning and management situations. Certainly there is urgent need to encourage and establish similar research in Malaysia for localized application.

5. POLICY PROPOSALS AND RECOMMENDATIONS

5.1 Summary Table

A table summarising the main agencies involved and existing legislation that empowers them to control and regulate various aspects of slope management is enclosed in **Annex 10.** Another Table in **Annex 11** identifies the main activities related to slope management and includes recommendations/proposals for legislative reform in the short, medium and long term. The report also contains another table summarising the proposed policies, strategies and institutional measures under the National Slope Master Plan (NSMP) and identifies the legal empowerment required for the agencies to act in the short, medium and long term.

5.2 Short-Term Proposals/Recommendations

It is envisaged that in the short term (defined as five years commencing from 2009 and assuming that SEA is set up within this term), the Slope Engineering Branch of the Public Works Department will be upgraded to be a full-fledged department (SEA) within the Ministry of Works. Within this period, it is expected that SEA will be largely focused on institutional issues related to its formation and establishing linkages for cooperation with other agencies. In line with this focus SEA should engage in and enter into a cooperative framework to enable smooth implementation of its duties. Such a cooperative framework will also require assistance from these agencies to "lean" on their legal powers to implement its duties similar to what is being done by GEO in Hong Kong. It may require the agencies to appoint officers of SEA as authorised representatives under the relevant legislation. This will then enable SEA to immediately carry out investigations, surveys and monitoring on any site. The table enclosed in **Annex 11** identifies the actions in the short term where SEA will have to lean on other agencies to implement its task. Some of the tasks that may be implemented in the short term include the following:

a) Draw up a framework for cooperation with key agencies such as the Town and Country Planning Department, relevant local authorities, Land Offices, Geological Survey and Department of Environment for support to implement some specific tasks such as hazard mapping, forensic investigations, site investigations, training, research, monitoring and early warning systems.

b) Inform and make available the specialist services and expertise of SEA to these agencies;

c) Review existing and develop/establish new guidelines, codes and standards for adoption by all agencies as their prescribed requirements for development on hill slopes;

d) Together with the agencies commence work to identify and agree on critical areas and priorities where SEA's expertise could be put to use. In this respect SEA could immediately provide expert advice and input to the one-stop centres in relevant local authorities for the issuance development planning considerations and approval; and

e) Commence work on amendments to existing legislation to strengthen powers related to improved slope management. Such legislation would include the Earthwork By-Laws; Land Conservation Act (currently being actively reviewed by a team of Government agencies); Street, Drainage and Building Act (including the Uniform Building By-Laws) and Civil Defence Act. Proposals for amendments to the Land Conservation Act were submitted earlier by the Project Consultants and is included herein as **Annex 12**. It is understood that the Civil Defence Act is being actively reviewed by the agency concerned and it may be worthwhile for the Slope agency to get in with its comments. The Consultants have also been informed that the Prime Ministers Department is considering converting the National Security Council Directive No. 20 (MKN 20) circular into legislation. The directive would rightfully address issues pertaining to the management of disasters arising from slope failure. SEA should also ensure that all local authorities adopt the Earthwork By-Laws as amended to enable issues related to slope management to be effectively implemented nationwide.

5.3 Medium Term Proposals/Recommendations

In the medium term (defined as 6-10 years) it is expected that SEA would have matured into a well-established specialist agency in management of slopes in the country. It would have gained valuable experience in working with other agencies and would be publicly acknowledged as the lead agency for slope management in the country. It would have identified various shortcomings in legislation which would need to be rectified with appropriate amendments to key legislation such as the Land Conservation Act, Local Government Act; Street, Drainage and Building Act and the Town and Country Planning Act. Amending such legislation is but one option available to SEA, and it will be a more difficult option as these laws are well-established and empower other equally well-established agencies. The Agency may well have to consider establishing a completely new law for the better management of slopes in the country. The table enclosed in Annex 11 identifies the actions in the medium term which SEA will have to implement. Some of the tasks that may be implemented in the medium term include the following:

a) Refine and further enhance procedures, guidelines and cooperative framework for working with other agencies particularly in terms of legal empowerment;
b) Adopt amendments to existing legislation, particularly relevant by-laws, to enable better implementation of slope management practices in the country including authorisation/delegation of powers to SEA;
c) Commence work on identifying separate and new legislation to comprehensively address and manage all issues related to the management of slopes in the country;
d) Consider the formulation of a Disaster Relief Management Act along the lines of similar legislation existing in other countries such as India and Australia. In this respect the move to upgrade MKN 20 into legislation may tie in with this proposal; and
e) Amendments to the Land Conservation Act and Civil Defence Act may have come into force. An assessment of the impact of these amendments will be conducted on improvements in efficacy of slope management in the country.

5.4 Long-Term Proposals/Recommendations

The table in Annex 11 has also identified the long-term proposals for legislative changes. In the long term SEA would have matured into a full-fledged independent body. It should be in a position where issues related to conflict of interest with its parent organisation no longer arise. Consistent with its independent nature, SEA should be supported by its own dedicated law on the management of slopes in the country. This law should be unified and applicable through out the country. However, implementation of this proposal to have a new law will face immense hurdles due to the constitutional position of "land" being largely a matter within the domain of state governments. The formulation of such a law will require extensive prior consultation with the state governments. It will require approval from the National Land Council, National Council on Local Government and even the National Planning Council (under the Town and Country Planning Act Amendments). A constitutional amendment may even be necessary if it is deemed appropriate that slopes would be better managed if it is a federal matter. In its final form it may be a model law providing uniformity of actions on the management of slopes throughout the country. It will be up to the state governments to consider and adopt the law for implementation in a particular state which would then make it a state law. Such a law may well require SEA to adapt itself to perform functions as a state authority vested with powers to initiate action on its own. Even with a dedicated law, SEA will necessarily have to continue to work with other government agencies on common issues related to better management of land.

6. CONCLUSION

6.1 Much ground has been covered since the commencement of the Study in the review of existing laws within Peninsular Malaysia, Sabah and Sarawak (admittedly the latter two states with some limitations). However, his report contains almost all the major recommendations and proposals relating to the NSMP. As far as legislation goes there will be a great deal of work to be undertaken, especially in the drafting of appropriate laws, which will support the actual implementation of the NSMP once it has been accepted by the government. Such drafting is not within the current terms of reference of the Project and will probably be a follow-up task for SEA. As identified in the NSMP in the short term, SEA could rely on existing legislation to carry out almost all of its major tasks. In the medium to long term, it is recommended that appropriate amendments to existing legislation together with new legislation should be considered at that juncture.

ANNEX 1:

LIST OF LEGISLATION RELEVANT TO MANAGEMENT OF LANDSLIDES

1. Waters Act, 1920
2. Geological Survey Act, 1974
3. Street, Drainage and Building Act, 1974 (as amended in 2007)
4. The National Forestry Act, 1984
5. The National Land Code, 1965
6. The Environmental Quality Act, 1974
7. Land Conservation Act, 1960
8. Town and Country Planning Act, 1976
9. Local Government Act, 1976
10. Mining Enactment, 1929
11. Civil Defence Act, 1951
12. Police Act, 1967
13. Fire Services Act, 1988
14. Building and Common Property (Maintenance and Management) Act, 2007
15. Public Order (Preservation) Act, 1958

MUNICIPAL RULES

1. Earthwork By-Laws
2. Uniform Building By-Laws (as amended in 2007)

STATE ENACTMENTS

1. Selangor Waters Management Authority Enactment, 1999.
2. Environment Protection Enactment 2002, Sabah
3. Town and Country Planning Ordinance, 1950, Sabah
4. Forest Enactment, 1968, Sabah

5. Land Ordinance, 1930, Sabah
6. Water Resources Enactment, 1998, Sabah
7. Minerals Ordinance, 1960, Sabah
8. Local Government Ordinance, 1961, Sabah
9. Natural Resources and Environment Ordinance, 2001, Sarawak

GUIDELINES

1. Urban Storm Water Management Manual, 1999, Federal DID
2. Guidelines on the Prevention and Control of Soil Erosion and Siltation in Malaysia, 1996, DOE
3. EIA Guidelines for Development of Resorts and Hotel Facilities in Hill Stations, 1995, DOE
4. National Guidelines for Landscaping, Town and Country Planning Department
5. Guidelines on Erosion Control for Development Projects in the Coastal Zone, Federal DID
6. Planning Guidelines – Preservation of the Natural Topography in Physical Planning and Development in Accordance with the Town and Country Planning Act, 1976, Town and Country Planning Department
7. Guidelines for Development of Highland Areas, Ministry of Natural Resources and Environment
8. Guidelines for Development of Environmentally Sensitive Areas, Town and Country Planning Department – Under consideration by the Town and Country Planning Department

ANNEX 2:

REVIEW OF LAWS RELATED TO SLOPE FAILURE IN PENINSULAR MALAYSIA

1. Constitutional Position: Federal/State Jurisdiction over Issues Related to Land

1.1 The Federal Constitution is the basis of the relationship between the States and the Federal Government. Part VI of the Federal Constitution, entitled "Relations Between the Federation and the States," details the distribution of legislative and executive powers between the Federation and the States. Article 73 entitles Parliament to make laws for the whole or any part of the Federation having effect outside as well as within the Federation. Article 73 also enables each state to make laws for the whole or any part of that state. The Federal Constitution enumerates the legislative power of the Federal and state Governments in the Ninth Schedule where three lists are provided. Parliament may make laws (Article 74) with respect to any of the matters enumerated in the Federal List (List 1, Ninth Schedule) or the Concurrent List (List III, Ninth Schedule). States may make laws with respect to any of the matters enumerated in the State List (List II, Ninth Schedule) or the Concurrent List. The Concurrent List enables both the Federal and state Governments to make laws on the items enumerated therein. Note that Federal Laws are generally applicable in all Federal Territories.

1.2 The Federal List, under which the Federal Government has sole jurisdiction to make laws, does not have any direct reference to "Land". Indirect reference to "land" would include the following items:

i) Item 10(a) – Roads, bridges, ferries and other means of communication if declared to be Federal by or under Federal law; and

ii) Item 12(b) – Survey of the Federation; social, economic and scientific surveys; meteorological organisations;

1.3 "Land" is more clearly and directly enumerated in the State List. A direct reference to Land occurs in Item 2 of the State List which allows a state to legislate on all aspects related to land including land tenure, colonization, land improvement and soil conservation. The State List goes on to enumerate numerous other items with indirect relationship to land including the following:

i) Item 3 – agriculture and forestry;

ii) Item 4 - Local Government and public nuisances;

iii) Item 6(b) – roads, bridges and ferries other than those in the Federal List;

iv) Item 6(c) – subject to the Federal List, water, control of silt and riparian rights;

v) Item 9 – creation of offences in respect of any of the matters included in the State List or dealt with by state Law; and

vi) Inquiries for state Purposes, including commissions of inquiry and collection of statistics with respect to any of the matters included in the State List or dealt with by state Law.

1.4 Drainage and irrigation and town and country planning are enumerated as a specific item in the Concurrent List. This means that both the Federal and the state Governments have legislative power over this particular area.

1.5 The exercise of the above-mentioned legislative powers as distributed under the three Lists is elaborated upon, by several other Articles of a general nature in the Constitution. Article 76 provides that Parliament may make laws with respect to any matter enumerated in the State List, but only for the purpose of promoting uniformity of laws of two or more States or if so requested by any state. However, any law made in pursuance of this Article shall not come into operation in any state until it has been adopted by the state legislature after which the law shall be deemed to be a state law. Pursuant to this Article, Parliament has made several laws including the National Land Code, Local Government Act and Waters Act. In the event of any inconsistency between Federal and state laws, Article 75 provides that Federal law shall prevail.

1.6 Chapter 2 of Part 6 of the Constitution provides for the distribution of executive powers. Article 80(2) provides that the executive authority of the Federation does not extend to any matter enumerated in the Concurrent List except insofar as may be provided by Federal or state law. Thus, for example, if the Federal Government decides to exercise executive authority in drainage and irrigation matters, then it would have to enact appropriate laws providing for such authority. Chapter 4 deals with the compulsory acquisition of land for Federal Purposes.

1.7 Article 91 prescribes the setting up of the *National Land Council (NLC)* which shall comprise a representative from each state and representatives of the Federal Government. The "Minister" shall chair the Meeting, and it shall meet at least once a year. The NLC shall formulate national policy for the "promotion and utilisation of land for mining, agriculture, forestry or any other purpose, and for the administration of any laws relating thereto… The Federal and state Governments (with the exception of Sabah and Sarawak) shall follow the policy so formulated." Both Governments may consult the NLC in respect of any matter related to the utilisation of land, any proposed legislation dealing with land or the administration of any law related to land. Similarly Article 95A establishes the *National Council for Local Government (NCLG)* for matters related to policy "for the promotion, development and control of Local Government" and "for the administration of any laws relating thereto; and the Federal and state Governments (with the exception of Sabah and Sarawak) shall follow the policy so formulated."

1.8 Part 7 of the Federal Constitution sets forth financial provisions relating to Federal and state matters. Article 110 stipulates that the States shall receive all proceeds from taxes, fees and other sources of revenue specified in Part 3 of the

10th Schedule. Part 3 of the 10th Schedule assigns revenue to the States from, among other sources, land, mines and forest fees and receipts in respect of specific services rendered by the department of state Governments, revenue of local authorities, receipts from land sales and rent from state property. However, Parliament, may from time to time by law substitute any source of revenue mentioned above with any other source of revenue of substantially equal value. In other words, if Parliament enacts a law that reduces or alters a particular source of revenue presently collected by the state Governments, then Parliament would have to substitute this with another source of revenue of equal value.

1.9 In conclusion, it may generally be stated that land, with almost minimal exception, is a state matter. The Federal Government has specific powers, but largely of an indirect nature. Parliament may make laws with respect to any matter in the State List but solely for the purpose of promoting uniformity of the laws of two or more States. Even then the law will become a state law. SEA may eventually establish its own laws on the paramount grounds of safety of life and property, but it is a moot point whether the state Governments would be willing to accept Federal jurisdiction over this matter. SEA will have to make a strong case for the law through the National Land Council and National Council for Local Government. Any such new law may well require amending the Constitution. SEA will have to show that it has the capacity and expertise to undertake the task. It will certainly need to address the predominant interests of the state administration over issues related to land and allay the fears of the latter over encroachment into entrenched constitutional rights. For these reasons it is felt that any specific new law on issues pertaining to slope management may only bear fruition in the long term.

2. <u>Land Conservation Act</u>

2.1 The Act appears to broadly divide land into "hill land" as defined in the Act and other land in general. Hill land is defined to mean "any land declared to be hill land" by way of gazette notification by the state. It is pertinent to note that we are not aware of any state which has to date declared any area as "hill land". Part II of the Act deals specifically with hill land. It contains provisions allowing a preventive approach to be adopted to control the planting of any short term crops on such land. Such lands shall not be cleared of any trees, plants or undergrowth except with the permit issued by the Land Administrator subject to such terms and conditions as he may impose. The planting of any short-term crops may be allowed by the Land Administrator on an annual permit provided this does not cause "appreciable soil erosion". If the owner or occupier fails to comply with the terms and conditions of the permit, the Land Administrator or any person authorised by the Land Administrator may take action to ensure that the terms and conditions are complied with. The Act also provides for the state to acquire any hill land for the purpose of preventing soil erosion and such acquisition shall be considered as for a public purpose under the Land Acquisition Act.

2.2 Part III applies to any land (not just hill land). It enables the Land Administrator to take appropriate action, whenever it appears to the Land Administrator that land owned by any person may result in:

a) Earth, mud, silt, gravel or stone that has caused or is likely to cause damage to other land, any water course or interfered or is likely to interfere with the cultivation of other land;

b) Damage that has occurred or is likely to occur by erosion or displacement of earth, mud, silt, gravel or stone on upon or from such land due to the steepness of the slope of the land.

The provisions enable the Land Administrator to take corrective measures as follows:

a) Issue show cause notice why an order should not be made to prohibit activities causing siltation/erosion (followed by process of appearance);

b) Issue prohibition order (through the court process);

c) Take measures and recover cost from the defaulting person (for gazetted hill land under section 10 and for other areas section 21).

Penalty for an offence under this provision is a fine not exceeding RM5,000 or jail term not exceeding six months.

2.3 Any owner or occupier may attend and show cause as to why the order should not be made against him. If the owner fails to attend or show cause to the satisfaction of the Land Administrator, the latter may proceed to issue an order to:

a) Prevent interference with or destruction or removal of any tree, plant, undergrowth, weed or grass within or from such parts of the land as may be specified;

b) Make, with the sanction of the State Secretary, drains and watercourses, dams and retaining walls as may be specified;

c) Take, with the sanction of the State Secretary, such action which appears to the Land Administrator likely to prevent and/or prohibit the doing of any act or thing that may facilitate the passage of earth, mud, silt, gravel or stone from the said land to other land or to any river, canal or drain.

2.4 The Land Administrator may specify the time within which the work or any act or thing as required by the order must be made or completed. The normal appearance procedures for the owner/occupier applies. The order may be varied by the Land Administrator but only with the sanction of the State Secretary. Orders made under Section 14 of the Act, which are mandatory and where the works does not exceed RM2,000 or an order which is prohibitory, shall be final and there shall be no appeal against such orders. Appeals shall be made to the High Court.

Penalties imposed by the Act are of course outdated with a fine of RM5,000.00 or imprisonment up to six months.

2.5 Section 19 also imposes a requirement for the owner/occupier to maintain the drain, dam, water course, wall or other works made pursuant to an order by the Land Administrator, and such maintenance shall be carried out so long as the order is not revoked. Where a prohibition is imposed by the Land Administrator pursuant to the order, the Registrar of Lands may enter such restrictions on the register of such title of the land. The Land Administrator may also carry out any acts or things which the owner/occupier had failed to do and recover the cost from the latter. The Act provides for detailed rules to be made if necessary. To date there are no rules made by any state under this Act.

3. Town and Country Planning Act

The Act contains the legal framework for the establishment of the National Physical Plan, development plans (comprising structure and local plans) and development planning control in the country. However, the respective states would have to adopt the Act and its various amendments prior to implementation.

In 2003, the National Physical Planning Council and National Physical Plan 2005-2010 were adopted to further enhance integrated land use planning. Thirty-five development standards and guidelines on the environment, housing, transport, land use, industry and urban surroundings were issued and implemented to improve urban planning and development. To date, the Department has prepared one planning guideline – Preservation of the Natural Topography in Physical Planning and Development in Accordance with the Town & Country Planning Act, 1976. Another Guideline for Development of Environmentally Sensitive Areas is under consideration by SEA.

Section 18 of Part IV of the Act stipulates that no person other than a local authority shall commence, undertake or carryout development unless planning permission in respect of the development has been granted. For this purpose, project proponents shall submit a *Development Proposal Report* (LCP) in accordance with the requirements of the local authority (refer to Section 21A). Project proponents may be required to incorporate an Environmental Management Plan in the LCP. The conditions for approval may include erosion and sedimentation control measures to be carried out.

It should be noted that the development proposal report appears to cover the development of infrastructure as well (refer to Section 19(2) on exemptions and Section 22 (2A(b)) on infrastructure). Section 22 (2A and 2B) requires that development for township with population exceeding 10,000 or having area exceeding 100 ha, any major infrastructure/utility or development on hill slopes/designated environmentally sensitive area shall be referred to the State Planning Committee. Section 22 allows the local authorities to regulate hill-site developments by imposing conditions which would ensure sustainability, environmentally friendly and safe to the public.

Local authorities also require that the application for the Development Order be accompanied with earthwork and building plans. Some states such as Selangor and Penang have also made it a requirement for the submission of a Geotechnical Report and an Independent Geotechnical Report by separate geotechnical engineers for areas identified as high risk development sites.

The planning permission is valid for 12 months but can be subject to renewal (except where it does not involve any building construction).

The penalty on the project owner for offences related to unauthorised development is a fine not exceeding RM500,000 or to an imprisonment not exceeding two years or to both and additional fine not exceeding RM5,000 per day for each day the offence is carried out after the first conviction of the offence.

During the construction stage the officers of the local authority and the pertinent technical departments monitor the implementation of the development projects to ensure that they are carried out according to the plans submitted. The authorities have the powers to stop the development work to enforce compliance by the project proponents to the planning and building approval conditions.

The penalty for carrying out development contrary to planning approval conditions is a fine not exceeding RM100,000 or jail not exceeding six months and an additional fine of not exceeding RM5,000 per day for each day the offence is carried out after the first conviction of the offence.

4. <u>Environmental Quality Act (1974)</u>

This Federal law establishes the position of the Director General (DG)of the Department of Environment (DoE) and confers the power to the DG to control matters such as pollution. The law covers all states in Malaysia. Section 34A of the EQA (included during 1985 revision) and the accompanying EIA Order form preventive instruments exerted as control during development planning stage. The Prescribed Activities are considered major activities likely to have a significant impact to the environment. Proponent of projects categorised as a Prescribed Activity must submit EIA Report to the Department of Environment and obtain its approval. The report shall be prepared in accordance to guidelines established by the Department of Environment. Among others, the report shall identify the environmental impact anticipated as the result of the project and the measures to mitigate it. The impact can be numerous but also include those caused by erosion and sedimentation.

Activities relevant to hillside development listed as prescribed activities under the EQA (Prescribed Activities) Order include:

(i) Conversion of hill forest land to other land use covering an area of 50 hectares or more; and

(ii) Hill station resort or hotel development covering an area of 50 hectares or more.

Penalties for carrying out Prescribed Activities without EIA approval is a fine not exceeding RM100,000 or imprisonment not exceeding five years or to both and a further fine not exceeding RM 1,000 per day for every day the offence is continued.

Before construction is started, the project proponent is required to submit an Environment Management Plan (EMP). Erosion and sediment controls (ESC) is part of this EMP. During the construction stage, the project proponent is required to submit a compliance report to the Department of Environment at stipulated regular intervals. The Department of Environment will require any development to abide by the Guidelines for Development of Highland Areas issued by the Ministry of Natural Resources and Environment.

Only consultants registered with the Department of Environment (DOE) can undertake EIA studies. However, the project proponents can appoint consultants to carry out the EIA for them, which makes the consultants very susceptible to conflict of interest.

For the post EIA stage, the Department of Environment relies on Section 31 and 37 of the EQA to obtain compliance by project proponent to conditions stipulated in the EIA approval letter.

Note that the penalties for offences under these sections are as follows:

a. Section 31 (Power to require owner or occupier to install, operate and repair) -Fine not exceeding RM25,000 or imprisonment not exceeding two years or to both and a further fine not exceeding RM 1,000 per day for every day the offence is continued;

b. Section 37 (Owner or occupier to furnish information) - Fine not exceeding RM2,000 or imprisonment not exceeding six months

For hillside development in Malaysia, the factor of safety (FOS) against slope failure recommended by the Geotechnical Manual for Slopes (GCO 1991) of Hong Kong is normally adopted with minor modifications to suit the local conditions.

5. <u>Local Government Act (LGA)</u>

The Act stipulates the local authorities to manage and regulate their respective jurisdictional areas. There are also some provisions in the act that can be used for management of slope purposes. However, it ishould be noted that these provisions appear to allow only reactive approach to be taken for the prevention of causing nuisance. These are as follows:

Section 81 – Definition of nuisance
Section 82 – Notice requiring abatement of nuisance

The penalty for offences pertaining to this provision is a fine not exceeding RM1,000 or imprisonment not exceeding six months or both.

It should be noted that the local authority might rely on Section 84 to control erosion and sedimentation where cause of nuisance arises outside local authority area.

The party person to be regulated under the LGA may be owner/project proponent/contractor either individually or severally.

The Institution of Engineers, Malaysia has set up a Committee comprising members from Building Control Unit, Ministry of Housing, universities and practicing engineers in private practice and formulated a Position Paper for Mitigating the Risk of Landslide on Hill-site Development. It was proposed in the paper that a new federal department called "Hill-Site Engineering Agency" be formed and established under the Ministry of Housing and Local Government.

6. <u>Street, Drainage and Building Act (As amended in 2007)</u>

Part V of the Act contains extensive provisions for the control and regulation of the construction of any building. It enables the local authority to impose controls over the construction, operation and maintenance of all buildings. There are also provisions for the safety and stability of any building under erection including the right of the local authority to direct remedial works to be undertaken to ensure the safety and stability of the building and its surroundings (Section 70B).

Section 70A of the Act contains explicit provisions to control earthwork in order to prevent soil erosion and sedimentation. The following are the provisions under this section:

<u>Subsection (1)</u> No person shall commence or carry out or permit to be commenced or carried out earthwork without having first submitted to the local authority plans and specifications in respect of the earthwork and obtained the approval of the local authority thereto.

<u>Subsection (18)</u> "Earthwork" includes any act of excavation, levelling, filling with any material, piling, the construction of foundations, or felling of trees, on any land, or any other act of dealing with or disturbing any land.

<u>Subsection (3)</u> Local authority may impose conditions.

<u>Subsection (4)</u> Local authority may issue stop work order.

Subsection (6) & (11) Local authority may implement corrective measures and recover costs from owner of the land.
Subsection (8) Local authority may enter site for inspection.
The penalty for offences under this provision is a jail term not exceeding 5 years or/and a fine not exceeding RM50,000 and additional fine not exceeding RM500 per day for each day the offence is committed.

In addition to the above, under Section 71, any person responsible for failure of any building or earthwork whether in the course of construction or after completion thereof due to one or more of the following factors:

a) Misconstruction or lack of proper supervision during construction;
b) Misdesign or miscalculation;
c) Misuse

is liable upon conviction to a fine not exceeding **RM50,000** or imprisonment of not more than **10 years** or both.

The authority may, after inquiry, declare any building to be in a ruinous or dangerous state, and require the building to be repaired, shut down or demolished (Section 83 and 84). It may require all persons to vacate the premises. The authority may itself demolish or repair a building and recover the costs from the owner in the event the latter fails to do so. Sections 97-98 empower the local authority (or its agents, contractors) to enter at all reasonable hours in the daytime into any land for the purpose of inspection or execution of any work. It may not enter any dwelling house in actual occupation without giving 24 hours prior notice. The state may declare any class of premises, for the control of which by-laws may be made, as liable to night inspection.

SDBA 1974 has been amended to replace the Certificate of Fitness for Occupation with the Certificate of Compliance and Completion (CCC) to be issued by an accredited professional. One-stop centres have been set up in all local authorities for approvals for any development projects. SEA will have to place itself in a position as an expert agency (identified as part of the vetting process within the system of the CCC) for vetting of all relevant development proposals for better slope management in the country.

7. Building and Common Property (Maintenance and Management) Act 2007

The objective of the Building and Common Property (Maintenance and Management) Act 2007 is to ensure a more systematic approach to the maintenance and management of high rise buildings and common property. This Act is applicable only in Peninsular Malaysia and the Federal Territory of Labuan.

"Common property" defined under Schedule H of the Housing Development (Control and Licensing) Act 1966 and Housing Development (Control and Licensing) Regulations 1989 as land not comprised in any parcel and accessory parcel. Common property is any provisional block and fixtures and fittings including lifts, refuse chutes, drains, sewers, pipes, wires, cables and ducts and all other facilities and installations used or capable of being used or enjoyed in common by all purchasers.

"Common property" also includes playing fields, recreational areas, driveways, car parks and parking areas, open spaces, landscape areas, walls and fences which are enjoyed by not only purchasers but by occupiers in general.

One of the most common and frequent dilemma faced by property owners is poor or lack of effective management and maintenance of their building and common property, especially by irresponsible and errant developers or management corporations.

Under this Act, a Commissioner of Building (COB) shall be appointed by the appropriate state government to make sure that the common property is managed and maintained satisfactorily. The COB is also entrusted with the responsibility in the carrying out of rectification works of any defective works during the defects liability period.

Management and maintenance of common property, particularly drains, sewers and pipes, are important measures against slope failure which in the long run trigger landslides. The issue of maintenance of buildings was much debated in the case of Highland Towers where lack/failure to maintain the drains had contributed to the occurrence of the landslide. A Building Maintenance Account is to be opened and maintained to fund the cost and expenses of carrying out repairs, cleaning services and periodical inspection on the safety of the building in accordance with the Street, Drainage and Building Act.

Under Section 38 of this Act, the Commissioner or authorised person may at reasonable times after notice, enter any building, land or premises to inspect if an offence has been committed under this Act.

Section 42 of this Act allows for the Minister with the concurrence of the state authority to make regulations which may be required for enforcing the provisions under this Act. Proper standards of maintenance and management in respect of buildings and common property may also be provided.

8. <u>Earthwork By-laws</u>

This by-law appears to be the main statue governing earthwork activities in most local authority areas. The by-law is a regulation made under the SDBA created using Section 70A (17) of the Act. The by-law contains provisions to allow a preventive approach to be taken.

Pursuant to Section 70A of the Act, Part II of the by-law stipulates that the engineer must submit earthwork plans to the local authority in a manner as detailed therein. The provision is limited only for purposes of erection of buildings, which is defined as any house, hut, shed or roofed enclosure, whether used for the purpose of human habitation or otherwise, and also any wall, fence, platform, staging gate, post, pillar, piling, frame, hoarding, slip, dock, wharf, pier, jetty, landing-stage or bridge, or any structure support or foundation connected to the foregoing.

The duties of the engineer are as follows:

a) Submit Plans, reports, specifications and particulars, including a preliminary site evaluation report together with details of top soil conservation, erosion and sedimentation control measures;
b) Supervise and inspect as necessary to ensure earthworks are carried out according to plans, specifications, directions, amendments or conditions imposed by the Council;
c) Notify the Council commencement of earthwork seven days before hand;
d) Notify the Council completion of earthwork within seven days.

The by-law does not cover minor earthworks, which is defined as any earthwork, which the Council by direction exempts from the provisions of the by-laws. Some local authorities, such as Putrajaya and Kuala Lumpur, have defined the meaning of minor earthwork.

Many local authorities administratively impose additional conditions pursuant to the by-law. These conditions are not uniform among the local authorities. Among others the conditions may comprise the following:

- Site inspection notice to be submitted before, during and after construction;
- Report with pictures to be submitted regularly);
- Report on water quality for detention pond to be submitted regularlyonthly);
- Earthwork to be phased out.

According to this by-law, any person who:

a) Knowingly or negligently submits plans, specifications, calculations or particulars which are false in any material particular; or

b) Without reasonable excuse fails to comply with any provision of the By-law,

shall be guilty of an offence and shall, on conviction, be liable to a fine not exceeding RM2,000 and shall also be liable to a further fine of not exceeding RM100 for every day during which the offence is continued. There are no jail terms. This by-Law may be suitably amended to include the concerns of SEA.

9. <u>Waters Act 1920</u>

This Act is only applicable in Melaka, Perak, Negeri Sembilan, Pahang, Federal Territory, Johore and Pulau Pinang. The Act empowers the state authority to regulate their respective rivers. Section 7A of the Act stipulates that no person shall, except under and in accordance with the terms and conditions of a license, cause to enter or discharge into a river:

a) Any poisonous, noxious or polluting matter that will render or is likely to render or contribute to rendering such river or part thereof harmful or detrimental or injurious to public health, safety or welfare, or to animal or vegetable life or health or to other beneficial uses of such river;

b) Any matter which by virtue of its temperature, chemical or biological content or its effect in discolouring the waters.

Penalty for an offence under this provision is a fine amounting to RM5,000.00.

10. National Land Code

Section 62 of the National Land Code allows the state authority to gazette areas for public purposes and impose restrictions therein. Examples include catchment areas. Approvals of land conversion may contain conditions for such conversions. Such conditions can include measures to ensure that there is no soil erosion or land failure occurs. The state authority (or any authorised representative of the latter) shall have rights of access and use over any alienated land for the purpose of inspecting, using and or maintaining any drain, sewer, pipe, cable or wire for the passage of water or any other substance (Sections 57 and58). These rights are in addition to the rights granted under any other law.

11. National Forestry Act 1984

The National Forestry Act 1984 (Sec. 10) contains provisions for the declaration of various forms of protected forest reserves. Many water catchment areas have been declared so far. The Act provides for forests to be declared for "soil protection and soil conservation" purposes. Areas in Cameron Highlands and parts of the Sg. Langat River Basin have been proposed to be protected under these provisions.

The National Forestry Act and the National Forestry Policy provide guidelines for forest management, conservation, utilisation, development and protection. The outcome of the National Forest Policy is the creation of a Permanent Reserved Forest that deals with sustainable forest management. With this programme, Section 10 of the National Forestry Act 1984 permits the State Director of Forestry with the approval of the state authority to classify Permanent Reserved Forest into 10 non-exclusive interesting Forest Functional Classes namely:

(1) Soil protection forest;
(2) Soil reclamation forest;
(3) Flood control forest;

(4) Water catchment forest
(5) Forest sanctuary for wildlife;
(6) Virgin jungle reserved forest;
(7) Amenity forest;
(8) Education forest;
(9) Research forest; and
(10) Forest for Federal purposes.

One avenue for protection of hill slopes is through the identification and declaration of such slopes as soil protection forest. The creation of RAMSAR sites is undertaken through this Act. Several sites have been declared including Tasik Bera, Pahang. About 4.84 million hectares of forested Land in Malaysia is classified as Permanent Reserved Forest.

A number of other legislation complements and supports the National Forestry Act. These include Water Enactment 1920 (provides guidelines for the maintenance of riparian strips of river reserves), Land Conservation Act 1960, National Land Code 1965, Protection of Wildlife Act 1972 (provides the legal framework for the protection of threatened and endangered species), Environmental Quality Act 1974 (amended 1985; prescribes EIA for activities involving forest land), and National Parks Act 1980 (provides the legal framework for the conservation of national/state parks).

12. Land Acquisition Act 1960

12.1 Ownership of property is an inviolable right granted to citizens under the Federal Constitution. The deprivation of this right through acquisition of any property can only be done in accordance with the law. The Land Acquisition Act governs the acquisition of private land and matters incidental thereto.

Under the Act, land is defined as alienated land within the meaning of state land law, land occupied under customary right and land occupied in expectation of title. State land law means the law for the time being in force in the state relating to the land.

12.2 Acquisition

12.2.1 Land Acquisition Act 1960 provides that the state authority can acquire any land needed for the following purposes:

a) Any public purpose;
b) By any person or corporation to acquire land for any purpose which the state authority deems beneficial to the country's economic development; or
c) For purposes such as mining, residential, agricultural, commercial, industrial or recreational or any combination thereof.

A person or corporation that is interested in acquiring any land for a purpose stipulated in b) and c) above, must apply in writing to the LA for the acquisition of the said land. The application shall be accompanied by:

a) The project proposal;
b) Layout and land acquisition plan;
c) Preliminary government valuation report of the land to be acquired; and
d) Prescribed fee and deposit under the Land Acquisition Rules 1998.

If the LA deems the application to be in order, it shall then be transmitted to the State Economic Planning Unit or the Committee in the case of federal territory.

Any federal or state corporation that holds land under any written law may be exempted in part or whole from paying the fees if the acquisition is for the purpose of public utility.

12.2.2 A Committee known as the "Jawatankuasa Khas Pengambilan Tanah" shall be established under this Act. In the case of a state, the Committee consists of the following members:

a) State Secretary as Chairman;
b) State Director of Lands and Mines as Secretary;
c) Director of the State Economic Planning Unit or representative;
d) State Director of Town and Country planning or representative; and
e) Representatives of other related government departments or agencies determined by the Chairman.

In the case of the Federal Territory of Kuala Lumpur, the Committee members are as follows:

a) Director General of the Economic planning Unit or representative as Chairman;
b) Under Secretary of the Federal Territory Development and Klang Valley Planning Division, Prime Minister's Department;
c) Representative of the Economic Planning Unit as Secretary;
d) Land Administrator of the Federal Territory;
e) Director General of Lands and Mines or representative;
f) Commissioner of the City of Kuala Lumpur or representative; and
g) Representatives of other related government departments or agencies as may be determined by the Chairman.

12.2.3 Any application to acquire land made under Section 3 may be withdrawn by any applicant before gazette publication of the declaration under Section 8 by giving a notice in writing to the LA. An inquiry shall be conducted by the LA on any such withdrawal to determine the forfeiture of deposit to compensate persons interested.

Similarly, the state authority can withdraw from the acquisition of any land of which possession has not been taken and such withdrawal shall be published in the Gazette (Section 35). Any injured or interested persons who have suffered damage or incurred cost as a consequence of the proceedings for acquisition shall be compensated with an amount determined by the LA.

12.2.4 The state authority shall publish in the gazette a notification in Form A of the land likely to be acquired. The state authority may then by way of a written authority in Form B, authorise any officer to enter upon and survey the land notified in Form A. However, no such authorised officer is authorised to enter into any building or enclosed court or garden attached to a dwelling house without the occupier's consent or a 3-day notice of intention to do so. The said land shall then be published in the Gazette (**Section 8**) and marked out and entered on the appropriate register (**Section 9**).

A similar empowering provision is seen in the Street, Drainage and Building Act 1974. The local authority (or its agents and contractors) is empowered by **Sections 97 and 98 of the Street**, **Drainage and Building Act 1974** to enter at all reasonable hours in the daytime into any land for the purpose of making any survey or inspection for the execution of any work. It may not enter any dwelling house in actual occupation without giving 24 hour prior notice. The state may declare any class of premises, for the control of which by-laws may be made, as liable to night inspection.

12.2.5 Upon the request by the Land Administrator, the state director of Town and Country Planning shall provide information on the land use of the land for the purpose of assessing compensation (**Section 9A**).

12.2.6 The Land Administrator may, pursuant to **Section 18**, take possession of any land in respect of which an award has been made under Section 14. The award is conclusive evidence of particulars of the land such as the area, apportionment of compensation and persons interested therein.

Notwithstanding the above, the Land Administrator is also empowered to take possession of land where no such award has been but a Certificate of Urgency has been issued under **Section 19**. Section 19 provides that where the state authority is of the opinion that any land is urgently required for a public purpose or for public utility, the state director may issue a 15-day notice and issue a Certificate of Urgency upon its expiry. If in the event there is an occupied building on the required land, possession is only taken of land not built upon. Notice in Form J is to be served to the occupier of building requiring him to vacate the building within such period not exceeding 60 days from the date of the notice. The Form also serves as a notice upon the owner, making an offer of compensation in respect of the building (**Section 20**).
A formal possession shall take place upon serving to the occupier a notice in Form K. The notice shall be served on the registered proprietor and the registering authority. The acquisition will then be entered in the appropriate registry.

12.3. Temporary Occupation or Use of Land

12.3.1 **Part VII** of the Land Acquisition Act provides provisions for temporary occupation or temporary use of land. **Section 57** stipulates the grounds for temporary occupation or use of any land to be for similar purposes specified in Section 3 earlier or to carry out public works on any land. The state authority may also require land for its need as a means of access to any other land under **Section 61**. This right of access is extended to vehicles including heavy machinery used for the public works. The state authority may direct the Land Administrator to procure the said temporary occupation or use of land for a period not exceeding three years.

12.3.2 The Land Administrator is required under Section 58 to give a written notice in Form Q to persons interested in the land. The notice shall indicate the purpose for which the land is needed and the offer of compensation. With regard to land required to carry out public works, the Land Administrator shall, in assessing the compensation, take into account any increase in the value or advantages which will accrue.

12.3.3 Once the term of occupation or use of any land stipulated in Section 57 expires, the land shall be restored to its original condition, otherwise compensation for any damage done or decrease in value of the land shall be paid (**Section 59**).

12.4 Section 68A clearly provides that any dealing with or use of any land subsequent to its acquisition under this Act shall not invalidate such acquisition.

12.5 An owner who has been subjected to acquisition under the Act may not challenge the exercise of acquiring the land per se, but may challenge the state authority for failing to pay adequate compensation or if the state authority fails to comply with the procedures for acquisition under the Act.

12.6. **Sabah and Sarawak**

12.6.1 In Sabah and Sarawak, indigenous landowners are given various types of protection under the laws of Sabah and Sarawak. This includes rights and privileges related to land and the use of land. Under the Sabah Land Ordinance, land held by indigenous landowners fall under the category of Native Land. **Section 65** provides "Customary tenure [which] means the lawful possession of land by natives either by continuous occupation or cultivation for three or more consecutive years or by title under this Part or under the Poll Tax Ordinance...". Under the Sarawak Land Code, the Minister may declare any land to be Native Area Land. Native customary rights are created in accordance with the native customary law of the community by the following methods:

a) Felling of virgin jungle and occupying the land thereby cleared;
b) Planting of land with fruit trees;
c) Occupation or cultivation of land;
d) Use of land for burial ground or shrine;
e) Use of land for rights of way; or
f) Any other lawful method

provided a document of title has been issued in respect thereof. When the customary rights are duly acquired amounting to ownership for residential or agricultural purposes, a grant in perpetuity, free of premium, rent and other charges is issued. In all cases, state land shall not be alienated until all customary rights therein have been surrendered, extinguished or the person entitled to such rights has been compensated. **Section 8** of the Sarawak Land Code, subject to Section 9, makes it illegal for a non-natives to acquire rights or privileges over land categorised as Native Area Land, Native Customary Land or Interior Area Land. **Section 9** allows for acquisition of land by non-natives provided the appropriate and relevant permit is issued and obtained any law regulating matters relating to minerals or licensed under this Code for the purposes of extraction and removing earth, gravel or other permitted materials or where such non-native has been deemed to be a native by the Majlis Mesyuarat Kerajaan Negeri by notification in the Gazette. **Section 13A** of the Code also prohibits acquisition of land by foreigners prior to the commencement of the Land Code (Amendment) Ordinance 1974 unless consent of the Minister is obtained (**Section 13B**).

12.6.2 The Native Court systems in Sabah and Sarawak, established by legislation passed by virtue of constitutional authority conferred under Item 13 of List IIA - Supplement to State List for States of Sabah and Sarawak in the Ninth Schedule to the Federal Constitution, also accord recognition, protection and enforcement of native customs, including native marriages, divorce, maintenance of children of customary marriages between natives, distribution of properties and disputes over land held under customary tenure.

12.7 The Land Acquisition Act does not contain express provisions of acquisition of land or temporary use of land for the purposes of safeguarding the slopes and hills in Malaysia that may be prone to slope failure and landslides. Nevertheless, the reason for acquisition given in Section 3(1)(a) of the Act is for "public purpose" is very wide. The phrase has not been given strict or restricted definition under the Act. Therefore, it may be possible to extend acquiring land which is identified as dangerous slopes and hills in order to protect life and property. It is noted that there has been no such case in the country thus far.

13. Uniform Building By-Laws 1984

The Uniform Building By-Laws 1984 (UBBL) was established under Section 133 of the Street Drainage and Building Act 1974 by the State Authority to make by-laws as necessary to carry out the provisions of the Act. Under the UBBL, provisions that are relevant and important in respect of slope failure and landslides are by-laws on drainage and protection of soil against erosion. Under **By-laws 82 and 84**, it is provided that where the subsoil of building sites are damp, necessary steps are to be taken to effectively drain the dampness and protect the building against damage from moisture. **By-law 83** requires that all air-wells and open spaces in and around buildings are protected against soil erosion. This includes the grounds under raised buildings. This protection not only is against erosion, but also prevents water from accumulating unwanted vegetation to grow or vermin to breed.

14. Civil Law on Negligence and Nuisance

The position of the law of negligence and nuisance is well illustrated by the case of Majlis Perbandaran Ampang Jaya vs Steven Phoa Cheng Loon & 81 Others (2004) Federal Court. The Highland Towers consisted of three blocks of apartments (Blocks 1, 2 and 3), built in front of a steep slope and originally owned by Highland Properties Sdn. Bhd. On the hill slope was a stream referred to as "East Stream". The East Stream originated from land that was being developed by Metrolux Sdn. Bhd. and MBF Properties Service Sdn. Bhd. The Ampang Jaya Municipal Council (MPAJ) and/or its predecessor had required or approved the diversion of the East stream. The natural course of water flow was altered to run across the hill instead of downhill for the purposes of development in the adjoining land. Subsequently, MPAJ is said to have failed or neglected to maintain the said diversion or to ensure its proper maintenance.

On 11.12.1993, after continuous rainfall for ten days, a landslide occurred, resulting in the collapse of Block 1, which then called for forced evacuation of the occupants/respondents from Blocks 2 and 3. The disastrous incident left 48 people dead, many homeless and serious damage to property. Even prior to the collapse of Block 1, there were landslides caused by interruptions to water flow and drainage due to clogged and improper drainage system.

As Blocks 2 and 3 were completely vacant and unoccupied for fear of instability, MPAJ had issued a statutory notice to the purchasers/owners to demolish these buildings but a High Court Order ruled against it, and the said notice was set aside.

After the collapse, MPAJ (the 5th Defendant) in its effort to stabilise the hill slope to prevent recurrence of a similar incident, called for a briefing with the owner of land directly behind the Highland Towers and some other parties. MPAJ instructed that a master drainage plan for the entire area to accommodate all landowners in the vicinity of Highland Towers be prepared within three months. A period of one year passed, but the plan was not prepared. At a second briefing held by MPAJ, the latter promised to have the plan prepared. The implementation and approval of the comprehensive plan as well as the rectification of the retaining walls were necessary for any further actions to be taken to protect the slopes from any failure. As the plan was never prepared, the 5th Defendant was unable to take steps to secure the stability of the slope behind Blocks 2 and 3.

The affected parties/respondents filed a suit in the High Court against various parties including the MPAJ for negligence and nuisance. There was then the appeal to the Court of Appeal, which led to this appeal to the Federal Court. For a better understanding of the chronology of this case, the relevant issues and findings of the High Court and Court of appeal shall be dealt with below. The following are the particulars of six areas of wrong identified by the plaintiffs:

- Firstly, <u>at the planning and design stage</u> of the Highland Tower project, the defendants had not taken reasonable care, skill and diligence in checking the plans submitted to ascertain whether they are reasonably fit for the purpose it was intended for. This included matters relating to watercourses, streams and rivers in the vicinity of the Highland Towers site, the Arab Malaysian land and the surroundings which were under the jurisdiction of the fourth defendant.
- Secondly, <u>at the construction stage</u> of the Highland Towers, the defendants failed to exercise reasonable care, skill and diligence to ensure the drainage system and the rubble walls on the Arab Malaysian land were adequately provided for and/or constructed in a workman like manner before the issuance of the CF to the three apartment blocks.
- Thirdly, <u>failure of the defendants to maintain and upgrade drains and rubble walls</u> on the Highland Towers site and the Arab Malaysian land and to

provide adequate drainage requirement to watercourses, streams and rivers after the Highland Towers was constructed.

- Fourthly, <u>failure to take any action</u> against damage caused by the clearing of the adjoining Arab Malaysian land.
- Fifthly, <u>for failing to take remedial measures</u> to remove, rectify and/or minimize the hazards posed on the Arab Malaysian land and the surroundings after the collapse of Block 1.
- Sixthly, in the aftermath of the collapse of Block 1 <u>for failing to prevent vandalism and theft</u> to Blocks 2 and 3.

High Court:

The developer of the Highland Towers (the first Defendant) was found to be guilty for negligence on the grounds that it proceeded to engage an incompetent and unqualified architect (the second Defendant) and even allowed him to appoint the third defendant as the consultant engineer for the project. Furthermore, as an owner of the Highland Towers site the developer had not been a reasonable user of its land as it had failed to maintain the drainage system and the retaining walls on the Highland Towers site, resulting in the damages suffered by the plaintiffs who are owners of the two apartment blocks and who must be considered as its neighbours.

The architect was also found liable as he had failed in his duty as an architect and had also refused to comply with the requirements imposed by the authorities on the drainage of the area. In addition, he had also colluded with the first and third defendants to obtain CF for the three apartment blocks of the Highland Towers without fulfilling the conditions as set out by MPAJ and/or its predecessors. The compliance of these requirements and conditions were part of his duties as an architect, and failure to do so is a breach of his duty of care.

The engineer was liable for nuisance as one of the creators of the nuisance by his acts and/or omissions. He should have exercised care to either design and construct a foundation to accommodate lateral loads or ensure that the slope was reasonably stable. Failure to do so was a breach of his duty of care he owes to the plaintiffs since his duty was to ensure the safety of the buildings he designed and built.

The claim against MPAJ was for negligence in their approving the diversion of the East Stream and in failing to detect any damage or defect in the building and drainage plans relating to the development submitted to the local authority by the architect and/or the engineer on behalf of the developer.

The Court found that water was the major factor in the collapse of the high wall behind Block 1 and the landslide that followed. The water that triggered the incident was held to have come from rainfall, which could not flow properly due to blockage by vegetation growing over drains and non-smooth flowing of water along the pipe culvert, which caused the water from the East Stream to overflow onto the slopes.

The High Court held that MPAJ was liable for negligence in respect of acts and omissions <u>prior to the collapse</u> of Block 1. Nevertheless, it was further held that the operation of Section 95(2) of the Street Drainage and Building Act offered immunity from any liability.

As for the acts and omissions by MPAJ <u>after the collapse</u>, the Court found MPAJ liable for failing to formulate and implement certain works or plans. It further stated that Section 95(2) was not applicable here as there was no building or other works involved in accordance with the SDBA.

Regarding post-collapse, Arab Malaysian, the fifth defendant as the owner of land behind the Highland Towers was held liable for actionable nuisance, namely for not having taken any measures to effectively abate the problem of flooding at the car parks of the Highland Towers even after being notified. It should have investigated, especially when the complaint was that the flooding emanated from its land. The court held that if the owner had indeed investigated, it would have certainly discovered the existence of the hazard, and therefore Arab Malaysian must be considered to have constructive knowledge of the hazard. This lack of care to investigate or even making some effort to look after its land does not absolve Arab Malaysian's claim of lack of knowledge of the hazard that caused the nuisance.

Metrolux (the seventh defendant) was the registered owner of a large piece of land located above Arab Malaysian land. The eighth defendant is the provider of management services to Metrolux to develop the Metrolux land into a housing estate. The Court found that as property developer and/or manager of development projects on a hill, these defendants must have known or ought to have known that by diverting watercourses on their land to the East Stream they would increase the volume of discharge to this outlet. With an extensive area of their land denuded of trees, they must have foreseen that water flowing over this area would carry with it eroded soil and silt which would be deposited down stream. And as proved, these caused or contributed to the failure of the drainage system resulting in the collapse of Block 1 and forced evacuation of Blocks 2 and 3.

Tropic (the sixth Defendant) was the company that carried out clearing works on Arab Malaysia's land. It was found not liable. The state Government of Selangor as the ninth Defendant and the Director of Lands and Mines Selangor as the tenth Defendant were also found not liable.

Court of Appeal

All the defendants who were found liable for negligence appealed to the Court of Appeal. The plaintiffs appealed against the order on immunity afforded to MPAJ with regard to the alleged post-collapse liability.

The Court of Appeal agreed with the High Court that the collapse of Block 1 was caused by water. The Court affirmed the findings of the High Court and dismissed the appeal by the defendants. However, the Court of Appeal allowed MPAJ's appeal on the **post-collapse liability** but found them liable for breach of duty **prior to** the collapse and set aside the immunity afforded by Section 95(2) of the Street Drainage and Building Act.

Federal Court

This appeal was by the MPAJ against the liability for pre-collapse. MPAJ's appeal is directed at the decision of the Court of Appeal in affirming the High Court's finding that the appellant was 15% liable to the respondents for negligence and nuisance. And the plaintiffs' cross-appeal is against the Court of Appeal's decision that their cause of action against MPAJ for alleged post-collapse liability should be under public law and not private law.

The Federal Court allowed MPAJ's appeal. Although MPAJ may be held to be negligent for requiring or approving the diversion of the East Stream without ensuring its proper maintenance, they are nonetheless protected and immunised against any liability under Section 95(2) of the Street Drainage and Building Act. The creation of the danger in the diversion of the East stream relates essentially to approval and inspection by MPAJ which falls squarely within the ambit of the second and third limbs of S. 95(2) of the Act.

Pertaining to the post-collapse liability, the Court was of the view that local councils need to have priorities with their limited resources and manpower. It was stated that the provision of basic necessities for the general public has priority over compensation for pure economic loss of some individuals. To impose such burdensome monetary liability on MPAJ may be against public policy. MPAJ's limited resources would be depleted and to utilise taxpayers' money to pay such debt would be unfair, unjust and unreasonable. Further, if such local council becomes financially crippled, then more economic loss may follow when other projects get stalled and may open the floodgates to joint tortfeasor liability due to errant or negligent developers and contractors.

The plaintiffs' cross-appeal was disallowed, but it was stated that the failure by MPAJ to formulate and implement the master drainage plan had resulted in damages incurred by the respondents who had to evacuate their apartments in Blocks 2 & 3. The elements of foreseeable danger and proximity are clearly discernible from the established facts. However, although the Court agreed that the plaintiffs' claim for negligence by way of writ action is perfectly proper in law, it would be against public interest to impose liability on MPAJ based on economic loss alone and for the reasons stated above.

15. State Laws and Guidelines

15.1 Mention must be made of the SWMA Enactment 1999 in Selangor which has extensive provisions for the protection of water resources and the declaration of designated areas and zones of protection. Such areas may include areas which have high risk of erosion resulting in siltation of rivers.

15.2 There are other minor subsidiary legislation and formal guidelines which do play a part in the prevention and control of soil erosion and sediment controls. These include the Refuse Collection, Removal and Disposal By-Laws and Parks By-laws. Some relevant guidelines include the Urban Storm Water Management Manual 1999, Guidelines on River Front Development, Guidelines on the Processing of Applications and Determination of Conditions for the Mining of Sand from Rivers; Guidelines on Erosion Control for Development Projects in the Coastal Zone all of which were issued by the Federal Department of Irrigation and Drainage; Guidelines on the Prevention and Control of Soil Erosion and Siltation in Malaysia, 1996 issued by the Department of Environment and the various other Guidelines issued by the Town and Country Planning Department for development on hilly areas and environmentally sensitive areas (see Annex 1). It will be opportune for the newly created agency to review all these guidelines and streamline them so that the standards and practices are consistent and conform to international best practices on slope management. A summary of some of the main guidelines related to development in highland areas is given below.

A. <u>Guidelines for Development on Highlands (Garis Panduan Pembangunan Di Kawasan Tanah Tinggi)</u>

Guidelines for Development on Highlands was issued to all government agencies for implementation on 22nd June 2002 and subsequently updated in December 2005 by the Ministry of Natural Resources and Environment. The objective was to provide a comprehensive guideline for the planning of development in highland areas.

These guidelines apply to any development of land for any activity including infrastructure, agriculture or any physical development on highlands with the height of 300 metres above sea level. Forest reserves above 1000 metres above sea level should be maintained as Soil Protection Forests and Catchment Forests.

Physical Development of any land shall be subject to the Construction Suitability Map (CSM) as indicated in the guideline. There are four classes in the CSM. The application of the guideline on any construction activity depends on the gradient of the land (between 25° to 35° or more) on which development is to be carried out and other technical factors as outlined in the guideline.

There is no mention of the agencies which may adopt and apply the guidelines.

B. <u>Guidelines for Conservation of Natural Topography in Physical Planning and Development in accordance with the Town and Country Planning Act 1976 (Garis Panduan Pemeliharaan Topografi Semulajadi Dalam Perancangan dan Pembangunan Fizikal Mengikut Akta Perancangan Bandar Dan Desa 1976)</u>

These guidelines are to assist the state and local authorities in maintaining natural topography in hill areas which is made available for development. These guidelines complement the requirement in the Town and Country Planning Act, which requires that the original state of topography in hill areas be maintained and development only permitted after consideration is given to the guidelines in topography conservation.

The guidelines apply to any land development involving construction of infrastructure, any structure and act which relates to or interrupts the natural state of land. Highland is defined to include land above 150 metres above sea level with a gradient more than 25°.

Hill areas categorised as 'low and medium risk hill area' (gradient below 25°) and 'high risked hill area' (gradient above 25°) are subjected to compliance with these guidelines.

These guidelines lists down the types of land areas that require conservation and contain provisions on safety measures, planning and development.

C. <u>Guidelines for Sensitive Area (Garis Panduan Kawasan Sensitif)</u>

These guidelines are still under review by the Town and Country Planning Department.

D. <u>Standards for Development of Sensitive Areas (Kaedah-Kaedah Pembangunan Kawasan Sensitif)</u>

These regulations relates to all environmentally sensitive areas including hills and slopes. The Project Consultants have been informed that the said document is for reference of government agencies only, therefore not for public circulation. As such, a copy of the regulations is unavailable for review.

ANNEX 3:

REVIEW OF LAWS RELATED TO DISASTER RELIEF AND RESCUE

1. Fire Services Act 1988

Under the Fire Services Act, the Fire Services Department, headed by the Director-General of Fire Services, is entrusted with the responsibility of carrying out effective and efficient functions necessary for the protection of persons and property from fire risks and matters connected therewith.

The Act defines 'calamity' to mean 'an occurrence by which life or property is likely to be endangered'. This definition is general and wide enough to capture events of natural disasters, which would include landslides.

The Fire Services Department has responsibilities under Section 5(1) of this Act to perform humanitarian services, which includes the protection of life and property in any calamity. The duties shall include:

a) Taking of lawful measures for:
    (i) Extinguishing, fighting, preventing and controlling fires;
    (ii) Protecting life and property in the event of a fire;
    (iii) Securing the provision of adequate means of exit in the event of fire from all designated premises;

b) Investigating the cause, origin and circumstances of fires; and

c) Performing humanitarian services.

In addition to the specified duties under Section 5(1), the Fire Services Department may also, under sub-section (2), be required to provide its services when imposed by laws or when directed by the Minister.

This Act does not specifically or clearly spell out the nature of responsibility of the Fire Services Department in the event of a landslide occurrence. However, Section 19 provides that on an occasion of emergency not involving fire or risk of fire, where there is a reason to believe that lives and property are in imminent danger, the Fire Officer shall exercise similar powers as those conferred by Section 18 which involves fire. The powers given to a Fire Officer under Section 18 are to:

(a) Take measures that isdeemed necessary or expedient to protect life and property;
(b) Remove any person who interferes with the operations of the Fire Services Department;
(c) Enter, break into or through and take possession of or demolish, or cause to be taken possession of or demolish any premises, place to put out fire, or protecting the premises, place from the fire or rescuing any person;
(d) Close any street near the site of the fire, control the traffic or crowd in any such street;
(e) Use any convenient supply of water.

Fire officers and auxiliary fire officers acting bona fide under powers given under this Act shall not be liable to any action for damages for any act done or omitted in the course of performing their duties on occasions of fire or any calamity.

2. Civil Defence Act 1951

Civil defence according to the Civil Defence Act includes any measures not amounting to actual combat for affording defences against and measures taken before, at or after **hostile attacks.**

Section 7 of this Act provides that the Yang di-Dipertuan Agong may call out members of the civil defence forces or services to report for service at such time and place notified by the Director General for Civil Defence. Under Section 8 of this Act, the Director General for Civil Defence, with the consent of the Minister, may order the civil defence forces or services to carry out relief and rehabilitation works for the safety of life, persons or property in the event of a disaster or impending disaster. This Act, however, does not define the meaning of disaster. The Act seems to be rather restrictive in nature as 'civil defence' as the term connotes was set up primarily to assist during **wars or hostile attacks** on the country. Further it should be noted that the **consent of the Minister** (Minister of Home Affairs) must be obtained prior to the organisation being used for relief or rehabilitation works during normal periods. The Act is clearly outdated and does not seem to reflect the current roles and responsibilities of the Department. The Department is apparently in the process of reviewing the Act.

The profile of the Civil Defence Department complements Section 8 whereby it provides that the department plays a role during times of hostile attacks as well as peace. Therefore, the involvement of this department in matters of landslide is justified under the latter category. The department's emergency helpline 991 includes services for landslide and the procedures adopted and implemented by the Civil Defence Department is the National Security Council Directive No. 20.

The Civil Defence Department is responsible under the directive to provide support services in works related to saving lives and properties, preparing and maintaining evacuation centres, and providing food and first aid services.

Further, general information about occurrences of landslides is made available by this Department in its website. It consists of information on warning signs and preparation prior to a landslide, actions to be taken during and after a landslide takes place.

3. <u>Police Act 1967</u>

This Act regulates all aspects related to the setting up, functions and responsibilities of the Police Force. The Police Force plays a vital role in maintaining public order.

Their involvement in any disaster is sanctioned by Section 7 of the Police Act, which states that they may be asked to serve during war or other emergency in conjunction with the local forces under any law or in the defence of Malaysia.

Section 20(3)(j) empowers a police officer to take lawful measures necessary in giving assistance in the protection of life and property. The police is also responsible under Section 21 to regulate and control traffic and maintain good order on public roads. Police officers are also authorised under Section 26 of this Act to place road barriers on or across public roads and streets in any public place, when necessary to maintain and preserve law and order. Such duties may be crucial in events of landslides along the roadways. Under the Public Order (Preservation) Act, the Police plays a critical role in any disaster.

4. <u>Highway Authority Malaysia (Incorporation) Act 1980</u>

The Act provides for the supervision and execution of design, construction, regulation, operation and maintenance of inter-urban highways, imposition and collection of tolls and other matters connected therewith. The Act does not deal directly with matters related to landslides and slope management along highways in Malaysia.

The Malaysian Highway Authority (MHA) is the statutory body set up under the Highway Authority (Incorporation) Act and is responsible to plan, execute, supervise and monitor all highway projects in Malaysia. **The Authority is empowered under Section 11 to establish the Highway Servicing and Surveillance Unit, to control access to and along the highways and undertake other reasonable measures in the discharge of its duties.**
There are more than ten manuals and guidelines issued by MHA which are implemented in the planning and building of highways.

The Public Works Department's Slope Engineering Unit has identified 1,303 high-risk hill slopes along the North-South Expressway, Kuala Lumpur-Karak-Kuantan Expressway and Federal highways. The Ministry of Works is now rehabilitating 698 critical hill slopes along Federal roads.

The Malaysia Highway Authority and Concession Companies are committed to provide safe and convenient driving to expressway users. Quick action and measures are required to be taken to mitigate loss and damage when incidents such as accidents, landslides and flood

One of several guidelines issued by the MHA is the Emergency Procedures Guideline. The guideline provides general instructions to deal with unusual incidents on expressways. It is intended that it will be regularly reviewed, updated and revised to conform to current practices in emergency management.

5. National Security Council Directive No. 20

This directive is perhaps the most important document related to disaster management in the country. The objective of this directive is to establish a land disaster management and relief system that will provide a swift, coordinated and effective response to any major disaster. The directive was issued by the National Security Council, Prime Ministers Department in May 1997 after the tragic events of the Highland Towers incident.

The Directive defines 'disaster' as a **sudden** and **complex** incident which causes **loss of lives, damage to property or natural environment**, severely affects **local activities** and requires **effective coordination of many agencies with deployment of extensive resources**. Landslide is classified as a 'disastrous incident' by this directive. The directive also excludes minor disasters from its coverage. These are indicated as 'non-disastrous incidents' which involve only 'a small number of victims, has no possibility of spreading and can be handled by relevant agencies with minimal resources and facilities at the local level, e.g. small fire or mishap on a lake or river'.

There are three levels of disaster categorised under this directive and controlled accordingly. They are as follows:

(i) Level 1 Disaster – District Level

It is a local incident which can be controlled, is not complex, causes minimal damage to life and property and does not jeopardize daily activities on a large scale. A District Disaster Management and Relief Committee (JPBBD) shall be established to control and manage such incidents through district level agencies, with or without limited assistance from outside. The District Officer heads the JPBBD. The District Chief Police Officer and District Fire and Rescue Services Chief would be the On-Scene Commander and Deputy Commander respectively. If the level of the disaster exceeds the capacity of the district to handle, assistance may be sought from the next level of disaster management and JPBBN should be informed. A chart showing the flow of communication and disaster relief is given in Annex E of the Directive.

(ii) Level II Disaster – State Level

It is a more serious and complex incident covering a wide area or exceeds two districts with a potential to spread. The extent of damage is greater with a large number of fatalities, extensive damage to property with adverse effect on daily activities. The responsible agency at this level is the state authority. The State Chief of Police shall be the On-Scene Commander and the Director of State Fire and Rescue Brigade shall be the Deputy Commander at this stage.

A State Disaster Management and Relief Committee (JPBBN) shall be established at the state level headed by the State Secretary (the Mayor for Federal Territory of Kuala Lumpur and Director of Administration for Federal Territory of Labuan respectively) to ensure the smooth running and coordination of management of any Level II disaster. It shall also assist in Level I disaster when requested.

(iii) Level III Disaster – Central Level

It is a more complex incident affecting a wide area or more than two states. Such disasters are to be handled by the Central Authority and led by a Minister appointed by the Prime Minister. The Director of Internal Security and Public Order, Royal Malaysian Police and the Deputy Chief of Operation of the Malaysian Fire and Rescue Department will be the Commander and Deputy Commander of disaster operation respectively. A Central Disaster Management and Relief Committee (JPBBP) shall also be established which shall be responsible for the management of the Level III disaster. In addition to this role, the JPBBP shall also be responsible for the overall management of disaster management in the country including policy formulation, public education, training and formulation of appropriate strategies. In this respect the National Security Division, Prime Ministers Department, plays a crucial role as the secretariat for disaster management and relief committees at all three levels. It is also responsible for the deployment and organisation of the elite SMART team.

The MKN 20 Directive lays down the steps and measures to be taken and followed in times of disasters. These include:

(i) Management at the scene of disaster based on zone;
(ii) Role and duty of major and secondary rescue agencies in disaster management;
(iii) Guidelines and standing order for agencies operation;
(iv) Collaboration between government agencies, statutory bodies and private sectors;
(v) Media control centre;
(vi) Management of disaster relief fund;
(vii) Release of statements and messages;
(viii) Declaration of disastrous situation; and
(ix) Enforcement.

Given the fact that the directive was issued in 1997, it is timely that a general review of the efficacy of the whole disaster management mechanism is undertaken and appropriate changes made where relevant. In this respect, it must be noted that this directive is merely a guideline for government agencies to follow, but has served its purpose quite well over the years. It may be timely also for due consideration to be given to the formulation of a Disaster Relief Management Act such as is found in many countries (the United States, Japan and United Kingdom) so that sound practices may be better organised with legal backing. It is noted that there are initiatives being taken to convert the directive into legislation.

6. Public Order (Preservation) Act, 1958

Under this Act, the Minister (of Home Affairs) may, where it is necessary for the purpose of maintaining or restoring public order in any area which is in danger, proclaim that area to be in a state of danger to public order. The Minister shall make the proclamation by way of any publication so that notification is brought to the attention of appropriate persons without the need for gazette. The notification will however have to be reproduced as soon as possible in the gazette and Parliament duly informed. The proclamation shall apply only to the specific area concerned and shall expire within one month unless renewed by the Minister from time to time. Once the proclamation is done, the Chief Police Officer or Officer in Charge of a Police District may regulate and control all public places within the proclaimed area. Powers of the police officers include the erection of barriers, imposition of a curfew, exclusion of persons and powers of requisition of any movable or immovable properties within the area. Compensation shall be payable for the requisitioning of any property by the agency which benefits from the service. In the event of a major disaster, it is possible that the provisions under this Act may be activated to enhance the existing powers of the police officers. This law also applies to Sabah and Sarawak.

ANNEX 4:

REVIEW OF LAWS RELATED TO SLOPE FAILURE IN SABAH

1. INTRODUCTION

1.1 It appears that the authorities in Sabah are well aware of the risks of slope failure. This is reflected in the adoption of the State Policy on Protection of Steep Hill Slopes. As mentioned earlier in this report, the management of landslides and slope failure focuses essentially on the conservation or development of any land. It will normally involve several parties and be made subject to relevant laws. The parties involved in Sabah, in general, are the same and maybe grouped into the following categories:

a) The owners and or occupiers – normally owner or occupier of the land and/or parties in joint venture;

b) Professional Service Providers - architects, engineers and others who design, obtain approvals and supervise the development;

c) Developers/contractors – developers and or contractors who may be the prime movers of a development project, carry out the works and would have formal approvals/agreements to that effect; and

d) Regulatory bodies that have the power to control all activities on any land. They regulate, approve, supervise and enforce the laws related to any development and all earthwork. These may include both federal as well as state/local agencies. Federal agencies may include the Public Works Department, Highway Authority and Department of Environment. State agencies would include the Town and Country Planning Department, Department of Irrigation and Drainage, Public Works Department, Land Administrator/District Officer, Municipal Councils, Environment Protection Department, State Economic Planning Unit and State Economic Development Corporation.

1.2 The control and regulation of all issues pertaining to land in the country is legally, and almost exclusively, within the purview and jurisdiction of the Sabah State Government (vide the Federal Constitution). A detailed review of the relevant laws in Sabah indicates that, by and large, there is no specific legislation that adequately addresses the myriad aspects of slope management. However, there are a number of laws related to land that provide specific powers related to the management of land such as the Land Ordinance, Forestry Enactment and Minerals Ordinance. There are other laws that are related to slope management such as the Town and Country Planning Ordinance, Local Government Ordinance, Water Resources Enactment and Environment Protection Enactment Sabah. These laws address issues of urban planning, hill development, soil erosion and water resources management. A detailed review of the relevant laws is included in this report in the various Annexes.

2. OBSERVATIONS ON LEGISLATION IN SABAH

2.1 At the state level, despite an awareness of the need for action to address the issues related to slope management, there is as yet no specific legislation that deals with the issues in its entirety. There is also no one agency that is exclusively tasked with the management of slopes. It can be concluded that, as far as the management of slope failure is concerned, the current legislation does not give the authorities an effective platform to manage the myriad issues associated with it. From the review undertaken of the legislation in Sabah, the following observations can be made:

2.1.1 <u>Disaster Management</u>

The National Security Council Directive No. 20 is applicable to Sabah. As mentioned earlier the objective of this directive was to establish a land disaster management and relief system that will provide a swift, coordinated and effective response to any major disaster. The directive was issued by the National Security Council, Prime Ministers Department in May 1997, prompted largely by the tragic events of the Highland Towers incident, which occurred in Kuala Lumpur. A review of the directive has been included in the earlier report and it is not intended to repeat the review. It is also noted that there are powers under other legislation for handling of a disaster particularly under the Local Government Ordinance for access into any area, demolition of hazardous buildings and declaration of hazardous areas. Local authorities may also provide relief to 'victims of natural catastrophes'.

2.1.2 Land Use Planning

The Town and Regional Planning Department, in compliance with the Town and Country Planning Ordinance, has prepared the State Structure Plan 2020. Structure and District/Local Plans are developed throughout the state by the local authorities. These plans must take into account the natural topography of the land including hill land. Local authorities are tasked with the implementation of these various plans. Under the Town and Country Planning Ordinance ,'development' is defined as "the carrying out of any building, engineering, mining, industrial or othr similar operation, on, over, or under land, the making of any material change in the case of any land or building or any part thereof or the subdivision or amalgamation of lands." A project proponent has to apply for development approval from the local authority before carrying out any works on any land. The development must also be consistent with the district and local plans. The local authorities are the planning authorities under the Town and Country Planning and Ordinance. The environmental concerns and impacts at this stage may also be considered at this stage for major projects including impact on land, soil erosion, slope failure, surface waters, groundwater, hydrologic balance, drainage regime, flooding, and sedimentation. Impact on human population will also be taken into account in terms of impact on and danger to communities. Land falling within a water catchment area would also be subject to the provisions of the Water Resources Enactment of which the Department of Irrigation and Drainage is the guardian. The District Catchment Management Committee set up under the enactment may impose conditions on any activity that may cause pollution or have an adverse impact on water resources such as soil erosion or sedimentation.

2.1.3 Land Use Conversion and Subdivision

Land conversion and subdivision is a standard procedure that needs to be carried out first in any land or property development. Applications for land use conversion must comply with the Land Ordinance and must be lodged with the District Land Office. The District Land Office will, prior to approval, seek comments from the relevant technical bodies including the Agriculture Department, Town Planning Department, Drainage and Irrigation Department, Local Planning Authority, Water Authority, Public Works Department and other departments where necessary, such as the Department of Environment, Department of Civil Aviation and Department of Minerals. The technical inputs from these agencies are often included in the conditions of approval for the conversion of land.

2.1.4 Control of Land Use

The Land Office/District Office is the principal agency responsible to regulate land use. The primary legislation that empowers the agency is the Sabah Land Ordinance. There are other legislation that enables various other agencies to regulate land use such as the Town and Regional Planning Department, Local Authorities, Environment Protection Department and Department of Irrigation and Drainage. Sabah has prescribed that any development on slopes of 20 degrees requires an EIA to be conducted under the Environment Protection Enactment. Under the Prescribed Activities Order, an EIA report together with a proposal for mitigation measures must be submitted for approval of the Director before commencement of any of the prescribed activities. The Minister may also declare any area as an environmental hazard zone which may cause danger to the health and safety of the people and restrict any use of the area as he deems necessary. The Director, in order to protect the environment, may impose measures or conditions on any use of land, earthwork or reclamation activity.

Section 28 restricts the use of any land that will significantly and adversely affect the environment. Land use includes:

(a) Any alteration, erection, extension, placement, removal, use or demolition of any structure or part of any structure in, on, under or over the land;
(b) Any excavation, drilling, tunnelling or other disturbance of the land; and
(c) Any destruction of, damage to or disturbance of the habitats of plants or animals in, on or under the land;

The Water Resources Enactment, as mentioned above, would also be relevant in the control of any land use that may cause an adverse impact on water resources.

2.1.5 Control of Construction Activities

Much of the state is under the jurisdiction of local authorities (municipal councils or district councils). These agencies implement various laws related to development including the Local Government Ordinance, and Town And Country Planning Ordinance. For development projects, during the construction stage the officers of the local authority and the pertinent technical departments monitor the implementation of the development projects to ensure that they are carried out according to the approved plans. The project proponent's consultants have to comply with various requirements under the Earthwork by-laws. However, it is to be noted that only some municipal councils in Sabah (the Kota Kinabalu and Sandakan Councils) have enacted Earthwork By-Laws. The authorities have the powers to stop any work that does not comply with planning and building approval conditions. For infrastructure projects, such as roads, drainage, railways, airports carried out by a government agency, the local authorities do not regulate such works. It is presumed that the government agency will impose and abide by construction best practices. Besides the above, the provisions of the Environment Enactment as mentioned above would also be relevant.

2.1.6 Management of Drainage Systems

Drainage and rivers have a major impact on hill slope conservation and maintenance. Planning for major drainage, flood mitigation and river rehabilitation are mostly carried out by the Department of Irrigation and Drainage. Local authorities are concerned with municipal level drainage systems and issues. However, some large local authorities such as Kota Kinabalu Municipal Council carry out planning of the total drainage systems within their municipalities. The Department of Irrigation and Drainage and local authorities are currently in a transitional stage in the adoption of the Manual for Stormwater Management for Malaysia (MSMA) which has been approved by the National Council on Local Government. The Department of Irrigation and Drainage has also produced several guidelines pertaining to rivers. The Water Resources Enactment contains provisions for ensuring that the water resources of the State are not adversely affected by development, particularly where the latter occurs in catchment areas. Any development on river reserves and on rivers will be subject to the control of the Enactment.

2.1.7 Environmental Management Plans

Issues related to the management of slopes and hill land may also be addressed through an integrated Environmental Management Plan (EMP). The EIA Order made under the Environmental Protection Enactment prescribes various activities to be made subject to a mandatory EIA to be carried out including developing on hill slopes above 20 degrees and above. The Town and Regional Planning Department requires an EIA to be included in the preparation of Statutory Plans.

2.1.8 Disaster Response and Management

There are various laws related to emergency services, public order and control. These include the Police Act and the Fire Services Act. There are also provisions in the Local Government Ordinance that enables the local authority to declare certain public spaces and buildings as unsafe, to evacuate people and to take appropriate measures to demolish, repair, maintain and manage such areas.

Local authorities may also provide relief measures. The National Security Council Directive No. 20 sets up a coordinating mechanism for agencies to respond to a disaster. This is an administrative guideline that is also implemented by Sabah government agencies.

2.1.9 Monitoring and Enforcement

In general enforcement of the various laws is easier said than done. In Sabah there appears to be some coordinated planning and management efforts for slope management. Efforts including enforcement may however be stymied by the overwhelming pressure to develop. Agencies may also be hampered by shortage of enforcement staff. The lack of clear legal powers within existing legislation to manage slopes could also be a hindrance to enforcement.

ANNEX 4-1:

DETAILED REVIEW OF LAWS RELATED TO SLOPE MANAGEMENT IN SABAH

1. Forest Enactment 1968

Sabah has enacted the Forest Enactment 1968 and the Forest Rules 1969. To accommodate current challenges in the forestry sector, the Forest Enactment 1968 has been amended accordingly. The Forest Enactment provides for the declaration of forest reserves, its use and management as well as for control of cutting and removal of forest produce from "state land" (publicly owned land which is not a forest reserve). On the other hadn, the Land Ordinance deals with alienation of state land, whereas removal (but not destruction) of forest produce on alienated land is subjected to the Forest Enactment. At present, the area of forest reserves gazetted under the Forest Enactment is 3,594,516 hectares.

The Forest Enactment also provides for provision on forest management, in the form of prohibitions against conducting most activities on Forest Reserves without authorisation. Issues such as power to authorise subsidies for encouragement of forestry, licence conditions, fees and exemptions and regulation or prohibition on the export of forest products and prescription of fees for exports are dealt with under this Enactment.

The Forest Enactment emphasises the importance of protecting forest resources. The most general are those that prohibit injuring any forest produce, negligent felling and introduction of fire in a forest reserve. Rule 11 of the Forest Rules makes it an offence to cut without authorisation a tree of less than the minimum diameter.

Any violations of the protective provisions such as damage of forest reserve through fire, prohibited acts in a forest reserve, illegal logging and removal from other areas, cutting of undersized trees are punished by fines and imprisonment and in the case of unauthorised entry for interference with fences or notice boards, by a fine alone [Section 20(1)(C) and 33(1)].

In addition to fines and imprisonment, the court may order for the cancellation of licences, the payment of any fees that would have been payable in the case of unlicensed acts that could have been licensed, and compensation of ten times the value of forest produce removed or damaged (Section 34). There is also provision for compounding of certain offences [entering closed area, practising shifting cultivation [Section 20(C))], subject to the payment of an amount based on the fine provided for the offence (Section 35).

Other state laws governing forestry include Park Enactment 1984, Culture Heritage (Conservation) Enactment 1997; Wildlife Conservation Enactment 1997; State Water Resources Enactment 1998; Environment and Conservation Enactment 1999; and Sabah Biodiversity Enactment 2000.

This Enactment is relevant to slope management insofar as management of hill land in forests are concerned, particularly where adjoining lands are occupied by people and/or buildings, structures and roads. Better management of slopes in such locations could be implemented with the assistance of the Forestry Department.

2. <u>Environment Protection Enactment 2002</u>

Preservation of the environment, biodiversity and natural resources are major concerns in Sabah. The relevant legislation pertaining to these aspects is the Environment Protection Enactment 2002.

Natural resources under the Environment Protection Enactment (EPE) include forest, land, rock and soil.

Environment Protection Council established under the EPE advises the state government on matters pertaining to the implementation of this Enactment. The Minister responsible for environment protection may order the Director of the

Environment Protection Department to formulate any environmental protection policy pursuant to and in accordance with this Enactment.

Section 11 authorises the Director to designate any area of land as an environmental protection area to protect the environment whilst Section 12 empowers the Director to prescribe the types of development activities which may adversely affect the environment. No one is allowed to carry out any prescribed activity without first submitting an environmental impact assessment report or a proposal for mitigation measures duly approved by the Director.

The applicant is also required under Section 12 to sign an agreement of environmental conditions or mitigation declaration. Failure to comply with the conditions may result in the imposition of a penalty not exceeding RM100,000 or a jail term not exceeding five years or both. Persons failing to comply with the terms and conditions of a mitigation declaration shall be liable to a fine not exceeding RM50,000 or a jail term not exceeding two years or both.

Pursuant to Section 12(2) the Environment Protection (Prescribed Activities) (Environmental Impact Assessment) Order 2005 makes it a mandatory requirement to submit EIA Report for the following prescribed activities related to hillside developments:

(i) Development of housing, commercial and industrial estates on hills with slopes having gradient of 20 degrees or more;
(ii) Resorts and recreational development on hills with slopes having gradient of 20 degrees or more; and
(iii) Major roads on hills with slopes having a gradient of 20 degrees or more.

Under the Order, submission of a mitigation measures report or on an environmental impact assessment report for approval of the Director is mandatory before the commencement of any of the prescribed activities.

The Minister may also, pursuant to Section 18, declare any area that poses a danger to the health and safety of the people as an environmental hazard zone and restrict any use of the area as he deems necessary.

In order to protect the environment, the Director may under Section 20 impose measures or condition on any activity to mitigate or prevent adverse impact to the environment. Activities falling within the ambit of this provision include:

(i) Any use of land, cultivation or methods of use thereof;
(ii) Earthwork or land reclamation;
(iii) Cutting of trees, clearing of or destruction of vegetation setting fire to land; and
(iv) Any activity relating to excavation or altering of any geographical or geological feature.

Section 28 restricts the use of any land that will significantly and adversely affect the environment. Land use under this section means:

(a) Any alteration, erection, extension, placement, removal, use or demolition of any structure or part of any structure in, on, under or over the land;
(b) Any excavation, drilling, tunnelling or other disturbance of the land;
(c) Any destruction of, damage to or disturbance of the habitats of plants or animals in, on or under the land;
(d) Any deposit of any pollutant in, on or under the land; or
(e) Any entry of any pollutant onto, or passing across, the surface of the land.

Any person who fails to comply with the terms and conditions of a licence shall be guilty of an offence and if convicted, shall be liable to a fine not exceeding RM30,000 or imprisonment for a term not exceeding one year or both. Section 58 makes any offence under this Enactment a compoundable offence.

Under Section 60, the Minister may provide rules for the following:

(a) The establishment and management of any environmental protection area;

(b) Prescribing licensing scheme and fee for any prescribed activity which has or is likely to have an adverse effect on the environment;

(c) Prescribing environmental standards for air, water and soil or permissible noise, and the measurement and control of each standard not inconsistent with the provisions of any regulation or rules made under any written law;

(d) Prescribing rate and procedure for imposition of any product fee, effluent fee, emission fee, user fee or waste disposal fee;

(e) Any use of land, cultivation of land and the methods used thereof, earthwork, hill cutting or land reclamation;

(f) Cutting of trees, clearing or destruction of vegetation or setting fire in any land;

(g) Any activity relating to any sewage line, waste water treatment plant, incineration plant and waste landfill and on the design, operation and maintenance of such line or plant; and

(h) Any activity relating to the excavation or altering of any geographical or geological feature;

It appears that the Director of the Environmental Protection Department (EPD) has considerable powers under the Enactment to take preventive measures to ensure that development on slopes do not cause any adverse impact. The submission of an EIA and Mitigative Measures reports can be powerful tools to ensure that the risk of failure of slopes is reduced. The state's adoption of the 20 degrees gradient as the benchmark for the EIA/Mitigative Measures reports introduces certainty into development policies. It would be interesting to know how strictly this policy is followed and what exceptions have been made, if any.

3. <u>Land Ordinance 1930</u>

The Sabah Land Ordinance deals with the rights to property by individuals or companies. Title rights given to any person is only for the right to use the surface of the land. The title holder does not have any rights to the extraction, removal or transportation of minerals or anything below the surface of the land including the removal of any soil, earth or other materials beyond the boundaries of the land. The Land Administrator has free access at all reasonable times to any alienated land. The owner of the land shall not commence any development or change the use of the land without the permission of the Minister. Broadly, under this Ordinance, land that is not alienated or otherwise reserved for specific purposes, e.g., forest reserve, is state land. Under Section 26, rivers, seashore and ridges of hills are reserved as well. Part IX of the Ordinance provides for penalties for trespasses or unlawful occupation of state land.

The Ordinance provides controls for the regulation of the development of any land. No land may be developed without the approval of the Land Administrator who may impose conditions to ensure that there are adequate protection against landslides and soil erosion. The latter also has free access to any alienated land for the purposes of carrying out inspections, which would be useful for the maintenance of hill slopes and during landslips.

4. <u>Water Resources Enactment 1998</u>

Soil erosion and landslide may be controlled, prevented and mitigated by adherence and compliance with the provisions under the Water Resources Enactment which concerns the State water resources and all matters connected therewith.

The Water Resources Enactment generally provides for provisions on the following matters:

(i) Management of the State's water resources;

(ii) Development, implementation and monitoring of catchment management plans including floodplain, surface water and groundwater management plans; and

(iii) Mitigation and control of floodwater.

The Yang di-Pertua if, on the advice of the Director, is satisfied that an area of state land, which may include state land within a forest reserve, requires specific protection to ensure a source of water, or water resources in a particular water body or locality is adequately protected may declare a water protection area. When this is done, such land shall not be alienated under the Land Ordinance and prohibited from any construction, plantation and clearing activities being carried out.

Land within a water protection area is subject to the control of the Director, except that any land within a forest reserve, which is included in a water protection area, shall be subject to the control of the Director of the Forestry Department.

Section 32 provides that any activities involving unlawful removal of materials from any land of an area forming the bed, banks of a water body, river and shore reserves shall be in contravention of this Enactment and may be impounded by order of the Director of the Water Resources and shall amount to an offence under the Enactment.

Activities in or on water bodies which may cause or lead to soil erosion and landslide are regulated and controlled by provisions under Part VII of the Enactment to protect the quantity and quality of water, its aquatic environment and safety.

5. <u>Sabah Minerals Ordinance 1960</u>

5.1 Mining activities in Sabah are regulated by the Ordinance. Under this Ordinance, no one shall mine upon any land, river, stream, lake, pond, watercourse or the foreshore and seabed within Sabah without a licence. The State has enacted the Minerals Enactment 1999 which is not in force yet.

Like water, mineral resources belong to the state. Therefore, approval and issuance of exploration licences and mining rights are decided by each state in consultation with federal agencies such as the Minerals and Geoscience Department and Department of Environment.

The Mining Ordinance provides that no person shall in the course of mining operations, alter or interfere with the bank or any river, stream, watercourse without permission form the Inspector of Mines or Director of Land and Survey. If any such unauthorised alteration or interference takes place, then that person shall be ordered to restore the same to its condition prior to the alteration or interference.

5.2 A prospecting permit or licence shall convey to the holder or licensee no right to interfere with the flow or with the banks of any river, creek, stream, watercourse or the sea shore or to undertake any work within five chains of any public railway, road, canal, navigable river, reservoir, irrigation work, aqueduct, building, garden or burial ground without the consent in writing of the Director and in accordance with such terms and conditions as the Director may impose.

It shall be lawful for the Director with the approval of the Minister to grant permits in the form of the First Schedule to prospect state land for metals or minerals on payment of such fee as may be prescribed.

5.3 Every application for a lease of land for mining purposes shall be made to the Director in the form for applications for land prescribed by the Land ordinance, and shall be dealt with as prescribed in such ordinance.

Every lease of land for mining purposes shall be subject to the provisions of the Land ordinance except where the same are inconsistent with the provisions of this Ordinance or with the terms of the lease. The Ordinance requires that the leasee carry on his mining operations in an orderly, skilful and workmanlike manner so as not to cause danger or damage to persons to the owners or occupiers of other lands.

Section 23 provides that property in and control of all rivers, creeks, streams, watercourse and the sea shore below the high water mark is reserved to the state land, and no person shall in the course of mining operations interfere with the bank of any river, creeks, stream, watercourse or sea shore without the consent in writing of the Director and upon such terms and conditions as the Director may impose.

6. <u>Local Government Ordinance 1961</u>

The Ordinance governs the setting up and operations of local authorities in the state. The various types of authorities are district, municipal and town councils, all of which would be declared and established under the Ordinance by the Minister. The functions of the local authorities include, among others (relevant to slope management):

a) Regulate and control all buildings and building operations and the repair and removal of ruinous and dangerous buildings and subject to any written law relating to town planning, prohibit the erection of a building of a particular class, design or appearance in particular districts, localities or streets or portions of streets;

b) Abate or remedy a nuisance. Nuisance is defined in the Ordinance as any act, omission or thing occasioning or likely to cause injury, annoyance, offence, harm, danger or damage to health or property and which affects the safety or rights of inhabitants at large. In the event the owner cannot be found or refuses to comply, the Authority may remedy the nuisance and recover the costs from the owner. If the nuisance emanates from acts committed outside the local authority area but impacts on inhabitants within the local authority, then the latter may act as if the act of nuisance is coming from within its jurisdiction.

The local authority has powers to enter and inspect any property with proper notice being given. If the owner cannot be found or the premises is unoccupied, the authority may post the notice and enter the premises pursuant to the provisions of the law. The authority may close (from occupation) or demolish any building if the latter is found to be in ruinous state and a danger to inhabitants.

It must also be noted that under the Town and Country Planning Ordinance, the local authorities are designated as the planning authorities for which any development of land has to be considered and approved by the local authorities. They are also required to draw up and implement the various Draft Plans and Local Plans for the local authority areas.

The general penalty for any person who is guilty of any offence against this Ordinance or any by-laws, for which no penalty is expressly provided, is a fine not exceeding RM10,000 or to imprisonment not exceeding two years or to both such fine and imprisonment.

7. Town and Country Planning Ordinance 1950

The establishment of the Central Town and Country Planning Board is stipulated in Section 3 of the Town and Country Planning Ordinance Cap.141 (TCPO). All major departments are members of the Board including the Environment Protection, Department of Irrigation and Drainage, Forestry, Public Works Department and Lands and Survey.

The Policy on Hill Slope Development seeks to strengthen the existing Town and Country Planning Ordinance by making it mandatory for land developers to adhere to guidelines for development on hilly areas when planning and implementing development activities on hill slopes.

The Draft Scheme shall be called Integrated State Planning Scheme (Structure Plan 2020) and herein after shall be referred to as the Structure Plan. The Sabah Structure Plan 2020 shall be prepared under the provision specified in the First Schedule [Section 1 (I)] of the Town and Country Planning Ordinance Cap. 141. The Structure Plan Area shall cover the whole State, including the territorial waters.

The Sabah Structure Plan 2020 is undertaken in accordance to the Planning objective of Town and Country Planning Ordinance Cap. 141, among others, to make provision for the orderly and progressive use and development of land, whether urban or rural, including the territorial waters of the State.

The Board meets on a monthly basis to undertake its functions as described below:

Consideration of Draft Planning Schemes

To consider all schemes submitted to it by local authorities and to make recommendations thereon to Yang Di-Pertua Negeri. This function is described in detail in **Section 9** and **Section 10** of the Town and Country Planning Ordinance Cap. 141. The Draft Schemes are equivalent to the Draft Structure Plans in Peninsular Malaysia.

Adviser to the Yang Di-Pertua Negeri

To advise the Yang Di-Pertua Negeri generally on the development of land (including territorial waters) within the state.

Supervision and Control of Local Authorities

To supervise and control local authorities in the exercise of powers and duties conferred and imposed on them by the Town and Country Planning Ordinance Cap. 141.

Preparation of Regulations Relating to Preparation of Draft Schemes

With the approval of the Yang Di-Pertua Negeri, the Board makes regulations for the procedures to be followed in connection with the preparation of Draft Schemes and the things mentioned in the Second Schedule of the Ordinance.

Development Control

The Department of Town and Regional Planning functions as the Secretariat of the Board with its Director functioning as the Board Secretary. The Director also functions as the adviser and the chief executive officer of the Central Board. In this capacity, the Director's function shall include:

a. Carrying out such duties as may be delegated to him by the Central Board;
b. Conveying to local authorities the decisions, instructions and recommendations of the Central Board; and
c. Advising local authorities on the preparation of draft schemes.

The Director shall also provide such technical assistance to the local authorities as he may deem necessary to assist them in carrying out their functions and duties under the Town and Country Planning Ordinance (Cap. 141).

It appears that the Town and Country Planning Ordinance would be a powerful tool to implement state-wide policies to regulate and control development on hill slopes so as to prevent landslides. The state of Sabah has in fact adopted strong policy on the protection of steep hill slopes.

8. State Policy on protection of steep hill slopes (Environmental Input for the Sabah Structure Plan 2020)

8.1 Among the various states in Malaysia, Sabah appears to be the only state that has considered and adopted a policy on the protection and management of hill slopes. This policy aims to maintain the integrity of the hill landscape in Sabah by the application of effective legislation and enforcement, and regional land use planning schemes for all important hill areas. It seeks to ensure proper planning and implementation of hill slope development activities so that the environment, landscape and surrounding settlements are not affected by the detrimental impacts arising there from.

Hill slope development activities shall be based on the following principles:

(i) Hillside scenery constitute an important part of the cultural and physical landscape of Sabah and as such are an integral part of the state heritage, yielding benefits locally, nationally and internationally, both for the present and future.

(ii) It is the responsibility of all sectors to maintain the hillside landscape of Sabah and ensure that it is prudently managed and developed.

(iii) Development on hill slopes must be planned and guided by the natural environmental setting - let the site influence the plan.

8.2 The objectives of the policy include:

(i) To strengthen the present framework for control and management of development on hill slopes

(ii) To ensure that all government agencies and the public are aware of and adhere to existing regulations, requirements and procedures

(iii) To identify the key issues, geographical locations and stakeholders involved in hill slope development

(iv) To prepare land use planning schemes and local plans for all important hill areas in the state

(v) To strengthen cooperation and management of hill slope development activities

8.3 The policy recognises that there is a need to better manage and control construction activities on hills to reduce environmental impact and to reduce loss of lives and property. Future management decisions on hill slope development should be based on the principle of sustainable development because of the unique values associated with hill slopes, which makes them a natural resource in their own right. Strategic planning with visual, conservation and recreational values can provide clearer directions for future uses and management.

The policy on hill slope development will help to ensure that such management decisions are implemented on a state-wide basis. Some controls on hill slope development can been found in some legislative controls administered by various government agencies. They include:

(i) The requirement to obtain the written approval from the city/municipal/local district council of the Development Plan under Section 23 of Land Ordinance 1930 and Land Rule 3(2)

(ii) The requirement to obtain approval from the Central Town and Country Planning Board to rezone the land on which construction will be carried out under Part I, Section 3 of the Town and Country Planning Ordinance 1950

(iii) The requirement to obtain EIA Approval from the Environmental Protection Department (EPD), Sabah to carry out construction activities on hills with slopes having gradient of 20 degrees or more.

It is noted that generally, the approvals for hill slope development are issued on a piecemeal basis and little attention has been given to the cumulative effects.

8.4 Major adverse environmental impacts of hill slope development identified in the policy are:

(a) Slope Erosion
Site clearing during earthwork results in the removal of vegetation and the creation of cleared surfaces, which become vulnerable to the erosive action of rain and surface runoff.

(b) Slope Stability
Development activities on hills may weaken natural slopes that have been stable for years. Slope cutting, earthwork and filling up and alteration of drainage patterns may change the stability of the soil and slope.

(c) Landscape impacts
The impact on landscape is the direct physical change to existing landscape features such as vegetation, topographical, geomorphological features and recreational facilities as well as buildings and structures.

Other adverse environmental impacts of hill slope development include loss of ecological habitat, noise from construction and transportation activities, vibration associated with piling, vehicular movement and blasting, dust and atmospheric pollutants from machinery and transport vehicles and wastewater and solid waste disposal.

8.5 The policy will be guided by the following strategies and action plans:

Strategy 1: Strengthen the present framework for control and management of construction on hill slopes (Development Plan level)

Action Plans:

(i) Enforce existing regulations and guidelines related to construction on hill slopes

(ii) Strengthen the existing Town and Country Planning Ordinance by making it mandatory for land developers to follow guidelines for development in hilly areas when planning and submitting development plan proposals

(iii) Strengthen the implementation of the Conservation of Environment (Prescribed Activities) Order and the accompanying guidelines for construction on hill slopes

(iv) Promote coordination in the implementation of hill resources management between the different units managing, controlling and enforcing regulations on construction activities on hill slopes at district and state levels

(v) Conduct seminars and other relevant information dissemination activities for all relevant government agencies personnel on regulations, requirements, procedures and criteria when processing and approving development plan proposals

Strategy 2: Enhance awareness on the present regulations, requirements and procedures for development on hill slopes

Action Plans:

(i) Conduct seminars and road shows and use mass media, pamphlets and booklets to inform land developers and the public on the regulations, requirements and procedures when planning and submitting development plan proposals for approval

(ii) Create awareness among land developers that construction on hill slopes might have adverse downstream effects and that they must do their part in reducing the negative impacts downstream and on adjacent land users. Land developers and the public should be made aware of the need that construction on hill slopes should be implemented without destroying the unique characteristics of the hills. The policy of 'let the site influence the plan' shall be adopted.

Strategy 3: Improve the knowledge database

Action Plans:

(i) Conduct studies to (a) document existing construction on hill slopes and their impacts on the environment, including slope stability, erosion and landscape impacts, (b) cut and fill activities, (c) agricultural activities – both shifting and permanent (d) identify catchment areas or hills with high ecological and landscape values where current or past development are/had taken place and take immediate action to conserve these areas, and (e) determine the development capacities of hills which are currently being developed. If the carrying capacities have been exceeded, take immediate action to restrict and control new constructions

(ii) Promote international, national and local collaboration on issues related to hill slope development.

Strategy 4: Prepare land use planning schemes and local plans for all important hill areas (planning – zoning - level)

Action Plans:

(i) Review existing land use planning schemes and local plans covering critical hill areas and update accordingly to be in line with the policy

(ii) Prepare new land use planning schemes and local plans for all hill areas with priority given to hills, which have potential to be developed. Land use planning schemes and local plans for hill areas have to be evolved with an area basis perspective, shall take into consideration the water catchment basis and must be prepared using an integrated approach taking into account conservation issues vis-à-vis development needs, thereby ensuring compatibility between conservation of hill natural resources and construction activities on hill slopes. The planning of hill areas shall be carried out in an integrated and coordinated manner between all agencies involved.

(iii) Ensure that land use planning schemes and local plans prepared are fully implemented and enforced

(iv) Take action to gazette hill areas which have been identified to be conserved

(v) Amend or enact new regulations to manage and control construction activities on hills where necessary, for example, legislation that specifies type of construction allowed and low-impact facilities, forbids high-rise structures on hills, limits density, demarcates sensitive hill areas that requires Special EIA, make developers put down a good behaviour bond to ensure that they take adequate care of the environment and make good any damage the development causes.

Strategy 5: Strengthen institutional implementation framework (implementation level)

Action Plans:

(i) Set up an inter-agency working group for hill development. This working group will be responsible for integrating all resource planning and setting state priorities

(ii) Identify the potential for reallocation of resources and seek new and additional sources for the implementation of the strategies of the policy on hill slope development.

ANNEX 5:

REVIEW OF LAWS RELATED TO SLOPE FAILURE IN SARAWAK

1. Forest Ordinance 1958

1.1 Land, forests and wildlife are matters of concern of the state. Sarawak Forestry is about the management and conservation of forests in Sarawak which includes matters such as forest sustainability, biodiversity conservation, strategic planning and land use. Sarawak has extensive protected areas which include forests, national parks and wildlife sanctuaries.

1.2 Sarawak Forestry is regulated by forest policy and legislation such as the Forest Ordinance 1958, National Parks and Nature Reserves Ordinance 1998, Wild Life Protection Ordinance and Rules 1998 and Planted Forests Rules of Sarawak 1997. These are complemented by other related federal and state legislation which play a role in the protection and conservation of forest in general. The Forestry Policy of Sarawak aims to protect the climate and physical condition of the country, prevent against damages of flooding and erosion and safeguard soil fertility and water supply.

1.3 The Forest Ordinance enables forest reserves to be established and preserved for the prevention of loss of biodiversity and the managed exploitation of resources. State land forest may, under **Section 3,** become a forest reserve by notification in the gazette. Any activity in such forest is prohibited without the prior written approval of the Director.

1.4 **Section 21** provides that no person shall in a forest reserve:

(i) Trespass;
(ii) Fell, cut, ring, mark, lop or tap any tree, or injure by fire or otherwise any tree or timber;
(iii) Cause any damage by negligence in felling any tree or cutting or dragging any timber;
(iv) Quarry stone, burn lime or charcoal or search for, collect or remove any forest produce or minerals;
(v) Erect any building, or clear or break up any land for cultivation or for any other purpose; or
(vi) Kindle, keep or carry any fire or leave any fire burning.

1.5 Under **Section 25**, state land may be classified as protected forest. **Section 36** prohibits a person from carrying out the following activities on protected forests:

(i) Erect any building, or clear or break up any land for cultivation or for any other purpose;
(ii) Fell, cut, ring, mark, lop or tap any tree, or injure by fire or otherwise any tree, or remove timber, firewood or charcoal;
(iii) Take or remove any forest produce;
(iv) Cause any damage by negligence in felling any tree or cutting or dragging any timber;
(v) Quarry stone, burn lime or charcoal or search for minerals;
(vi) Kindle, keep or carry any fire or leave any fire burning; or
(vii) Commit any other acts of trespassing.

1.6 Besides the above **Section 67A (1) and (4)** provide some control and preventive measures pertaining to activities of felling and extracting timber. To further reduce the detrimental effects of forest harvesting on the environment, Sarawak has embarked on helicopter logging in the state since 1993. Helicopter harvesting is an aerial harvesting system whereby logs are lifted out vertically from the forest and flown to the roadside or drop zone. The use of helicopters provides a viable alternative harvesting system to the conventional ground-based system using crawler tractors. The advantages of this system in regard to protecting the environment are it reduces damage to surrounding trees and avoid exposure of ground surface due to skid trails. By using this system, less roads are required for transportation which means reduced activities of clearing the forest for roads.

The **National Parks and Nature Reserves Ordinance 1998** also offers some protection to the forest environment. **Section 26** of the Ordinance 1998 provides that no person without the permission of the Controller, clear any or break up any land in a natural park or nature reserve, destroy or remove any plants or prospect for minerals.

Wildlife is an important part of the Sarawak culture. The Sarawak Forestry Department is responsible for the administration and enforcement of the **Wild Life Protection Ordinance and Rules 1998**. The Wildlife Protection Ordinance provides for better protection of wildlife, establishment and management of wildlife sanctuaries and all matters ancillary thereto.

The Planted Forests Rules 1997 is a subsidiary legislation made under Section 95(1)(w) and (x) of the Forests Ordinance 1958 to regulate and administer matters related to planted forests. The development of such planted forests is regulated by licenses granted by the Director of Forests, with the approval of the Minister of Planning and Resource Management.

2. Public Park and Greens Ordinance 1993

The Public Park and Greens Ordinance makes provisions for the control and management of any special area of land to enhance the environment and the regulating of proper planning for the preservation and protection of green. The Ordinance could be used to gazette hilly land from being developed and preserved as parks.

3. <u>Mining Ordinance</u>

Like water, mineral resources belong to the states, therefore the approval and issuance of exploration licences and mining rights are decided by each state upon consulting with the federal agencies such as the Minerals and Geoscience Department and the Department of Environment.

The Mining Ordinance provides that no person shall in the course of mining operations, alter or interfere with the bank or any river, stream, watercourse without permission form the Inspector of Mines or Director of Land and Survey. If any such unauthorised alteration or interference takes place, then that person shall be ordered to restore the same to its condition prior to the alteration or interference.

4. <u>Land Code</u>

All properties in state land including all rivers, streams, canals, creeks and watercourses and the bed thereof shall vest solely in the government.

Section 209 clearly states that any person who unlawfully occupies or builds on any state land or clears, ploughs, digs, encloses or cultivates any such land, shall be guilty of an offence which carries a penalty of a fine of RM1,000 for first offence and RM5,000 and 2 years' jail term for second and subsequent offence.

The Land Code of Sarawak provides that all lands shall be subject to the right of the government to prospect for minerals and the right conferred to any person by any law relating to mining. The lands shall be held subject to an implied right that a holder of a mining lease or prospecting licence without means of access to the land over which mining rights have been granted, shall have a right of way over such land.

The Sarawak state also concerns itself with the matter of Native Customary Land (NCL) Rights. NCL rights are rights acquired by the indigenous people of land from their ancestors which lack documentation records of legal ownership. The

Sarawak Government also assists in preserving and developing NCL. Under **Section 4(3)**, the Director of Lands and Surveys may with the approval of the Minister, declare by notification in the Gazette, any land to be Native Area Land.

The State Planning Authority shall be established under **Section 228** to plan, regulate and control all matters of development and land and building use. The functions of the State Planning Authority include:

(i) To consider and approve plans for sub-division and land development;

(ii) To formulate policies and guidelines for local authorities and give directions to them on land use and development which includes improvement of the environment; and

(iii) To formulate policies and plans for development and re-development

The matters taken into consideration before an approval for sub-division is given include ensuring proper sewers and drains and the compliance with the requirements for the protection and improvement of the environment. It is possible that considerations related to slope management could be included as one of the issues to be considered by the State Planning Committee prior to any approvals being granted the functions mentioned above.

Section 230 provides that failure to comply with the approved plan or comply with any requirement imposed by the State Planning Authority shall entail a penalty of a fine of RM500,000 and for a continuing offence, a further RM1,000 every day during which the offence continues.

The Director may also issue an order to stop works and demolish any works which are not in compliance. Any person who fails to comply with the order shall be guilty of an offence and liable to pay a fine of RM500,000 and imprisonment for three years.

Section 239 empowers any person authorised by the Director to enter upon any land or building at all reasonable hours to carry out inspection, investigation, examination or survey which may be necessary to enforce the provisions herein.

5. Water Ordinance 1996 / Water Supply Ordinance

This Ordinance replaces the Water Supply Ordinance (Cap. 141). Generally, the Ordinance is intended to regulate:

(i) The conservation, protection, development and management of water resources of the state; and

(ii) The supply and distribution of water

The Water Ordinance applies to the state of Sarawak. The Sarawak Water Resources Council established under this Ordinance has the duty to, inter alia, broadly monitor the plans and actions of any government agencies or private agencies which may significantly affect the quality or quantity of the water resources and water catchment areas in the state.

Section 8(3)(a) allows the creation of a water catchment area to protect or conserve the water resources in any area within the state of Sarawak. Sungai Sarawak Kiri has been gazetted as water catchment area by G.N. 3120/93.

Penalty for any breach of the provisions under this ordinance is stipulated by Section 11(2) which consist of a fine of RM100,000 and imprisonment for 5 years.

6. Natural Resources and Environment Ordinance 1996

The Natural Resources and Environment Ordinance--through one of its leading agencies, the Natural Resources and Environment Board--protects and manages environmental quality and natural resources of the state such as the sources of water, aquatic life and plants in rivers and foreshores.

Rules, guidelines and directions for the protection and enhancement of the environment shall be provided by the Natural Resources and Environment Board under the Natural Resources and Environment Ordinance. Section 11 A (1) of the Natural Resources and Environment Ordinance stipulates the statutory requirements for EIA on development activities having impact on the environment. The following activities are specified as Prescribed Activities under the **Natural Resources and Environment (Prescribed Activities) Order** which may affect sources of water:

(a) Mining pursuant to any mining lease, certificate or licence issued under the Mining Ordinance, covering an area exceeding 50 hectares or involving use of any chemicals; and
(b) Open cast mining or prospecting for minerals likely to affect the landscape of the mining area so as to require rehabilitation upon cessation of mining activities.

Anyone undertaking any prescribed activities is required to submit an EIA and obtain approval of the relevant authority prior to commencing the same.

7. Minerals Ordinance 2004

The Mineral Ordinance generally deals with minerals and the activities of prospecting and mining thereof or any other matters related thereto. This Act does not cover mineral oil. Where relevant, the provisions of the Land Code apply to mining land and matters related thereto. The Land Code takes precedence over this Ordinance in the event there arises any conflict between the two.

All matters related to minerals, mining land and its activities are regulated and managed by the State Minerals Management Authority established under **Section 7** of this Ordinance. This Section also empowers the Authority to make rules to regulate its own procedures.

The Authority can call upon the Chief Inspector, Controller of Environmental Quality, the Director of Environment Sarawak and the Controller of Rivers to submit any report, study or investigation undertaken for any mining area, mine or effect of mining activities on the environment or the waters of any rivers in the state. By doing so, perhaps the activities and dangers of soil erosion, slope failure and landslides may be identified and prevented.

Prospecting and mining activities in, upon or under any land, river, stream, lake, pond, watercourse, foreshore or seabed are only permitted if a valid mining tenement has been issued. Upon consulting the State Planning Authority, the Authority may prescribe areas where no mineral tenement shall be granted.

Prospecting licences issued under this Ordinance are imposed with conditions for the licence holder to comply with. It includes submitting information and periodical activity reports, compensating for loss and damage to land and property, restoring the prospecting area to a safe state and to such environmental standards prescribed (**Section 23**).

With regard to mining activity, **Section 43** provides that no mining lease shall be granted for any area within the prospecting area unless a written consent of the holder of such licence has been obtained. The leasee shall only commence development work or mining on the land upon obtaining the approvals, if required, of a mine feasibility study under **Section 55**, mine rehabilitation plan under **Section 108** and an EIA required under the Natural Resources and Environment Ordinance (**Section 45**). Removal of materials such as forest produce, earth, coral and sand from the land are prohibited under **Section 53**.

The certificate or mining lease granted imposes conditions to ensure that the activities are carried out in a proper and safe way with much cognizance given towards protecting the environment. Any kind of activity that may alter or interfere with the banks of any river, stream or watercourse is prohibited unless permitted in a water licence or water permit or permitted in writing by the Controller of Rivers.

Anyone who carries out panning, prospecting or mining without a licence or lease under this Ordinance shall upon conviction be liable to pay to the Government a sum not exceeding five times the royalty payable in respect of any minerals unlawfully taken and a sum not exceeding three times the value of such minerals. Persons found liable for the aforesaid shall also be liable to pay for the related offence under this Ordinance which includes as follows:

(i) For conducting panning without a valid licence, a fine not exceeding RM10,000 or imprisonment for a term not exceeding one year or both;

(ii) For mining without a valid licence or lease, a fine not exceeding RM500,000 or imprisonment for a term not exceeding ten years or both;

(iii) For breaching term and condition of mineral tenement, a fine not exceeding RM100,000 or imprisonment for a term not exceeding five years or both; and

(iv) For unlawfully removing material such as timber, forest produce, plant, vegetable, animal, earth, rock and sand, a fine not exceeding RM1000,000 or imprisonment for a term not exceeding three years or both and to pay the value of thing removed .

8. <u>Sarawak Rivers Ordinance 1996 and Sarawak Rivers (Cleanliness) Regulations 1996</u>

The Sarawak Rivers Ordinance mainly provides for the control and regulation of traffic by water in ports and harbours or on rivers wholly within Sarawak and in the foreshore. There are about 35 major rivers in Sarawak gazetted under this Ordinance.

'River' under this Ordinance includes any port, river, channel or foreshore declared to be a river under Section 11. All matters pertaining to rivers are regulated by the Sarawak Rivers Board established under **Section 3**. The Board's functions to ensure that the rivers are safe and clean include:

(i) Plan and recommend to the government the development and improvement of the riverine transport system within Sarawak;

(ii) To take lawful, necessary and reasonable practicable measures to keep the river and port clean;

(iii) To make general investigations for preventing erosion of banks and shores by waves and currents and determine suitable methods to protect, restore and develop them;

(iv) To prevent obstruction of any river or watercourse; and

(v) To control and regulate traffic by water in ports and harbour or on rivers and in the foreshores within the limits of Sarawak.

The Board is responsible for protecting any river within the definition provided under this Ordinance. Its duties under **Section 12** include providing aids to navigation of vessels, pilotage services and ensuring safe navigation and the cleanliness of the river and its banks.

Rivers are also protected by controls and prohibitions under the Natural Resources and Environment Ordinance through the Natural Resources and Environment Board. The Board may also construct and maintain works on any land for the protection of foreshores and riverbanks against erosion and encroachment of sea.

The Sarawak Water Resources Council under the <u>Water Ordinance</u>, functions to promote the conservation, development and management of water resources in Sarawak and the related land-use and environmental issues.

The conduct of EIAs and the subsequent implementation of appropriate measures under the EQA is also an effective tool for the prevention, mitigation and control of erosion and landslides at riverbanks arising from development projects.

Sarawak Rivers (Cleanliness) Regulations are regulations made under the Ordinance. The Regulations govern and regulate matters of discharges or disposals into rivers and on measures to maintain cleanliness in rivers.

Useful and applicable guidelines are Guidelines on River Front Development by the Department of Irrigation and Drainage and Handbook of Environment Impact Assessment Guidelines by the Department of Environment.

9. <u>City of Kuching Ordinance No. 2/88 / City of Kuching North Ordinance No. 3/88</u>

Section 10 of the Local Authorities Ordinance 1996 states that the City of Kuching shall be administered by the Commissioner of the City of Kuching North as appointed under the City of Kuching North Ordinance 1988 by the Yang Di-Pertua Negeri.

The Commissioner shall have jurisdiction over the area of the City of Kuching North described in the Schedule of this Ordinance.

The local authority may from time to time make, amend or revoke by-laws where necessary to maintain the health, safety, quality of life and well-being of the inhabitants or for the good order and government in respect of the following:

(i) To regulate the repairing, cleaning, watering and lighting of streets, roads, canals and bridges;
(ii) To regulate the planting, preservation and removal of trees, flowers and shrubs in public places;
(iii) To provide for the protection from damage or interference of any local authority works or property within any public or private place within the local authority area;
(iv) To provide for the establishment, regulation and management of any public park to regulate the maintenance and upkeep of private

gardens, property or land and for the clearance of rank vegetation in any property;

(v) To control or regulate the removal of earth, sand, stone or rock.

10. Local Authorities Ordinance 1996

The power and authority for the local authority to act and perform duties shall be pursuant to and as stipulated by the provisions of this Ordinance. Any uncertainty in determining the exercise of these powers shall be clarified by the Majlis Mesyuarat Kerajaan Negeri through the related Minister.

The duties and responsibilities of the local authority under this Ordinance shall include the following:

(a) To carry out or assist in the carrying out of works ordered by the state government;

(b) To assist the federal and state government officers in carrying out their duties with regard to maintaining public roads, buildings and other facilities;

(c) To improve and maintain good and healthy standard of living for the people within its jurisdiction; and

(d) To enhance the environment and prevent pollution.

The local authority has jurisdiction and authority over public places within its area and has power to temporarily close the public places (**Section 100**), or with the approval of the Majlis Mesyuarat Kerajaan Negeri, permanently close any public place or alter the boundaries (**Section 102**). **Section 119** also puts the local authority to be responsible for public roads other than a federal road pursuant to Section 67 of the Road Transport Act 1987. Its responsibilities include maintenance of roads, drains, landscape, regulate and divert traffic, and do the necessary to ensure the safety and convenience of the public on any public road within its area.

Private roads on the other hand shall be laid, maintained and repaired by the owners or occupiers.

Under **Section 99** the local authority has control and care of all public places within its jurisdiction. This includes the protection and preservation of the greens under the Public Parks and greens Ordinance 1993.

The local authority is empowered under **Section 104** to prevent the occurrence of or for remedying any nuisance or condition which is likely to be injurious or dangerous to health. The definition of 'nuisance' provided under this Ordinance includes any act, omission or thing occasioning or likely to be injurious or dangerous to health or property. In the absence of any specific provision with regard to the involvement of the local authority in matters of maintenance of slope or slope failure and landslide, it may be necessary to state that any occurrence of soil erosion, slope failure or landslide may be taken to fall within the ambit of this section as amounting to nuisance, to empower the local authority to act therein.

The local authority's purview of duty with regard to matters of sewerage and drainage works is regulated by **Sections 132-138**.

11. Buildings Ordinance 1994

The Sarawak Building Ordinance applies in areas and to the extent as specified in the First Schedule. Under the Ordinance, the Planning Authority is responsible to regulate, control and plan all matters pertaining to the conservation, use and development of land and building.

This Ordinance does not allow any person to erect any building without approval by the competent planning A\authority of the site plan under Section 3 and the written permission of the local authority under Section 8 being obtained first.

The local authority may, on the advice, direction or instruction of the planning authority give directions to the person submitting a plan and specification for the following:

(i) The levels at which the foundation and lowest floor are to be laid;

(ii) The raising of level of the site to form a stable and healthy foundation and the materials to be used; and

(iii) The prohibition of building in an area on the ground where there is likelihood of danger or injury to health if erection of building is permitted.

Any failure of building due to misconstruction or lack of proper supervision during construction, misdesign or miscalculation or misuse by the responsible person shall entail a liability and penalty of RM50,000 and imprisonment for 10 years if found guilty (**Section 9**).

Any nuisance which may be dangerous or injurious to health and property is regulated and controlled under **Sections 28-32**. 'Nuisance' defined under this Ordinance is any act, omission or thing occasioning or likely to occasion injury, annoyance, offence, harm, danger or damage to sight, smell or hearing or which is likely to be injurious or dangerous to health or property.

The local authority may enter at all reasonable hours in the day time into and upon any building or land to survey or inspect for the execution of any work or for ensuring compliance of the provisions of this Ordinance. If the dwelling house is in actual occupation, then the local authority is required to give a 24-hour notice to the occupier.

Building and construction activities are also subjected to the Building By-laws provided in the Fourth Schedule under the Building Ordinance.

By-law 53 requires that the foundation of a building shall be safe and stable so as not to cause instability or damage to any part of the building or any adjoining building or works.

By-law 59 is relevant to protect the soil from erosion, slope failure or landslide. It requires damp subsoil of the building site to be effectively drained or such steps to be taken to effectively protect the building.

Protection to air-wells and open spaces in and around buildings are to be protected against soil erosion where necessary steps need to be taken to prevent accumulation of water or growth of unwanted vegetation which may hinder proper water flow.

The Buildings (Amendment) Ordinance, 1997 incorporates all the building by-laws and is implemented by the local authorities. As commonly known, where any construction of building also involves various department and authorities, applicability of other laws are inevitable. The planning authority works in cooperation with the local authorities. The Ordinance is said to help control the built environment, ensuring adequate minimum living standards and safety in all buildings in Sarawak. The Ordinance presents the best avenue for better slope management to be effected in the state.

12. <u>City of Kuching North (Earthwork) By-Laws 2002</u>

Under the Earthwork By-laws, submission of plans and specifications are required for the approval of the Commission before commencement of any earthwork (**By-law 3**). These By-laws, in its application and implementation of its provisions, gives due regard to the provisions of the Natural Resources and Environment Ordinance.

By-law 5 provides that the engineer appointed in a construction or building works is the person responsible for the proper execution of the earthwork.

Survey plans relating to earthwork are required to show information on matters pertaining to drainage, mainstreams, natural watercourses and earthwork methods. This information may be relevant to the management and prevention of slope failure and landslides.

There are provisions under the by-laws, which lay down requirements to ensure the safety of foundation works and which emphasize on adequate protection to adjoining properties. Safety measures include carrying out soil investigation, determination of water table in foundation earthwork, submission of a geotechnical report and design report.

Where any person fails to submit the plans, specifications and other particulars as required under the First and Third Schedules, fails to comply with directions and orders under these by-laws or contravenes the provisions of these by-laws, he shall, on conviction, be liable to a fine not exceeding RM5,000 and a further fine of not exceeding RM200 for every day of the continued offence.

ANNEX 6:

SUMMARY OF EXISTING LEGISLATION RELATED TO SLOPE MANAGEMENT IN PENINSULAR MALAYSIA

Title	Relevant Subsidiary legislation	Relevance to Slope Management
1. Waters Act, 1920	• Nil	• Protect and conserve rivers and water sources from degradation and pollution • Control over development in water catchment areas • Presently of not much relevance to slope management
2.Geological Survey Act, 1974	• Nil	• May be considered as a vehicle to implement better data collection on geology and hazard maps • Is relevant to current activities of the Slope Engineering Branch
3. The National Land Code, 1965	• State Land Rules	• Could be used to deal with illegal squatters. • Right of access to land when necessary • Classification of land – could introduce a new class for hilly land • To impose conditions related to slope management when there is an application for conversion of land • May impose conditions on any activity on hill land
4. Street, Drainage and Building Act, 1974 (as amended in 2007)	• Uniform Building By Laws 1984, as amended 2007	Authority over all developments related to building standards and design within municipal areas Drainage issues may be regulated Hong Kong GEO uses Building Code to regulate the development and maintenance of all buildings in the Territory. Similar standards and codes

Title	**Relevant Subsidiary legislation**	**Relevance to Slope Management**
		may be issued under Malaysian Legislation.
5. The National Forestry Act, 1984	• Nil	Not directly related but can be used to prohibit logging on hill slopes including uncontrolled/illegal activities in forest areas Certain forests on hill slopes may be declared as Soil Erosion Forests
6. The Environmental Quality Act, 1974	• Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987	• Generally requires most activities covering more than 50 hectares for an EIA to be conducted. • Guidelines on Soil Erosion has been issued. • DOE has required project proponents to take into consideration impact on slopes and mitigation measures to be built in.
7. Land Conservation Act, 1960	• Nil	• Specifically intended to regulate all activities on hill slopes • Hill slopes to be defined by Land Administrator • Allows the latter to impose controls on any development or activity on hill land • Also gives powers to Land Administrator to enter and remedy a potentially dangerous situation • Potential for this legislation to be reviewed and amended to enable better and more developed slope management practices to be implemented in accordance with the Master Plan • Cabinet directive have been issued for development on hill slopes
8. Town and Country Planning Act, 1976	• Various Guidelines have been issued under the Act. Implementation of these guidelines may vary from state to	• Deals with spatial planning. Hill land has been developed without much rules and guidelines.

Title	Relevant Subsidiary legislation	Relevance to Slope Management
	state.	• Guidelines have been issued for development of hill slopes in Sabah • Local plans and structure plans including development in hill areas are approved under this Law and the Local Government Act • Potential for better planning and standards to be imposed using this Law
9. Local Government Act, 1976	• Earthwork By-Laws • Establishment of local authorities • Parks By Laws • Draft Structure and Local Plans are approved by the local authorities as the planning authority	• Deals with all forms of earthwork including hill cutting • MASMA Guidelines has been adopted by Cabinet for implementation by all local authorities • Local authorities also have powers to: - approve development projects with proper terms and conditions - ensure maintenance of public/private properties - ensure safety of public - abate nuisance - enter into and access to all properties under reasonable circumstances • Slope agency will have to work very closely with all local authorities now and in the future and may have to continue to rely on the extensive powers under this legislation
10. Police Act, 1967	• Nil	• Police have general powers to take charge of any incident for public order and safety • Investigate, collect evidence, engage in search and rescue • Control access into and out of any disaster area • Charge, detain, investigate any person/act for criminal offences
11. Civil Defence Act, 1951	• Nil	• Act provides for the setting up of this voluntary force to act during times when the nation is faced with an hostile act

Title	Relevant Subsidiary legislation	Relevance to Slope Management
		• Recently they have been mobilised for natural disasters as a response team • The Act is being revised and updated – potential to use the new act for better response mechanisms
12. Fire Services Act, 1988	• Nil	• Act provides for the Fire Services Department to act in times of natural disasters.
13. Public Order (Preservation) Act, 1958	• Nil	Minister may proclaim any area to be in danger. CPO has powers of control and regulation over the area. Includes powers of requisition of movable and immovable property.

ANNEX 7:

SUMMARY OF EXISTING LEGISLATION RELEVANT TO SLOPE MANAGEMENT IN SABAH

Title	Relevant Subsidiary legislation	Relevance to Slope Management
Environment Protection Enactment 2002 (repealed and replaced with the Conservation of Environment Enactment)	• Prescribed Activities Order	Protects and conserves natural resources and safeguards the environment
Forest Enactment Sabah No. 2 of 1968	Contains eight subsidiaries • Date of Commencement • Forest Rules, 1969 • Imposition of Fee under rule 12 (3) • Forest (Prohibition of Export) Rules, 1982 • Imposition of Cess for Export of Sawn Timber under rule 12 (3) • Imposition of Additional Charge for Debt Redemption Trust Fund under rule 12 (3) • Imposition of Special Charge under rule 12 (3) • Notice of Investment of Powers under section 4 (3)	Not directly related but can be used to prohibit illegal logging and illegal squatters
Housing (Control and Licensing of Developers) Enactment, 1978	• Housing (Control and Licensing of Developers) Rules, 1980	To control housing developers especially those who are errant
Land Ordinance, 1930	• Land Rules • Appointments • Land (Temporary Planting Permit) Rules • Rent Revision Rules, 1958	Deals with illegal Squatters Preservation of river, seashore and hills
Local Government Ordinance, 1961	• Various rules have been made in relation to the establishment of municipal councils	Authority over all developments within municipal area including entry for safety reasons
Mining Ordinance, 1960	• Mining (Fees) Regulations, 1960 • Mining Regulations, 1969 • Mining (Inspector of Mines)	Control over mining in any area. Could be used to avoid soil erosion and mining activities on hilly areas.

Title	Relevant Subsidiary legislation	Relevance to Slope Management
	Regulations, 1976	
Parks Enactment,1984	• Kinabalu National Park Regulations, 1971 • Tunku Abdul Rahman National Parks Regulations, 1974 • Turtle Island National Park Regulations, 1979	Prohibits environmentally degrading activities within the parks
Town and Country Planning Ordinance, 1950 Sabah Cap. 141		Deals with spatial planning. Allows hill land to be developed in accordance with rules and guidelines. Guidelines have been issued for development on hill slopes.
Water Resource Enactment, 1998		Control over development in water catchment areas
Wildlife Conservation Enactment,1997		Deals with the protection of wildlife and their habitat
LOCAL AUTHORITY LEGISLATION		
Kota Kinabalu Municipal Council, 1982	Planning By-Laws	Local plans and structure plans including development in hill areas
	Earthwork By-Laws	Deals with all forms of earthwork including hill cutting
Sandakan Municipal Council, 1981	Earthwork By-Laws	Deals with all forms of earthwork including hill cutting
Tawau Municipal Council, 1982	Earthwork By-Laws	Deals with all forms of earthwork including hill cutting

ANNEX 8:

SUMMARY OF EXISTING LEGISLATION RELEVANT TO SLOPE MANAGEMENT IN SARAWAK

Title	Relevant Subsidiary legislation	Relevance to Slope Management
Natural Resources and Environment Ord. 1996	• Prescribed Activities Order	Protects and conserves natural resources and safeguards the environment
Forest Ord. 1958	• The Planted Forests Rules 1997	Not directly related but can be used to prohibit illegal logging and illegal squatters
Public Park and Greens Ordinance, 1993	• Nil	To establish and manage public parks and greens. Could be used to declare hilly areas as parks and greens.
Land Code	• Land Rules	Deals with all aspects of land administration including rivers, lakes and water resources. Land use approvals are given under this Ord. Also provides for customary land rights.
Local Authorities Ordinance, 1996	• Various rules have been made in relation to the establishment of municipal councils	Provides for the establishment of local authorities which have authority over all developments within municipal area including action against any act of nuisance.
Minerals Ordinance, 2004		Control over mining in any area. Could be used to avoid soil erosion and mining activities on hilly areas.
Building Ordinance 1994		Controls and regulates all buildings within the areas specified.
LOCAL AUTHORITY LEGISLATION		
City of Kuching North Municipal Council	Earthwork By-Laws	Deals with all forms of earthwork including hill cutting

ANNEX 9:

REVIEW OF INTERNATIONAL PRACTICES

HONG KONG

1. INTRODUCTION

1.1 Hong Kong has a history of tragic landslides with fatalities of more than 470 people. Today, through concerted action, the risk has been greatly reduced. Given the geographical nature of the territory, which is largely comprised of steep terrain and high intensity rainfall, the Government of Hong Kong has been proactive in the management of slopes in the territory. It is an accepted fact that the occurrence of landslides can never be prevented. On average, about 300 incidents affecting man-made slopes, walls and natural hillsides are reported in Hong Kong each year. A total of 57,000 slopes have been catalogued by the authorities in Hong Kong.

2. SLOPE SAFETY SYSTEM IN Hong Kong

2.1 Policy and Strategies Adopted by Hong Kong

The Hong Kong Government's overall policy objective is to maintain the highest standards of slope safety. It has managed to meet this objective and vision through a comprehensive Slope Safety System. The system commenced with the formation of a specialised section, namely the Geotechnical Engineering Office (GEO) of the Civil Engineering and Development Department (CEDD) in 1977. The Slope Safety System comprises of seven key strategies:

i) Improve slope safety standards, technology, and administrative and regulatory frameworks;
ii) Ensure safety standards of new slopes;
iii) Rectify substandard government slopes;
iv) Maintain all government man-made slopes;
v) Ensure that private owners take responsibility for slope safety;
vi) Promote public awareness and response in slope safety through public education, publicity, information services and public warnings; and
vii) Enhance the appearance and aesthetics of slopes

GEO, which was established in 1977, focused action and attention to the issue of slope safety. The systematic approach adopted by the GEO in effectively tackling the mandate given to it by the government is impressive. GEO's immediate strategy, upon its formation, was to mitigate the risk level of new man-made slopes. This was achieved by introducing statutory controls on all new development and working with the Buildings Department. GEO then catalogued existing slopes--some 57,000 sizeable man-made slopes and retaining walls in Hong Kong--and carried out a preliminary field inspection of all of them. This exercise resulted in the identification and assignment of responsibility for every slope and the prioritisation of slopes for remedial works. It then embarked on a Landslip Preventive Measures (LPM) Programme with an annual expenditure of about HK$900 million to upgrade substandard government slopes. A total expenditure of about HK$650 million is also spent each year by the maintenance departments to properly maintain all government slopes.

In May 1995, a Slope Safety Technical Review Board (SSTRB) was formed to advise the government on technical aspects of slope safety. Three board members were selected based on their high international standing in the geotechnical engineering profession, possession of appropriate knowledge and experience related to slope safety and with no involvement in commercial projects in Hong Kong. The Slope Safety System is reviewed regularly and benchmarked internationally through the SSTRB.

Other measures were adopted to achieve the strategies outlined above. GEO adopted a transparent and public-friendly approach to all its actions. A catalogue of slopes and the technical information it contains are publicly available on the Internet in both Chinese and English languages. All its guidelines and notices are available on the Internet free of charge. It has an ongoing and sustained public education campaign exhorting the public to be key stakeholders in the effort to promote land slide safety and reduce fatalities and injuries. Nothing that squatters appeared to be major victims in landslides, GEO started a programme to assess squatter villages located on slopes. The strategy was to clear critical slopes of squatter huts on safety grounds and to provide guidance to the residents of squatters on landslide risk and personal safety.

GEO has set up an extensive network of rain gauges throughout Hong Kong to provide real-time rainfall data for the issue of public landslip warnings. This programme is jointly organised with the Hong Kong Observatory which issues the warnings. GEO operates a 24-hour year-round emergency service manned by its officers. Detailed investigation of serious landslides are undertaken to continuously improve its knowledge and standards. In addition to enhancing the stability of slopes, GEO requires all slopes to look as natural as possible and blend with the surroundings.

The effectiveness of the Slope Safety System is indicated by the declining casualty rate. It is accepted by GEO that, due to Hong Kong's physical setting and pace of development, the risk of landslides can never be zero. GEO's strategy of working in partnership with all levels of society, i.e., with other government agencies, private owners and the general public, has shown positive results. GEO currently has a professional staff establishment of over 200 specialist engineers and scientists, who are supported by approximately 300 technical grade staff in geotechnical, civil, explosives, quarrying, laboratory, cartographic and works supervisory fields. In total, GEO has staff manpower of over 650 in a wide range of activities.

Hong Kong also has an effective Disaster Management System to respond to any major disaster. A contingency plan is in place with the functions and responsibilities of each department established with detailed operational instructions. The Security Bureau of the Chief Executive of Hong Kong is in charge of every major disaster. Emergencies are divided into three tiers with the first tier support being provided by the Fire Services, Police and Civil Aid Service. An Emergency Management Support Centre is maintained by the Security Bureau on a 24hour, seven day a week basis. GEO also has an Emergency Support Centre which is activated when a major disaster occurs. It would also appear that Land Slip Warnings are issued on a regular basis by the Hong Kong Observatory in consultation with GEO – no consultation is deemed necessary with the political level prior to the issuance of such warnings.

2.2 Regulatory Controls in Hong Kong

2.2.1 GEO is the main agency for on slope management in Hong Kong. However, it is remarkable that GEO itself does not have inhouse legislation to support its actions. It relies to a great extent on the following legislation, which is under the ambit of other agencies as indicated below:

a) Buildings Ordinance - Buildings Department;
b) Planning Ordinance - Planning Board
c) Lands Administration Ordinance – Lands Department

2.2.2 The main legislation in operation in Hong Kong that manages all development on land is the Buildings Ordinance. This Ordinance is administered by the Buildings Department. The main objective of this legislation is to ensure that the construction of all buildings in Hong Kong is undertaken in a safe manner without prejudicing the safety, security and convenience of the public. The vast majority of the 57,000 registered slopes in Hong Kong are man-made slopes and therefore fall under the ambit of this Ordinance. It is to be noted that registration of the slopes is **not** a legal requirement but is a task taken on by the GEO as part of its responsibility. Natural terrain, where there are no buildings, are controlled through the Land Administration Ordinance through stricter enforcement of lease conditions. Zoning of lands for various uses is undertaken through the Planning Ordinance which provides due consideration of he terrain of the land in its planning. However, it appears that a policy of "no terrain is too difficult to build on" seems to be adopted with stringent engineering and maintenance standards being adopted instead for such developments.

2.2.3 GEO exercises control at all stages of development through a system of auditing, orders, practice notes, guidelines and registration. All contractors, engineers, architects and consultants are registered and bound by a duty to perform their duties professionally. All new works will require its design works to be audited by GEO if necessary. GEO can submit a "In Principle Objection" certificate in which case the developer will have to show measures to mitigate landslide dangers. Prior to commencement of works, a commencement order has to be obtained. In the event of potential failure of existing hillsides, a Dangerous Hill Slope Order is issued, requiring the private owner to take appropriate measures to address the problem. The measures to be adopted must be approved by GEO. The landscaping of slopes has been made possible through an Order issued by the Environment, Transport and Works Bureau under the EIA Ordinance. The full powers of the Building Ordinance including 'cease works order' may be brought to bear on the works. Special areas, such as areas with special soil conditions or other unique features, could be declared as a "Scheduled Area" under the Ordinance upon which special conditions may become applicable for any works in that area.

2.2.4 The maintenance of government slopes is handled through administrative means with GEO's technical input. The departments are responsible for the maintenance of slopes under their control. These include departments with control over highways, parks and drainage areas. GEO acts as the technical advisor for any geotechnical works undertaken by government agencies. GEO plays an active role in the drawing up of land use planning. It would appear that there is close cooperation amongst all agencies. However, it should be noted that the structure of governance is Hong Kong is rather flat. The structure of administration is relatively straightforward as there is no state or local authority involved. There is consequently clear lines of authority and responsibility with little or no issues of turf management among agencies.

2.2.5 GEO, in carrying out its vast duties, has taken the logical step of allowing the industry to self regulate as much as possible. Thus, it is incumbent on the private owners of hill slopes to maintain their slopes. In the event of works, they have to engage professional engineers and draw up appropriate designs and carry out the works. GEO merely audits and approves. In the event of failure of works, it is incumbent on the consultants/contractors to rectify the problems and carry out remedial works at their cost. There is no blacklisting of such contractors/consultants as long as the works are carried out. Contractors/consultants are guided in everything they do through the numerous guidelines, practice notes and other material that are issued from time to time by GEO. These are available for free on the web. However, there is some grousing by the consultants that these detailed guidelines kill innovation and new ideas.

3. CONCLUSION

3.1 Hong Kong is one of the leading agencies around the world in terms of effective slope management practices and performance. Among the major conclusions and lessons that can be drawn from this visit are the following:(Anuri: I already did this write-up correction in the main sectoral report. Cut and paste it.)

a) The change in public perception of fatalities and their refusal to accept any tragic events was perhaps the prime mover of change in Hong Kong. It is with such backing that subsequent actions of the Executive became easier and more palatable to the legislature.

b) The creation of a specialised agency focused on geotechnical control of all major works laid the basic foundation for the system. The fact that it was part of a major engineering department did not deter it from carrying out its role and responsibility. There appears to be no conflict of interest nor hindrance to its performance;

c) The systematic approach to the problem at hand was another major factor towards the success. An assessment of the problem was first carried out in the form of identifying and cataloguing the slopes. A priority programme was then drawn up. All new works were made subject to geotechnical design audits. A programme was started for remedial works for slopes. Regular maintenance of slopes was not ignored.

d) The system is supported by appropriate regulatory controls – both formal and informal. It is remarkable that the key agency did not go out on a limb to have its own legislation. That the system has worked so well is partly due to the comprehensive (one stop) approach taken by one agency (the Buildings Department) to ensure that all technical inputs are obtained from all agencies before a project is approved. It is moot that there has been no incident where the input of the Geo has been rejected or overlooked by the Buildings Department. The role of the GEO is accepted/respected by the industry and legal authority does not appear to be an issue. However all orders, legal notices are issued by and under the Buildings Ordinance. The latter Ordinance itself does recognise the role of Departments such as GEO in the enforcement of the law.

e) The deliberate efforts made to ensure and encourage stakeholder participation in the management of the problem is a key factor in the success of the programme. Thus the industry is encouraged to self regulate itself. Registration of engineers and their professionalism is left to its peers. Almost all information is freely available to the industry. Investigation of accidents is contracted out to consultants. Active and effective public participation is encouraged throughout the planning process. The public are constantly being educated and encouraged to be vigilant and take measures to be safe. That these efforts are successful is shown by the long waiting list for the public to be accepted as volunteers in the Civil Aid Service of Hong Kong.

f) There is sufficient budgetary funding being allocated for both new capital works, maintenance works and public education and awareness campaigns;

g) There is a great deal of transparency of all actions being taken by the GEO and other agencies too. Public access to information is undeniably better than in almost all agencies in Malaysia. This translates into better accountability for monies spent and more effective agencies.

h) Public education and campaigns is an important part of the overall strategy to reduce injuries and fatalities. It is considered as money well spent (on par with monies spent for physical works) as the occurrence of landslides cannot be totally eliminated by only engineering solutions. It is to be an ongoing programme targeted at a wide spectrum of the public.

INDIA

1. Landslides have been and still are a major and widely spread natural disaster in the hilly terrain of India including the Himalayas. Life and property are often put in danger. One of the worst tragedies took place at Malpa Uttarkhand (UP) on 11th and 17th August 1998 when nearly 380 people were killed in a massive landslide that washed away the entire village.

   Improper land use practices such as heavy tilling, agricultural practices and settlement patterns have contributed to creep and withdrawal of toe support in many cases. Deforestation, seasonal agricultural activities and increased settlement contribute to soil failure that eventually leads to landslide. Developmental activities such as construction of buildings, road cutting, embankments, cut and fill structures causing modification of natural slopes, blocking of surface drainage, loading of critical slopes and withdrawal to toe support equally promote vulnerability of critical slopes.

2. In India, the basic responsibility of disaster management lies with the state government. The Central Government, with its physical and financial resources provide the needed help and assistance to support relief efforts in the wake of major natural disasters. The dimensions of the response at the level of the national government are determined in accordance with the existing policy of financing the relief expenditure and keeping in view the gravity and requirements for relief.

3. Mitigation of disaster is wide-ranging in scope and complex in its relationship with government ministries and agencies. In the context of disaster management, legislative provisions that exist in India are in the form of:

   (i) Amendments to town/country planning acts and master plan area development rules

(ii) Land-use zoning in hazard prone areas and establishing techno-legal regimes

(iii) Incorporation of safety requirements in building by-laws of local bodies that applicable to new buildings and extensions of old buildings. Empowering local bodies to exercise control.

(iv) Legislation to upgrade hazard resistance of critical buildings for use and safety of large number of people – schools, hospitals, cinemas, congregation halls, water tanks, towers, telephone exchanges, fire stations, headquarters of police and administration.

4. There are four specific Indian standard codes related to cyclones and landslides. These are only guidelines and are not mandatory.

5. In India, a national core group has been constituted under the Chairmanship of Secretary, Border Management and consisting of the Secretary, Department of Science and Technology;Secretary, Road Transport and Highways; and the heads of Geological Survey of India and the National Remote Sensing Agency for drawing up a strategy and plan of action for mitigating the impact of landslides, provide advise and guidance to the state governments on the various aspects of landslide mitigation, monitor the activities relating to landslide mitigation including landslide hazard zonation and evolve early warning systems and protocols for landslides and landslide risk reduction. The government has designated Geological Survey of India (GSI) as the nodal agency responsible for coordinating and undertaking geological studies, landslide hazard zonation, monitoring landslides and avalanches, studying the factors responsible and suggesting precautionary and preventive measure.

6. 74th Constitutional Amendment (Twelfth Schedule)

Tasks in the functional domain of the Urban Local Bodies defined under The 12th Schedule of the 74th Constitutional Amendment Act of India 18 include the following:

(i) Urban planning including town planning

(ii) Regulation of land use and construction of buildings

(iii) Planning for economic and social development

(iv) Roads and bridges

(viii) Urban forestry, protection of the environment and promotion of ecological aspects

7. **Town and Country Planning Ordinance, Cap. 378 and National Land Use Planning Commission Act, 3/84**

This Ordinance is one of the two laws which are the basic laws with respect to organised and planned land uses. The Town and Country Planning Ordinance is the basic legislation enacted for the purpose of land use planning in urban or town areas. The purpose of land use planning is to ensure orderly development of land, and to protect the health and welfare of the public and the natural environment. Land may not be developed except in accordance with a land use planning scheme, where one is applicable, and without prior ‘planning consent’ from the relevant authority. Failure to abide by the scheme is an offence. Those uses which are not considered to be ‘development’ are listed in the Second Schedule to the Ordinance.

The Minister has the authority to make regulations regarding land uses within the planning areas. If it is necessary for the government to acquire land for a public purpose to conform to the scheme's requirements, the Minister has such authority and compensation for the loss is due to the owner/occupier.

JAPAN

1. Landslide disasters in Japan have occurred every year where the total number of deaths due to landslides is about half of those caused by earthquakes, including the catastrophic 1995 Kobe Earthquake.

   The Japan archipelago, which is often described as 'scar-laden islands', is geologically very unstable. Additionally, since the islands are located within the monsoon zone, they receive abundant rainfall. Coupled with early summer rainy spells and later typhoons, numerous landslides occur, resulting in staggering damages.

   Large and small landslides occur almost every year in nearly all regions of the world. Landslide disasters in Japan have occurred every year where the total number of deaths due to landslides is about one half of those caused by earthquakes, including the catastrophic 1995 Kobe earthquake. Since 1960, Japan has experienced a high level of land utilisation as part of the national polity. In particular, residential developments near and around large cities, reclamation of coastal regions, and construction of dams and highways have severely altered the existing topography (which is one of the major contributing factors that cause landslides). Due, in part, to this relationship, residents in general have a keen sense of awareness concerning landslide disasters.

2. In Japan, there are several laws that relate to landslides in aspects of prevention and emergency services.

2.1 **The Disaster Countermeasures Basic Act 1961** aimed to remedy inadequacies in the old disaster reduction framework and promote comprehensive, systematic efforts by the government to reduce disasters. It has five main thrust:

i) To clarify disaster reduction responsibilities and implement programmes to prepare for, provide emergency response to, and recover from disaster;

ii) To promote comprehensive administrative efforts towards disaster riskreduction;

iii) To promote systematic administrative efforts towards disaster management;

iv) To provide public financial resources to cope with disaster; and

v) To set out procedures for proclaiming disaster emergencies.

2.2 Other laws referred to in matters of disaster reduction efforts are the Disaster Relief Law and the Large-scale Earthquake Countermeasures Act.

2.3 The heads of Designated Government Agencies shall, when relief activities are deemed necessary, issue orders pertaining to supplies and their distribution. The prefecture governor may also order persons in the medical, civil engineering and transportation services to engage in activities related to Relief Activities. Persons engaged in relief activities who suffer injury, illness or death as a result of such activities shall be paid allowances as set forth in Government ordinance.

2.4 **The Meteorological Service Law 1952** contains provisions to ensure sound development of the national meteorological service through establishing a fundamental system of the service and thereby to contribute to the enhancement of public welfare by promoting the prevention of disasters, maintenance of safety of transportation, prosperity of industries, etc and at the same time to promote international cooperation in the meteorological services.

2.5 The law concerned with riverine erosion control contributing to flood mitigation or eliminating flood cause is **Sabo (Erosion Control) Law 1897.**

Many of the Sabo Law provisions deal with sabo facilities such as dykes and canal construction and restriction of harmful acts within the designated sabo area.

2.6 **The Landslide Prevention Law 1958** was enacted to execute landslide prevention works such as drainage andconduits and to manage the designated landslide threatened area with restriction of harmful acts. These works are carried out by the Minister of Land, Infrastructure and Transport when the works are big or require high technology.

2.7 Collapse of steep slope (above 30 degree by the legislative definition) is often caused by heavy rainfall with the largest number of victims. **Law for Prevention of Disaster due to Collapse of Steep Slopes 1969** was enacted to execute slope failure prevention works such as slope protection and retaining wall and to manage the designated danger area of steep slope failure with restriction of harmful acts.

SRI LANKA

1. The droughts during the dry seasons and windstorms, floods and subsequent landslides during the rainy seasons due to cyclones from the Bay of Bengal pose prime concern to Sri Lanka. Evidence shows that the frequency of landslide occurrences has increased in Sri Lanka over the years. The National Building Research Organisation (NBRO), which is the mandated institute for landslide hazard assessments, recorded around 136 landslides during 1986-87 period. In early June 1988, Sri Lanka experienced a devastating landslide, which caused over 300 deaths. According to Parliament Reports, approximately 225,000 people in ten districts were affected by floods and landslides that destroyed over 15,00 homes.

   Most of Sri Lankan landslides are caused by the percolation of rain water into the fractures of weathered rocks. The landslides are thus associated with accumulating and/or flowing water on or below the surface in mountainous terrains.

2. In May 2005, the Sri Lanka Disaster Management Act was enacted providing legislative and institutional arrangement for Disaster Risk Management establishing a powerful National Council for Disaster Management under the President and the Disaster Management Centre (DMC) as the lead agency for disaster risk management.

3. **Sri Lanka Disaster: Countermeasures Act (Proposed)** provides that disaster means actual or imminent occurrence of an event which endangers or threatens to endanger the safety or health of persons or destroys or damages any property, and this includes landslides.

   This Act is proposed to provide for:

(i) Establishment of the National Council for Disaster Management;
(ii) Establishment of the National Disaster Management Centre;
(iii) Appointment of a Technical Advisory Committee;
(iv) Preparation of disaster management plans;
(v) Declaration of a state disaster;
(vi) Award of compensation; and
(vii) Matters connected therewith or incidental thereto.

The Council established under this Act shall be responsible for direct policies and programmes with adequate publicity given to them; facilitate emergency response, recovery, relief, rehabilitation and reconstruction; promote public awareness; advise the Minister on guidelines; recommend allocation of fund and all related matters thereto.

The National Disaster Management Centre is established under the Ministry of the Minister and headed by a Director appointed by the Minister. Every ministry, government department and public corporation is to counter any disaster or impending disaster and submit a detailed Disaster Management Plan to the Centre.

4. **Disaster Management-International Level**

4.1 The Disaster Management and Information Programme, which was established in 2003, is a joint collaboration of the Green Movement of Sri Lanka and the Disaster and Development Centre in United Kingdom.

4.2 The legal division of the Green Movement of Sri Lanka aims to assist victimized communities of large development projects and avert misguided politically motivated action harmful to the environment. Based on this idea, the legal division of the Movement conducts the following activities:

- Legal aid mechanisms to educate people on environmental laws and to take legal action if and when necessary
- Awareness raising programmes conducted for the victimized communities and representatives of the environmental organisation about environmental problems in their area with a view to getting more details activities that are detrimental to the environment.

In the past, legal actions have been taken against unauthorised mining of graphite, disposal of garbage in forest reserves, destruction of tank bunds, pollution of rivers and lakes and construction of unauthorised roadways.

4.3 Sri Lanka became a party to the Tampere Convention on the Provision of Telecommunication Resources for Disaster Mitigation and Relief Operations of 1998 in January 2005.

The Preamble of the Convention recognises the essential role of telecommunications in humanitarian assistance and the need for its facilitation, and recalls the major legal instruments, such as respective Resolutions of United Nations and of the International Telecommunications Union, which prepares the way for the Tampere Convention.

4.4 Sri Lanka Institute for Development Administration (SLIDA), one of the founding members of the Asian Disaster Mitigation Training Network (ADMIT), and Asian Disaster Preparedness Centre (ADPC) signed a MOU on 3 January 2000 to promote cooperation between the two institutions in developing and delivering courses in disaster management at local, provincial, national and regional levels in Asian countries.

AUSTRALIA

1. The risk posed by landslides is assessed for a one in 1,000 rainfall event. Significant risk is posed to people living on slopes greater than 25 degrees, while on slopes less than that, the risk is significantly lower. Also, areas with unstable soil types will be more susceptible to landslides. As a result of this, significant blockage and/or destruction of roads is expected.

2. With regardx to landslide mitigation, guidelines for the control of slope instability within the city of Gold Coast were developed by the Council to encourage good hillside practice to be included in building design. The planning scheme also provides hazard rating information on development on steep slopes and unstable soils.

3. Emergency management in Australia involves a mix of prevention, preparedness, response and recovery activities and risk management and relies upon an active partnership between all spheres of government, the private sector, non-governmental organisations and the general community, including hundreds or thousands of trained volunteers.

4. Under the Australian Constitution, the primary responsibility for the protection of life and property rests with state and territorial governments as they exercise control over most of the functions which are necessary for effective disaster prevention, preparedness, response and recovery. Each of these state and territory governments has developed counter-disaster arrangements, operates emergency service agencies and coordinates related activities through emergency/disaster management committees. These emergency service agencies rely heavily on the support of trained volunteers who provide services such as search and rescue, fire-fighting and medical care.

5. The Federal Government takes responsibility for providing guidance and support in developing state and territory capacity for emergency management and to provide requested assistance in the event of a major emergency when state or territory resources are inappropriate, exhausted or unavailable. Such assistance is coordinated through Emergency Management Australia (EMA), located in the Attorney-General's Department. Whilst the Federal Government remains an active participant in emergency management and civil defence, its role has shifted more towards directed financial support, the development of national education and training programmes, policy development and national coordination as the states and territories have become increasingly self-sufficient in responding to disasters. The Federal Government also provides specialised assessment, warning and monitoring services for meteorological and geological hazards.

6. Australia's 750 local government authorities also play a key role due to their close links with the communities they serve. Non-governmental organisations, such as Red Cross, St. John Ambulance Brigade, and the Salvation Army, are an essential component in Australian disaster response/relief arrangements and in supporting communities in the disaster recovery phase. As the focus of disaster mitigation strengthens, Australia's emergency management family is expanding to further recognise the important roles played by the private sector and professional institutes in developing and implementing mitigation plans and strategies.

7. Six of the states and territories have enacted disaster management legislation. The Australian Capital Territory has draft legislation awaiting government consideration, and Western Australia has administrative arrangements for emergency management and is currently examining options for legislation. All states and territories have well-developed plans and procedures in place, which are approved by respective peak emergency management committees and these are supported by plans and arrangements at regional and local government levels.

8. In recognition of the challenge between development pressures and landslide hazard, in the year 2000 the Australian Geo Mechanics Society (AGS) published a benchmark technical paper called "Landslide Risk Management Concepts and Guidelines" (AGS, 2000),which significantly updated an earlier 1985 guideline. The purpose of AGS (2000) was to establish uniform terminology, define a general framework, provide guidance on risk analysis methods, and provide information on acceptable and tolerable risks for loss of life. It represents a continued recognition by AGS of the pragmatic benefits of incorporation of the concept of risk in the assessment of potential landslides, particularly in planning and management situations. AGS (2000) was the culmination of a seven-year review that was in response to increased appreciation in Australia and internationally of the benefit of a risk management approach to landslide assessment and management, and was recognised in the report of the Coroner's Inquiry into the 1997 Thredbo landslide. Whilst AGS (2000) presented concepts and guidelines to assist practitioners, there remained a need to provide supplemental information to further assist practitioners, but to also assist regulators and provide advice to the broader Australian population. This was recognised by the SCCG and in turn by the NSW and Commonwealth governments through the National Disaster Mitigation Programme.

ANNEX 10:

LIST OF LEGISLATION AND CURRENT REGULATIONS RELATED TO SLOPE MANAGEMENT IN PENINSULAR MALAYSIA

Legislation	Lead Agency / Stakeholders	Relevant Provisions

1. Waters Act, 1920	• Lead: District and Land Office
	• Other Stakeholders:
	  • Department of Drainage and Irrigation
	  • State Secretary
	  • Department of Environment
	  • Local Authority
	  • State Water Authorities
	  • Public Works Department
		• Sec. 2 – river banks shall be restored to their original condition
		• Sec. 3 – rivers are under the control of state and where lands are held by the government, such control exercised by head of such department under the direction of state authority
		• Sec. 6 – presumption of interference by owner adjoining the bank of river
		• Sec. 7 – no diversion of water from any river except with a licence granted by the district officer with state authority approval
		• Sec. 14 – no revetment, structure or building to be constructed within 50 feet of river bank or within flood channel

2. Geological Survey Act, 1974	• Lead: Mineral and Geosciences Department
	• Other Stakeholders:
	  • Department of Environment
	  • District & Land Office
	  • Mines Department
	  • Local Authority
	  • Town & Country Planning
	  • Public Work Department
		• Sec. 3 – Director General of Geological Survey, Deputy Director General and other officers be appointed to implement provisions under this Act. The Director General may authorize in writing any person to conduct geological survey in his behalf.
		• Sec. 4 – the Minister may from time to time, give directions to the Director General
		• Sec. 5 – Director General may authorize any gelogical survey officer to undertake consultation, analysis or other service for anyone upon obtaining approval of land proprietor/occupier
		• Sec. 6 – designate areas for geological survey
		• Sec. 7& 8 – power to enter land with 14-day notice to land proprietor, occupier, leasee and carry out necessary works to conduct geological survey
		• Sec. 11-14 – require any person prospecting, developing wells and excavating land to notify the DG of the activities carried out and anyfossiliferous material found

Legislation	Lead Agency / Stakeholders	Relevant Provisions

3. The National Land Code, 1965	• Lead: District and Land Office
	• Other Stakeholders:
	  • Town and Country Planning Department
	  • Department of Environment
	  • Department of Drainage and IrrigationPublic Works Department
	  • Mines Department
	  • Survey Dept.
		• Sec. 6 – the Director General of Lands and Mines is appointed under the Federal Lands Commissioner Ordinance 1957 to carry out functions under this Act. The Yang di-Pertuan Agong appoints the Deputy Director General, Assistant Director Generals and other officers deemed necessary.
		• Sec. 7 – Minister may by gazette delegate to the Director General powers under this Act, subject to conditions and restrictions, but excluding power to make orders
		• Sec. 12 – state authority may appoint a State Director of Lands and Mines, Registrar of Titles and Director of Survey for the State. Other appointments include Deputy Directors, Assistant Directors, Deputy Registrars, Deputy Directors of Survey, District Land Administrators, Survey Officers and other officers deemed necessary.
		• Sec. 13 – state authority may by gazette delegate powers to ahe State Director, Registrar, Land Administrator, other officer appointed under Section 12, except the power to make rules and dispose land stipulated therein
		• Sec. 62 – land areas may be gazetted for public purpose and restrictions imposed
		• Sec. 57 & 58 – authority has right of access and use over alienated land to inspect, use and maintain drainage system
		• Sec. 122 – allows authority to impose conditions on land alienated for “buildings or industry” including area or proportion to be built on and type, design, height and structure of building.

4. Street, Drainage And Building Act, 1974 (as amended in 2007)	• Lead: Local Authority
	• Other Stakeholders:
	  • Town and Country Planning Department
	  • Department of Environment
	  • Department of Drainage and Irrigation
		• Sec. 4 - the local authority is responsible for maintaining and repairing public streets
		• Sec. 50 – local authority to construct and maintain drains and water courses
		• Sec. 70 – no new building shall be erected without written permission of

Legislation	Lead Agency / Stakeholders	Relevant Provisions
	• Public Works Department • Sewerage Services • Department of Occupational Safety and Health • Construction Industry Development Board	the local authority • Sec. 70A – controls earthworks to prevent soil erosion and sedimentation • Sec 70A(1) – no earthworks without approval of plans and specifications by the local authority • Sec 70A(3) – conditions may be imposed • Sec 70A(4) – stop work order may be issued • Sec. 70A(6)&(11) – may implement corrective works and costs borne by owner of land • Sec 70A(8) – The local authority or authorized person may enter any land, building or premises, day or night, without notice, to execute work under this section • Sec. 70A(13) – provisions under this Section does not apply to earthworks carried out by or on behalf of the Federal or State Government • Sec. 70B – 70D – relates to safety and stability of buildings under construction. Review to be conducted if defect, deformation or deterioration in structure of building under erection is detected. Local authority may require submission of amended plans on stabilisation of slope. If not complied with, may order cessation of works, direct remedial work for safety and stability of building and surrounding areas or, in the extreme, take any other measure or demolish the building. Local authority or any person authorised by it or on its behalf may enter site of a building at any time without notice to the owner. • Sec. 83 &84 – declare dangerous buildings and to be repaired, shut down or demolished • Sec 86 – 90 –any premise that is a nuisance, injurious or danger to health.Local authorities may take actions to deal with such nuisance including requiring abatement of the nuisance by the owner. • Sec 97, 98 & 99 – any local authority, by its officers, employees, agents or contractors, may enter during the daytime into any building or land for the purpose of making any survey or inspection to execute any work with certain provisions for occupied buildings and night inspections. • Sec 100 – offence for obstruction of any

Legislation	Lead Agency / Stakeholders	Relevant Provisions
		local authority or its officers, agents or contractors in the performance of their duties.
5. Uniform Building By Laws 1984	• Lead: Local Authority • Other Stakeholders: • Town and Country Planning Department • Department of Environment • Department of Drainage and Irrigation • Public Works Department • Sewerage Services • Department of Occupational Safety and Health • Construction Industry Development Board	• Sec. 3 – all plans to be submitted to local authority for approval. • Sec 25 – issuance of certificate of completion and compliance by competent person. Local authority or any officer authorised by it may inspect construction at any time.
6. The National Forestry Act, 1984	• Lead: Forestry Department • Other Stakeholders: • Department of Environment • Department of Drainage and Irrigation • District & Land Office • Department of Wildlife and National Parks • Survey Department • Forest Research Institute of Malaysia • Malaysian Timber Industry Board • Marine Parks Department Malaysia • Public Works Department	• Sec. 3 – the State Director of Forestry, Deputy Directors, District Forest Officers and Assistants, and other officers are appointed by the State Authority • Sec 5 – the Director may delegate his powers and duties to any forest officer not below the rank of Assistant District Forest Officer • Sec.6 – state authority may delegate to the Director its powers conferred under the Act • Sec. 10 – State Director of Forestry Dept may, with the state authority's approval, declare areas as protected forest reserves for protection and conservation against soil erosion and catchment areas
7. The Environmental Quality Act, 1974	• Lead: Department of Environment • Other Stakeholders: • Fisheries Department • Forestry Department • Town and Country Planning Department • Land and Mines Department • Public Works Department • Department of Drainage and Irrigation • Marine Department • Marine Parks Department • Agriculture Department • Local Authority • District and Land Office • FRIM	• Sec.3 – the Director General is appointed by the Minister and conferred with administrative powers under the Act to control pollution. Deputy Director Generals and other officers may further be appointed to exercise any powers, duties and functions of the Director General under this Act. • Sec. 34A – require Environment Impact Analyses (EIA) to be conducted during the development planning stage and reports to be submitted for approval of the DOE State Officers. Prescribed activities requiring EIAs are stipulated in the Order. • EQA(PA)(EIA) Order – hillside development is prescribed activity • Preliminary EIA is to assess the

Legislation	Lead Agency / Stakeholders	Relevant Provisions
		impactof prescribed activities whilst a Detailed EIA is undertaken for projects with major impact to the environment. The Preliminary EIA process is headed by the State Director and the Detailed EIA Process is headed by the Director General of Environmental Quality. • Sec. 31&37 – to ensure compliance by project proponents to conditions in the EIA approval letter. Penalty is imposed for non-compliance.

8. Land Conservation Act, 1960	• Lead: District & Land Office
	• Other Stakeholders:
	  • Town and Country Planning Department
	  • Local Authority
	  • Department of Drainage and Irrigation
	  • Public Works Department
	  • JOEA
		• Sec. 3 – the Ruler in Council or the Yang di-Pertua Negeri may declare any area or land as hill land.
		• the Land Administrator is responsible for ensuring implementation and compliance of the provisions under this Act
		• Sec. 5 - controls planting of short-term crops on hill land.
		• Sec. 6 - no clearing of trees, plants, undergrowth without permit and subject to conditions imposed
		• Sec. 8 - power to acquire any hill land pursuant to the Land Acquisition Act for public purpose to prevent soil erosion
		• Sec. 11 - may take appropriate action with the sanction of the State Secretary, where damage has occurred due to erosion, displacement of earth, mud, silt, gravel and stone
		• Sec. 12-18 - issue a show cause notice, prohibition order, take measures and recover cost from defaulting person
		• Sec. 19 – owner/occupier to maintain drains, dams, water courses, walls and other works pursuant to an order

9. Town and Country Planning Act, 1976	• Lead: Town and Country Planning Department
	• Other Stakeholders:
	  • District & Land Office
	  • Department of Environment
	  • Department of Drainage and Irrigation
	  • Public Works Department
	  • Water Authority
	  • Fire Services Department
	  • Local Authority
	  • Ministry of Local Government
		• Sec. 3 – the state authority is responsible for the planning and development of land and building within thearea of the local authority of the state
		• Sec. 4 – the State Planning Committee shall be established and may direct local planning authority
		• Sec 18 – no body other than the local authority shall undertake development unless planning permission is granted
		• Sec. 21A – impose requirements on project proponentsfor compliance
		• Sec. 22 – local authorities regulate hillside developments by imposing conditions for sustainable,

Legislation	Lead Agency / Stakeholders	Relevant Provisions
		environmentally friendly and safe development
10. Local Government Act, 1976	• Lead: Local Authority/District Councils • Other Stakeholders: • All Government agencies and departments	• Sec. 8 – every local authority area is administered by a local authority • Sec. 9 - the state authority may give directions to the local authority • Sec. 81,82 & 84 – may control erosion and sedimentation if they pose a nuisance within as well as outside the local authority area • Sec 101 (v) – to do all things necessary for or conducive to public safety and health

11. Police Act ,1967	• Lead: Royal Malaysian Police
	• Other Stakeholders:
	  • Civil Defence Department
	  • Fire Services Department
	  • Malaysian Highway Authority
	  • Public Works Department
	  • Local Authorities
		• Sec. 3 – responsible for maintaining law and orderand preserving public peace and national security
		• Sec. 4 – the Royal Malaysian Police established under Section 3 shall be headed by the Inspector-General who shall be responsible to the Minister. He shall have all the powers conferred to a Commissioner or Chief Police Officer. The Deputy Inspector-General shall have similar powers.
		• Sec. 7 – may serve during war or other emergencies with local forces
		• Sec. 20(3)(j) –take lawful and necessary measures to protect life and property
		• Sec. 21 – regulate and control traffic and maintain order on public roads
		• Sec. 26 – authorized to place road barriers on public roads and streets to preserve law and order

12. Civil Defence Act, 1951	• Lead: Civil Defence Department
	• Other Stakeholders:
	  • Police Force
	  • Fire Services Department
	  • Public Works Department
	  • Essential Services Departments such as water and rail
		• Sec. 4 – the Director-General for Civil Defence and Assistant Director-Generals may be appointed by the Yang di-Pertuan Agong
		• Sec. 7 – provide services under the direction of the Yang di-Pertuan Agong
		• Sec. 8 – the Director-General may, with the Minister's consent, order relief and rehabilitation services for safety of life and property in the event of impending or occurring disasters
		• provide emergency services for landslides under National Security Council Directive No. 20 (MKN Directive 20) such as saving lives and properties, managing evacuation centres and providing food and first aid services

Legislation	Lead Agency / Stakeholders	Relevant Provisions

13. Fire Services Act, 1988	• Lead: Fire & Rescue Services Department
	• Other Stakeholders:
	  • Police Force
	  • Local Authorities
		• Sec. 2 –authorised officer for the purposes of this Act means the Director-General and any Fire Officer or Auxiliary Fire Officer authorised by the Director-General
		• Sec. 3 – each sttate shall have a director of Fire Services
		• Sec. 7 – the Director-General may, by gazette, delegate his powers under this Act to any fire officer
		• Sec. 5(1) – perform humanitarian services such as protecting life and property in any calamity. Definition of calamity under Sec. 2 may include landslides.
		• Sec. 5(2) – provide services imposed by law or the Minister
		• Sec. 19 – exercise of powers (similar to powers under Sec. 18) to protect life and property on occasion of emergencies not involving fire

14. Public Order (Preservation) Act, 1958	• Lead: Royal Malaysian Police
	• Other Stakeholders:
	  • Civil Defence Department
	  • Armed Forces
	  • Essential Services Departments
		• Sec. 2 –the Chief Police Officer includes a Commissioner of Police authorised to exercise powers and perform duties under this Act
		• Sec. 4 – regulate, restrict, control or prohibit use of public roads or places to maintain public order
		• Sec. 6 – may place barriers on roads or public place

ANNEX 11:

SUMMARY TABLE OF PROPOSALS AND RECOMMENDATIONS

Activity	Agency involved	Applicable Laws	Remarks	Recommendations on legislation
1. Overall policy and institutional framework	1. Public Works Department, Slope Management Division which has a comprehensive approach to the problem; 2. Some Local Authorities do have policies related to development on slopes. 3. TCPA and DOE have adopted some guidelines on development of hill areas and environmentally sensitive areas.	1. Town and Country Planning Act; 2. Local Government Act; 3. Street, Drainage and Building Act. 4. National Land Code. 5. Geological Survey Act 6. Police Act 7. MKN 20	No specific law on management of slopes is available. The legislation mentioned in column 3 contain provisions related to overall duties of the agencies	1. Short term – set up procedures with existing legislation/agencies to carry out required functions. Obtain authorisation under existing legislation. Identify and commence work on amendments to critical legislation 2. Medium term – make amendments to critical legislation such as the Earthwork By-Laws and Building By-Laws to enable greater emphasis to be given to geotechnical considerations. 3. Long term – should consider the possibility of having specific legislation for the integrated management of slopes and to empower the dedicated Agency.
2. Hazard Mapping & Assessment	1. Slope Management Division 2. Some Local Authorities may have implemented this for specific areas 3. DOE may have carried out work related to development on specific slopes.	1. Town and Country Planning Act; 2. Local Government Act; 3. Street, Drainage and Building Act. 4. National Land Code. 5. Geological Survey Act	Largely administrative task but may need legislation to ensure that private parties undertake this activity as part of their obligations. Also need for agency to determine the standards and methodology for adoption by all parties. May need to enter into private property to carry out investigations, survey and install monitoring equipment.	1. Short term – consider administrative arrangements to enable the systems to be installed; Obtain authorisation under existing legislation. Identify and commence work on amendments to critical legislation 2. Medium term – make amendments to Guidelines, Earthwork By-laws, UBBL to require this task to be implemented by Developers. Include also the right to enter and carry out activities by SEA related to investigation/assessment/mappi ng. 3. Long term – may consider incorporating this requirement in the new legislation
3. Early Warning and Real-Time Monitoring	1. Slope Management Division 2. Possibly PLUS may be monitoring the Highways 3. DID/DOE may be monitoring aspects related	1. Town and Country Planning Act; 2. Local Government Act; 3. Street, Drainage and Building Act. 4. National Land	This being relatively new to management of slopes there is as yet no concerted efforts in this area.	1. Short term – consider administrative arrangements to enable the systems to be installed; Obtain authorisation under existing legislation. 2. Medium term - amend the Earthwork By Laws/Land Conservation Act. Require this task to be implemented by Developers/Operators for critical

Activity	Agency involved	Applicable Laws	Remarks	Recommendations on legislation
	to water quantity and quality 4. Meteorology Department issuing warnings of rain/storm	Code. 5. Geological Survey Act 6. Highway Authority Act		areas as a condition of development. Include also the right of Agency to enter and carry out related activities. 2. Long term – may consider incorporating this requirement in the new legislation
4. Loss Assessment	1. Slope Management Division 2. Local Authorities	1. Town and Country Planning Act; 2. Local Government Act; 3. Street, Drainage and Building Act. 4. National Land Code. 5. Geological Survey Act 6. Police Act 7. MKN 20	There appears to be limited effort presently in this area. What little taking place is not properly documented or collated.	1. Need to develop and adopt methodologies/guidelines and standards in the short term. Consider administrative arrangements to enable systems to be installed; Obtain authorisation under existing legislation. 2. Medium term - make amendments to Guidelines, Earthwork By-Laws, UBBL to enable this task to be implemented. Include also the right to enter and carry out activities by SEA related to investigation, assessment, forensic work. 3. In the long term will have to consider the possibility of having legal powers to enter sites to carry out assessment and investigations.
5. Collection of Information	1. Slope Management Division 2. Private parties such as PLUS monitoring the Highways 3. DID/DOE on aspects related to water quantity and quality 4. Meteorology Department 5. Local authorities	1. Town and Country Planning Act; 2. Local Government Act; 3. Street, Drainage and Building Act. 4. National Land Code. 5. Geological Survey Act 6. Police Act 7. MKN 20	There appears to be no systematic collection, collation and documentation of information on slope failure.	1. Need to develop and adopt systems, methodologies, guidelines and standards in the short term. Also work with other agencies to request them to submit the required information. Obtain authorisation under existing legislation. 2. Medium term - may consider amending the Earth Works By Laws/UBBL to require information to be submitted by private parties and to enable investigations to be carried out. 3. In the long term will have to consider the possibility of having legal powers for besides the above, also to enter sites to carry out assessment and investigations.
6. Training	A new activity to be undertaken by the Slope Management Department	1. MKN 20	No legislation will be required. MKN 20 should be modified for Emergency Drills related to landslide	No legislation will be required. Co-operative agreements will have to be considered with other agencies to obtain their cooperation for trainers/training.
7. Public Awareness	A new activity to be undertaken by the Slope Management Department in cooperation with the local authorities	1. MKN 20	No legislation will be required. MKN 20 should be modified for matters related to landslides and slope management	No legislation will be required. Co-operative agreements/guidelines will have to be considered with local authorities, Ministry of Information and other agencies to obtain their cooperation for joint activities.

Activity	Agency involved	Applicable Laws	Remarks	Recommendations on legislation
8. Loss reduction measures	1. Slope Management Division 2. Private parties such as PLUS, Developers in critical areas 3. Local authorities 4. DOE	1. Town and Country Planning Act; 2. Local Government Act; 3. Street, Drainage and Building Act. 4. National Land Code. 5. Geological Survey Act 6. Land Conservation Act	Need to review/amend and or develop regulations, guidelines and or design codes	1. In the short term these guidelines may be implemented administratively through the approval processes under the Local Government Act and or SDBA. Obtain authorisation under existing legislation for Agency to act. 2. In the medium term appropriate amendments may be introduced in some of the legislation and their related subsidiary legislation mentioned in column 3. 3. In the long term new legislation will have to be considered to enable the regulations, guidelines and or design codes to be implemented.
9. Emergency preparedness, response and recovery	1. Fire and Rescue Services Dept. 2. Police Department 3. PM's Department 4. Civil Defence Department 5. Slope Management Division 6. Local authorities	1. Police Act 2. Civil Defence Act 3. Local Government Act 4. Fire Services Act 5. Public Order (Preservation) Act 6. Street Drainage and Building Act 7. MKN Directive 20	Need to revise and update MKN 20. Proposals to amend the Civil Defence Act is being considered.	1. In the short term the Slopes Department will have to play a bigger role in providing technical assistance to the other relief agencies. 2. In the medium term it may have to take an active role in emergency preparedness for slope failure. 3. In the long term appropriate legislation may be considered to enable effective response and recovery in critical situations.
10. Research & Development	Slope Management Division	Nil	The newly created agency will have to play a critical role in establishment standards, guidelines and design codes for which localized research will be essential.	1. Short term administrative arrangements will have to be made with local authorities and other private bodies (such as PLUS) for research to be undertaken. 2. In the medium to long term appropriate legislation may be considered to obtain access/information to/from disaster sites for forensic investigations to be carried out and data to be obtained.

ANNEX 12:

PROPOSED AMENDMENTS TO THE LAND CONSERVATION ACT

1. Introduction

1.1 A detailed review of the Act was undertaken in a paper entitled "Review of the Land Conservation Act". The paper concluded that, in general, the Act adequately covered the three aspects related to development of land, which are planning, construction and post construction processes. However, several recommendations were made to ensure that the Act was updated to take into account current concerns and enable actions to be taken by the relevant agencies. Amendments to the Act will have to be made to enable these recommendations to be implemented. In general, the nature of the recommendations is such that the structure of the whole Act should be reviewed. A copy of the recommendations made in the earlier paper is enclosed as **Appendix 12-1** for ease of reference.

1.2 It must be stated from the outset that any proposal made here for amendments or changes to the Act is being made in isolation and only from a certain viewpoint which may not necessarily be correct. It may also contradict or duplicate other provisions be considered for inclusion in the amended Act.

2. Proposed Amendments to the Act

2.1 Scope of Application

The scope of the Act will have to be changed to make it very clear that the objective of the Act would be to also reduce the occurrence of landslides and slope failure. The Act should also apply to any activity that may cause slope failure, endanger lives and damage property.

2.2 Structure of the Act

The structure of the Act may have to be reviewed in the light of the different emphasis being given by the government. The new structure should take into account the differing needs of the different sectors involved such as management of water resources, land conservation and utilisation for agriculture and slope management.

2.3 Administration of the Act

The authority body which has primary responsibility for implementation of the Act should also be carefully determined. It would appear that in almost all instances, except in areas outside their jurisdiction, local authorities would control and be intimately involved in every development. Other government agencies could be delegated powers to handle certain matters.

2.4 Owner/Occupier to be made Responsible

The Act should be amended to change the focus of action from the government to the private sector. The owner/occupier, for example, should be made responsible for ensuring that no slope failure should arise on his land nor shall his land result in damage to any other land or person. The developer of any land must design, construct and maintain any development with due regard to adequate/appropriate measures for slopes. All such measures will require the prior approval of the relevant agency and be subject to auditing at any time.

2.5 Procedure for Action

The procedure for taking action by the authorities should be simplified and transparent. The procedure should be different for an emergency situation and a normal one. The procedures adopted in Hong Kong (the Dangerous Hill Slope Order, Drainage Order, Cease Work Orders) are examples of what can be done. Similar examples exist in the LUAS Enactment and the Akta Bekalan Elektrik 1990, where rights of entry and works to be carried out without acquisition of land is provided for. These provisions could be used as a basis for the drafting of some relevant provisions to be included in the proposed amendments to the Act. Note also that there are other provisions in other parts of the LUAS Enactment, which gives powers to authorities for entry and enforcement.

3. Conclusion

It is difficult to draft individual clauses in an Act without taking into cognisance other provisions in the Act. For this reason, a sample provision as been included as a possible option to be considered by the individual who will finally draft the whole set of amendments to the Act.

ANNEX 12-1:

RECOMMENDATIONS ON THE LAND CONSERVATION ACT

The following recommendations are made to correct the identified weaknesses in the Act:

1. The scope of application of the Act should be made very clear. The objective of the Act should be to reduce the occurrence of landslides and decrease the risk of fatalities and injuries that arises from slope failure. The Act should apply not only to land as such but also to any activity that may cause landslides to occur. The focus of the Act should be on the adoption of appropriate measures for all new developments and proper maintenance for existing slopes. The Act should also enable the authority to declare any special area as a 'scheduled are/" where soil conditions or terrain requires more stringent conditions to be adhered to.

2. The authority which has primary responsibility for implementation of the Act should also be carefully determined. The Land Administrator may no longer be the appropriate controlling authority as development of man-made slopes is more related to construction and development rather than mere land conversion. When it comes to management of slopes, the mode of clearing of land and earthwork (particularly the geotechnical aspects) is more important than the mere action of clearing or carrying out of the earthwork itself. The Land Administrator would not have the requisite expertise, which may be one reason why the Act has not been implemented anywhere in the country. It would also be true that some developments such as buildings (on land zoned for such) may not involve the Land Administrator at all. It would appear that in almost all instances, except in areas outside their jurisdiction, local authorities would control and be intimately involved in every development. Most local authorities apply the Earthwork By-Laws for any works carried out in their jurisdiction. It would be better that they are made the primary authority with responsibility for implementation of the Act. The local authority (such as the Buildings Department in Hong Kong) can then consult other specialised agencies such as the National Slope Agency for geotechnical input in any development. The local authority would also be appropriate as there is the need for maintenance works to be carried out on existing slopes. Among the various departments, the local authorities are in the best position to ensure that this is implemented as they are structured to be on the ground where the problem occurs. On a related matter, it is to be noted that not all local authorities/district councils have adopted the Earth Works By-Laws and it is recommended that they do so. The Earth Works By-Laws also needs to be amended so as to make it more amenable to control earthwork on hill slopes.

3 The Act should be amended to change the focus of action from the government to the private sector. The owner/occupier, for example, should be made responsible for ensuring that no slope failure should arise on his land nor shall his land result in damage to any other land or person. The developer of any land must design, construct and maintain any development with due regard to adequate/appropriate measures for slopes. All such measures will require the prior approval of the relevant agency and be subject to auditing at any time;

4 The procedure for taking action by the authorities should be simplified and transparent. The procedure should be different for an emergency situation and a normal one. The procedures adopted in Hong Kong (the Dangerous Hill Slope Order, Drainage Order, Cease Work Orders) are examples of what can be done;

5 It should be noted that the Street, Drainage and Building Act; Town and Country Planning Act and the Local Government Act already impose planning approvals and processes for all developments within municipal areas. Therefore, one must be careful not to duplicate these requirements. What needs to be done is for geotechnical inputs to be made a part of this process and greater attention to be paid to slope management;

6 There is no requirement for monitoring and control measures during construction and also post construction maintenance of slopes. The owner should be held responsible for these aspects and to submit regular reports to the authorities;

7 The Act does not contain provisions for the authorities to act in the event of an emergency or disaster on the land. The authorities should have the right to move in and take control under such circumstances;

8 The Act does not appear to allow the authorities unobstructed access to land identified as a danger to others. This may be so because the Land Administrator already has such powers vested in him under the National Land Code. Should another agency be made responsible, then this provision will become necessary including the power to take appropriate measures (if the owner fails to do so) and recover the cost;

9 The Act must allow for other departments such as the Slope Agency to be authorised to act. Delegation of powers by the responsible authority to another department with the requisite expertise will be necessary in order to cut short the time taken to react to certain emergencies;

10 Perhaps a key issue to be answered is whether the relevant public authorities should be made legally liable for failure and take appropriate measures. For example, government projects are currently exempted from the provisions of certain laws such as the Street, Drainage and Building Act. Should such exemptions continue to be provided, especially when there is ambiguity over projects carried out by privatised bodies (such as PLUS claiming to be doing work for and on behalf of the Malaysian Highway Authority) also claiming exemption;

11 Certainly the penalties and the enforcement powers and procedures provided for in the Act need to be revised;

12 Details should be spelt out as to what rules may be made under this Act. Some possible rules include the gazetting of scheduled hill land, categorisation of hills, type of works that may or may not be carried out, phased development of construction on hill land and the protection of rivers and water courses from silt and erosion.

ANNEX 13:

SEA BUDGET REQUIREMENT

1) Staff requirement

Post	Grade	Salary (RM)		No. required		
		Min.	Max.	HQ	RO	Total
Management						
Director General (DG)	JUSA A/B	7225	9040	1		1
Deputy DG I (Technical Services)	JUSA B/C	6572	8230	1		1
Deputy DG II (Supporting Services)	JUSA B/C	652	8230	1		1
Division Head	JUSA C	6136	7673	6		6
Branch Head	J 54	4570	6491	11		11
Regional Head	J 54	4570	6491		6	6
				20	6	26
Technical Staff						
Senior Geotechnical Engineer	J48,52	3852	6114	17	6	23
Geotechnical Engineer	J41,44	1816	4822	17	6	23
Engineer	J41,44	1816	4822	17	6	23
Senior Geologist	J48,52	3852	6114	1		1
Geologist	J41,44	1816	4822	5		5
Senior IT Specialist	J48,52	3852	6114	1		1
IT Specialist	J41,44	1816	4822	2		2
Geophysicist	J41	1816	4822	1		1
Meteorologist	41	1816	4822	1		1
				62	18	80
Non-Technical Staff						
Senior Administrative Officer	M48,52	3852	6114	1		1
Administrative Officer	M41,44	1816	4822	2		2
Senior Legal Advisor	48, 52	3852	6114	1		1
Legal Advisor	41	1816	4822	2		2
Senior Accountant	48, 52	3852	6114	1		1
Accountant	41	1816	4822	2		2
Senior Economist	48, 52	3852	6114	1		1
Economist	41	1816	4822	2		2
Senior Communication Officer	48, 52	3852	6114	1		1
Public Relation Officer	41	1816	4822	1		1
Mass Communication Officer	41	1816	4822	1		1
				13		13
Technical Supporting Staff						
Senior Technical Assistant	J32, 36	2187	4151	6		6
Technical Assistant	J29	1550	3431	6	6	12
Senior Technician	J22, 26	1932	3301	18	6	24
Technician	J17	844	2584	36	12	48
Draughtsman	J17	844	2584	6	6	12
				72	30	102
Technical Supporting Staff						
Executive Officer	N29, 36, 38	2414	4912	2		2
Senior clerk	N22, 26	1916	3267	6		6
Clerk	N17	821	2398	18	6	24
Secretary	N19	801	2036	9		9
Typist	N11	710	1932	18	6	24
Junior Clerk	N11	710	1932	18	6	24
Drivers	R3, 6	702	1573	26	6	32
				97	24	121

Table 1.1: Manpower requirement

	Head Office	Regional centres
Management		
Lead Engineer	20	6
Technical Staff		
Geotechnical Engineer	34	12
Civil Engineer	17	6
Geologist	6	-
IT Specialist	3	-
Geophysicist	1	-
Meteorologist	1	-
Supporting technical staff	72	30
Non-technical staff		
Administrative Officer	3	-
Legal Advisor	3	-
Accountant	3	-
Economist	3	-
Public Relation Officer	2	-
Mass Communication Officer	1	-
Supporting administrative staff	97	24

Emolument and Operational Costs	Head Office	Regional Offices (6 nos.)
1) Salary		
Average monthly salary (calculated from the above table)	714,186	196,737
Hence, average annual salary	8,570,226	2,360,844
2) Allowance;		
Current JKR CKC budget, allowance is 40% of the basic salary		
Hence, annual salary + allowance	11,998,316	3,305,182
3) Office Expenses		
Current JKR CKC budget, office expenditure is 75% of the annual salary + allowance		
Hence, annual office expenses	8,8998,737	2.478,886
Total	20,997,054	5,7784,068

Yearly Emolument & Operational Costs

Year	HQ Staff Strength (RM)					Regional Offices (RM)							Annual Total (RM)	TERM TOTAL (RM)
	25%	25%	25%	25%	Sub-Total	1st	2nd	3rd	4th	5th	6th	Sub-Total		
2009	2,522,000				2,522,000								2,522,000	
2010	5,249,263				5,249,263								5,249,263	7,771,263
2011	5,460,312	5,249,263			10,709,575								10,709,575	
2012	5,679,846	5,460,312	5,249,263		16,389,421	964,011						964,011	17,353,432	
2013	5,908,206	5,679,846	5,460,312	5,249,263	22,297,627	1,002,770	964,011					1,966,781	24,264,408	52,327,416
2014	6,145,748	5,908,206	5,679,846	5,460,312	23,194,111	1,043,086	1,002,770	964,011				3,009,867	26,203,979	
2015	6,392,840	6,145,748	5,908,206	5,679,846	24,126,639	1,085,024	1,043,086	1,002,770	964,011			4,094,892	28,221,530	
2016	6,649,866	6,392,840	6,145,748	5,908,206	25,096,659	1,128,648	1,085,024	1,043,086	1,002,770	964,011		5,223,539	30,320,199	
2017	6,917,226	6,649,866	6,392,840	6,145,748	26,105,679	1,174,026	1,128,648	1,085,024	1,043,086	1,002,770	964,011	6,397,565	32,503,244	
2018	6,917,226	6,917,226	6,649,866	6,392,840	26,877,158	1,221,228	1,174,026	1,128,648	1,085,024	1,043,086	1,002,770	6,654,781	33,531,939	150,780,891
2019	6,917,226	6,917,226	6,917,226	6,649,866	27,401,545	1,270,328	1,221,228	1,174,026	1,128,648	1,085,024	1,043,086	6,922,339	34,323,884	
2020	6,917,226	6,917,226	6,917,226	6,917,226	27,668,905	1,270,328	1,270,328	1,221,228	1,174,026	1,128,648	1,085,024	7,149,581	34,818,485	
2021	6,917,226	6,917,226	6,917,226	6,917,226	27,668,905	1,270,328	1,270,328	1,270,328	1,221,228	1,174,026	1,128,648	7,334,884	35,003,789	
2022	6,917,226	6,917,226	6,917,226	6,917,226	27,668,905	1,270,328	1,270,328	1,270,328	1,270,328	1,221,228	1,174,026	7,476,564	35,145,469	
2023	6,917,226	6,917,226	6,917,226	6,917,226	27,668,905	1,270,328	1,270,328	1,270,328	1,270,328	1,270,328	1,221,228	7,572,866	35,241,771	174,533,398
														385,412,968

2) Rental Rates for Prime Office Space

(REF:http://www.mida.gov.my/)

Location	RM	US$	RM	RM
Alor Setar, Kedah	15.00 - 25.00	4.53 - 7.54	15.00	25.00
Georgetown, Penang	16.00 - 40.00	4.83 - 12.07	16.00	40.00
Ipoh, Perak	12.00 - 19.00	3.62 - 5.73	12.00	19.00
Kuala Lumpur	54.00 - 165.00	16.29 - 49.79	54.00	165.00
Petaling Jaya, Selangor	38.00 - 48.00	11.47 - 14.48	38.00	48.00
Seremban, Negeri Sembilan	18.80 - 26.90	5.67 - 8.12	18.80	26.90
Melaka	11.00 - 25.00	3.32 - 7.54	11.00	25.00
Johor Bahru, Johor	17.20 - 30.10	5.19 - 9.08	17.20	30.10
Kuantan, Pahang	13.00 - 27.00	3.92 - 8.15	13.00	27.00
Kuala Terengganu, Terengganu	21.30 - 24.50	6.43 - 7.39	21.30	24.50
Kota Bharu, Kelantan	9.50 - 35.50	2.87 - 10.71	9.50	35.50
Kota Kinabalu, Sabah	15.00 - 27.00	4.53 - 8.15	15.00	27.00
Kuching, Sarawak	18.00 - 30.00	5.43 - 9.05	18.00	30.00

The above rates are approximate rentals (gross) per sq. metre per month inclusive of service charge. Note: 1 sq. metre = 10.76 sq.ft.

The average office rental in Kuala Lumpur is RM109.50.

The UK Health and Safety Law (Ref: http://books.google.com.my/books):
Architects and planners usually use average work space of 10 m^2 (inclusive of all support and ancillary spaces such as circulation and catering). The British Council of Offices suggests a good practice range of 12 - 17 m^2. Hence, an average work space of 14.5 m^2 is used in the following calculation.

	Head office	Regional office (1 no.)
No. of employees	266	13
Space per person (m^2)	14.5	14.5
Total space (m^2)	3,857.0	188.5
Rental rate (RM)	109.50	21.67
Rent per month (RM)	422,341.50	4,085.31
Rent per year (RM)	5,068,098.00	49,023.71

Yearly Rental

Year	HQ (RM)	Regional Offices (RM)							Annual Total (RM)	Term Total (RM)
		1st	2nd	3rd	4th	5th	6th	All 6		
2009										
2010	5,000,000								5,000,000	5,000,000
2011	5,000,000								5,000,000	
2012	5,000,000	50,000						50,000	5,050,000	
2013	5,000,000	50,000	50,000					100,000	5,100,000	15,150,000
2014	5,000,000	50,000	50,000	50,000				150,000	5,150,000	
2015	5,000,000	50,000	50,000	50,000	50,000			200,000	5,200,000	
2016	5,000,000	50,000	50,000	50,000	50,000	50,000		250,000	5,250,000	
2017	5,000,000	50,000	50,000	50,000	50,000	50,000	50,000	300,000	5,300,000	
2018	5,000,000	50,000	50,000	50,000	50,000	50,000	50,000	300,000	5,300,000	26,200,000
2019	5,000,000	50,000	50,000	50,000	50,000	50,000	50,000	300,000	5,300,000	
2020	5,000,000	50,000	50,000	50,000	50,000	50,000	50,000	300,000	5,300,000	
2021	5,000,000	50,000	50,000	50,000	50,000	50,000	50,000	300,000	5,300,000	
2022	5,000,000	50,000	50,000	50,000	50,000	50,000	50,000	300,000	5,300,000	
2023	5,000,000	50,000	50,000	50,000	50,000	50,000	50,000	300,000	5,300,000	26,500,000

3) <u>Total Budget Requirement</u>

Year	Emoluments & Operation Costs (RM)	Office Rental (RM)	Annual Total (RM)	TERM TOTAL (RM)
2009	2,522,000		2,522,000	
2010	5,249,263	5,000,000	10,249,263	12,771,263
2011	10,709,575	5,000,000	15,709,575	
2012	17,353,432	5,050,000	22,403,432	
2013	24,264,408	5,100,000	29,364,408	67,477,416
2014	26,203,979	5,150,000	31,353,979	
2015	28,221,530	5,200,000	33,421,530	
2016	30,320,199	5,250,000	35,570,199	
2017	32,503,244	5,300,000	37,803,244	
2018	33,531,939	5,300,000	38,831,939	176,980,891
2019	34,323,884	5,300,000	39,623,884	
2020	34,818,485	5,300,000	40,118,485	
2021	35,003,789	5,300,000	40,303,789	
2022	35,145,469	5,300,000	40,445,469	
2023	35,241,771	5,300,000	40,541,771	201,033,398

2. HAZARD MAPPING AND ASSESSMENT

2 HAZARD MAPPING AND ASSESSMENT

2.1 Overview

2.1.1. Introduction

Slope assessment and slope management are important aspects of slope engineering. Slope assessment is used to assess the condition of slopes either on a large scale or individually. It is also carried out to understand the mechanism that triggered the event and to predict the potential future occurrences of landslide. Slope management is the efficient use of available funds for slope rehabilitation based on the priority ranking of slopes using hazard and risk techniques. Some examples of the use of slope management with particular reference to Malaysia are described in this chapter. Some of the most common terms and definitions that are used to describe slope assessment are described below.

Hazard maps have been used throughout the world to identify areas of either existing or potential slope instability. Such maps have been applied to land development projects, new and existing highways, and mining works (Hurley et l 1995).

In general, hazard maps can be developed in a number of ways, ranging from simple qualitative or historical assessment, to varying degrees of site mapping and scientific analyses involving statistical and other numeric software packages.

Landslide hazard refers to the natural conditions of an area potentially subject to slope movements. It is defined as the probability of occurrence of a landslide of a given magnitude, in a pre-defined period of time, and in a given area (Varnes and IAEG, 1984). The definition incorporates the concepts of *spatial location* (“where”), magnitude or intensity (“how large”), and *frequency of occurrence*. Location refers to the ability to forecast where a landslide will occur; magnitude refers to the prediction of the size and velocity of the landslide; and *frequency refers* to the ability to forecast the temporal recurrence of the landslide event (Guzzetti et al., 1999). Ideally, a landslide hazard map will portray the location and probability of occurrence of mass movements of pre-defined magnitudes in the study area (Carrara et al., 1995, 1999; Guzzetti et al., 1999).

The methods for preparing hazard maps have been categorized by Hutchinson (1992) into three groups, namely:

- **Geotechnical method** : This approach involves sampling, logging and testing, and is generally considered too expensive for regional studies. The Geotechnical method and Direct Methods (described below) are generally adopted for site-specific projects rather than regional studies.

- **Direct Methods**: This method is based on geomorphological mapping, geological mapping and remote sensing (primarily aerial photography). This method produces a landslide map that can be converted in a hazard map, through appropriate subdivision and zoning of activity.

- **Indirect Methods:** The Indirect Methods assume that there are a number of significant factors that relate to slope instability, and that these factors combine at certain locations to result in slope failure. The simplest indirect methods involve univariate and bivariate analyses to identify single parameter or pairs of parameters that cause or contribute to slope instability. An example of univariate analysis is a plot of slope failure versus slope height, and an example of bivariate analysis is slope angle versus slope height. The level of complexity involves multivariate analysis. Multivariate analyses include factor mapping (herein described as factor overlay) combined with numerical methods to identify hazardous areas.

Hazard maps are used to develop assessments of vulnerability of life and property to landslides and is incorporated into development planning and control and emergency management. They are of primary importance for the management and prevention of hazards.

A landslide hazard map indicates the possibility of landslides occurring throughout a given area, and areas are ranked qualitatively from very low to high hazard. That is, the landslide hazard map shows how likely landslides will happen in the future, at a givenspot compared to other parts of the hill. A hazard map may be as simple as a map that uses the locations of old landslides to indicate potential instability, or as complex as a quantitative map incorporating probabilities based on variables such as rainfall thresholds, slope angle, soil type, and levels of seismic tremors. An ideal landslide hazard map shows not only the chances that a landslide may occur at a particular place, but also the chance that it may travel a given distance down a slope.

The elements of a hazard map are listed below. Some maps may not display all the elements depending on the purpose of the map.

- **A base map** is required. As the base map, a topographic map or a photographic map can be used. The topographic map is more effective to understanding information for a hazard map than ortho-photos. A photographic map contains too much information to be interpreted. Recent developments in survey technology, such as the advancement of LLight Detection and Ranging (LiDAR) technology with high - resolution digital ortho-rectified photographs, has nelped malce the base map preparation easier and more accurate.
- **Disaster prevention information** is the most important information that should be provided to residents. The forecast area of disaster should be included, and past disaster records may be included if needed. Alternatively, the map can be divided into both types.
- **Evacuation-related information** should be disseminated to residents. The location of refuge areas and evacuation routes to be used in case of a disaster are shown in the map. Residents can see their evacuation route and places of refuge on the hazard map. In addition, the system and instructions to accurately warn of an impending disaster and appropriate evacuation procedures are also described, for example, a forecasting or warning siren.

- The behaviour of disaster phenomena and the basic knowledge on natural phenomena are also described.

2.1.1.1 Definition of a Landslide

In order to carry out hazard assessment, an understanding of landslide mechanism and factors affecting landslide is important.

The term "landslide" describes a wide variety of processes that result in the downward and outward movement of slope-forming materials including rock, soil, artificial fill, or a combination of these. The materials may move by falling, toppling, sliding, spreading, or flowing. The various types of landslides can be differentiated by the kinds of material involved and the mode of movement. A classification system based on these parameters is shown in **Table 2.1.**

Rapidly moving landslides or debris flow pose the greatest risk to human life, and people living or travelling through areas prone to rapidly moving landslides face increased risk of serious injury. Slow moving landslides can cause significant property damage, but are less likely to result in serious human injuries.

Table 2.1 Classification of landslides (Varnes, 1978)

TYPE OF MOVEMENT		TYPES OF MATERIAL		
		Bedrock	ENGINEERING SOILS	
			Predominantly coarse	Predominantly fine
Falls		Rock Fall	Debris fall	Earth fall
Topples		Rock Topple	Debris Topple	Earth topple
Slides	rotational	Rock Slump	Debris slump	Earth slump
	translational	Rock Block slide	Debris block slide	Earth block slide
		Rock slide	Debris slide	Earth slide
Lateral Spreads		Rock spread	Debris spread	Earth spread
Flows		Rock flow (deep creep)	Debris flow	Earth flow (soil creep)
Complex		Combination of two or more principal types of movement		

Geologists also describe the types of movement of a landslide as either:

- Translational (where movement occurs along a flat surface)
- Rotational (where sliding material moves along a curved surface)
- Wedge (where movement occurs on a wedge-shaped block formed by intersecting planes of weakness, such as fractures, faults and bedding)

The size of a landslide usually depends on the geology and the initial cause of the landslide. Landslides vary greatly in their volume of the rock and soil, the length, width, and depth of the area affected, frequency of occurrence, and speed of movement. Rotational and translational slides are generally slow moving and can be deep, whereas wedge failures generally occur suddenly and are shallow.

Landslides are events that occur in space and time. As such, it is usually possible to identify either one or more landslide causes and one landslide trigger. The landslide causes are the reasons that a landslide occur in that location and at that time. Before any landslide assessment is carried out, the factors contributing to landslide and type of landslide mechanism are identified. Interpretation of future landslide occurrence requires an understanding of conditions and processes controlling landslides in the area subjected.

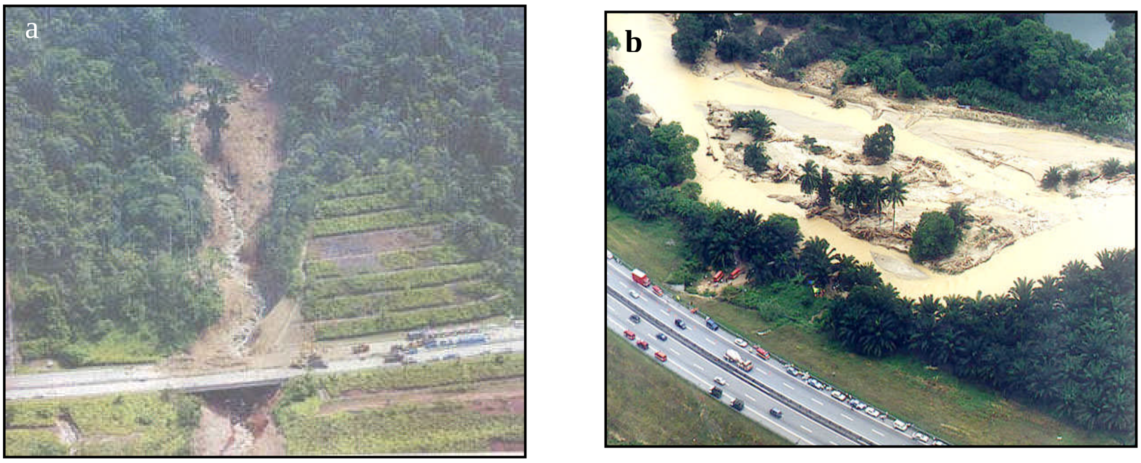
Factors influencing where landslides occur can be divided into two sets, **Preparatory** and **Triggering** (Sharpe, 1938). Preparatory factors are characteristics of the landscape which remain unchanged or vary little from a human perspective. The steepness of a slope or the type of rock, for example, presents changes only with the passage of long periods of time. Preparatory factors such as rock type and slope steepness can be recognised and identified for specific landslides long after their occurrence. By examining existing landslides in an area, it is possible to recognise how preparatory factors contributed to these slope failures. Identifying conditions and processes promoting past instability makes it possible to use these factors to estimate future landslides.

Triggering factors are landscape characteristics that change quickly as a result of some triggering event. Ground vibration due to earthquakes, a rapid rise in groundwater levels, and increased soil moisture due to intense precipitation are examples of variable factors. It is often necessary to be present at the time a landslide occurs or shortly thereafter to assess these factors. Due to the lack of long-term records relating landslide activity to historic earthquakes, storms, or other initiating factors, preparatory factors are usually used to estimate landslide hazard. As such, identifying landslide areas is not an accurate science and leads, in general, to depicting hazard-prone areas based on estimation. At best, landslide and landslide susceptible areas can be identified along with expected triggering events. At worst, some areas may not be detected at all.

The three main preparatory factors namely: past history, slope steepness and bedrock are the minimum components necessary to assess landslide hazards. It is also desirable to add a hydrologic factor (the triggering factor) to reflect the important role which ground water often plays in the occurrence of landslides. An indication of this factor is usually obtained indirectly by looking at vegetation, slope orientation, or precipitation zones. All of these factors can be mapped by a ground mapping team. Specific combinations of these factors are associated with differing degrees of landslide hazards. The identification of the extension of these combinations over the area being assessed results in a landslide hazard map.

2.1.1.2 Classification of Landslides in Malaysia

Debris flow: A debris flow is a form of rapid mass movement in which a combination of loose soil, rock, organic matter, air, and water mobilize as slurry that flows down a slope. Debris flows include more than 50 percent fines. It is commonly caused by intense surface-water flow, due to heavy precipitation that erodes and mobilizes loose soil or rock on steep slopes. Debris flows are also triggered from other types of landslides that occur on steep slopes, are nearly saturated, and consist of a large proportion of silt- and sand-sized material. Debris flow source areas are often associated with steep gullies, and debris flow deposits are usually indicated by the presence of debris fans at the mouths of gullies.

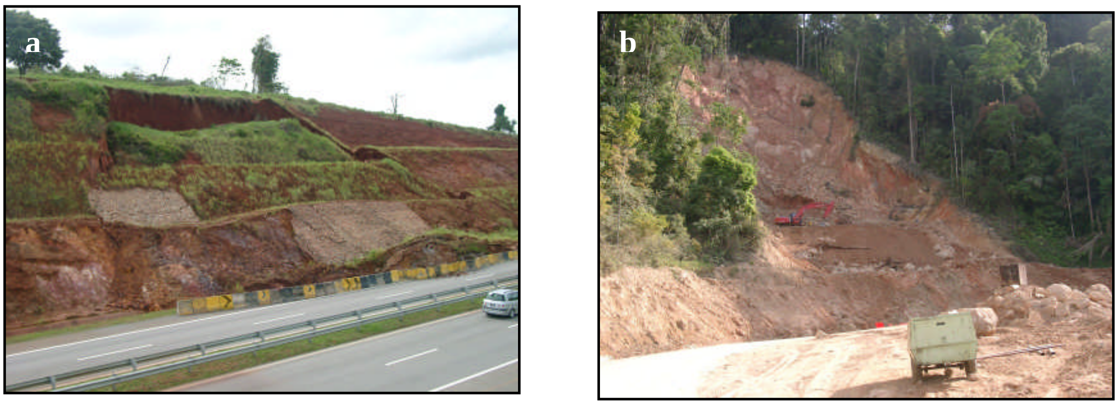


Gunung Tempurung Pos Dipang

Figure 2.1: Debris flow

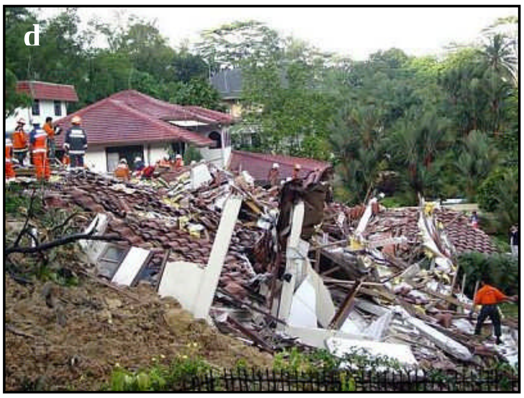
Larger debris flow is capable of moving trees, large boulders and even cars. This type of failure is especially dangerous as it can move at great speeds, is capable of crushing buildings and can strike with very little warning.

Deep seated Landslides: Landslides in which the sliding surface is mostly deeply located below the maximum rooting depth of trees (typically to depths greater than 10 metres). Deep-seated landslides usually involve deep regolith, weathered rock, and/or bedrock and include large slope_failures associated with translational, rotational, or complex movement.



KM 153 East Coast Expressway Gunung Raya, Langkawi, Kedah

Kg.Pasir, Ampang, Selangor



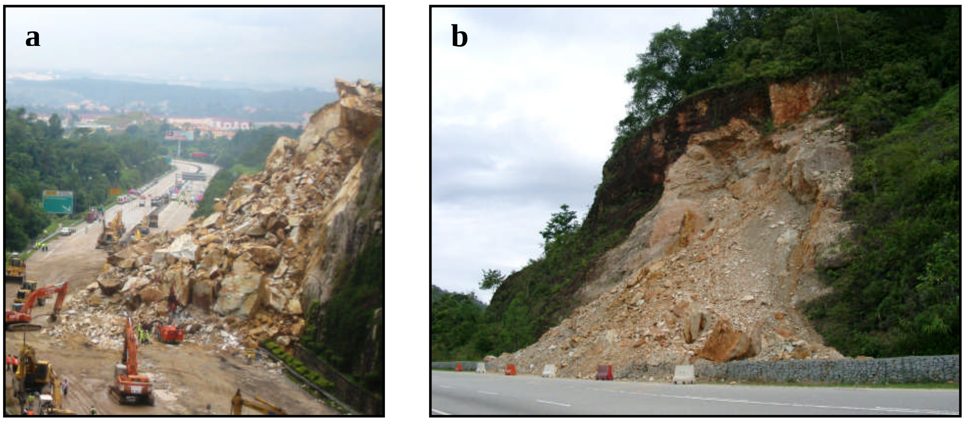
Taman Hill View, Ampang, Selangor

Section 10, Wangsa Maju, Selangor

Highland Tower, selangor

Figure 2.2: Deep seated failure or rotation

Rock fall: "A fall starts with the detachment of soil or rock from a steep slope along a surface on which little or no shear displacement takes place. The material then descends mainly through the air by falling, bouncing, or rolling" (Varnes, 1996).



Bukit Lanjang, Kuala Lumpur East West highway, Perak

Figure 2.3: Rock fall at a) Bukit Lanjan b) Grik, Lebuhraya Timur Barat

Many different processes cause rocks to become unstable and fall including gradual weathering and erosion, tree-root growth, and weakening of supporting rock by saturation from ground water.

2.1.1.3 Analysis and Discussion

Hazard analysis is the process of identification and characterisation of potential landslides together with an evaluation of their corresponding frequency of occurrence. Landslide hazard identification requires an understanding of the slope processes and the relationship of those processes to geomorphology, geology, hydrology, climate and vegetation. From this understanding, it will be possible to:

- Classify the types of potential land sliding: the classification system proposed by Varnes (1984) as modified by Cruden & Varnes (1996) is a suitable system (refer to Appendix 1). It should be recognised that a site may be affected by more than one type of landslide hazard, e.g., deep - seated landslide on the site, while rock fall and debris flow from above the site.
- Assess the physical extent of each potential landslide being considered, including the location, aerial extent and volume involved.
- Assess the likely initiating event(s), the physical characteristic of the material involved and slide mechanics.

- Estimate the resulting anticipated travel distance and velocity of movement.
- Address the possibility of fast - acting processes, such as flows and falls, from which it is more difficult to escape.

2.1.2. Objectives

The objective of this component is to develop a framework for establishing an inventory of susceptible areas and different types of landslide hazards and risks at a scale useful for planning and decision-making. It is also to identify the probability of occurrence of a specific hazard, in a specific future time period, as well as its intensity and area of impact.

2.2 Problem Statement

In general, landslide hazards in Malaysia are only assessed on a case-to-case basis. Hazard assessments are only usually carried out well after signs of distress are observed or after a landslide incident. Hazard assessments are also limited to a localized area or individual slope. There is limited landslide hazard assessment carried out in Malaysia and the efforts are mainly from the Government sector and highway concessionaires. Landslide assessment are mainly linear assessments as part of safety measures for road networks.

As for area-based assessments, a few local agencies/stakeholders, i.e., Malaysia Centre for Remote Sensing, Minerals and Geoscience Department, have initiated methods of landslide hazard assessment. However, this information, including the inventory of known landslides, plan for mapping and guidelines, are not available or co ordinated nation wade. Due to a lack of co ordination and standardization for hazard mapping and assessment, numerous systems and types of methodology have been proposed by various parties to develop hazard maps.

2.2.1. Current Situation

An inventory of known landslide hazards in Malaysia is needed to plan for mapping and assessing landslide hazards. At the moment, landslide records are only based on various media sources obtained between 1973 and 2007. The landslide events within this period are not recorded in detail. The available information is insufficient for landslide hazard analysis, such as failure dimension and causes of failure.

From the preliminary data compilation of landslide records, the reported landslide events are concentrated mainly in hillside development areas. Records show that Kuala Lumpur (19.2%) and Selangor (16.6%) are the most landslide-prone areas, followed by Perak (13.4%) and Pahang (12.3%) (Refer to **Figure 2.4**). Based on all available records, 55% of landslide incidents occurred in hilly areas (refer to **Figure 2.5**).

Table 2.2: Landslide inventory and geomorphologic distribution

State	Year	Total Landslidees	Geomorphologic		
			Hilly	Mining	River
Perak	1970 - 1979	3		1	1
	1980 - 1989	7	1	4	
	1990 - 1999	36	21	2	3
	2000 - 2004	6	5		
Selangor	1970 - 1979	3	1	2	
	1980 - 1989	4	2	2	
	1990 - 1999	38	17	3	4
	2000 - 2004	12	12		
Pahang	1970 - 1979	2	2		
	1980 - 1989	3	2		1
	1990 - 1999	26	15		3
	2000 - 2004	14	9		
Kelantan	1970 - 1979	2	2		
	1980 - 1989	2			2
	1990 - 1999	5	4		
	2000 - 2004	7	3		
Johor	1970 - 1979	1	1		
	1980 - 1989	1			1
	1990 - 1999	12	7		2
	2000 - 2004	3	2		
Kedah	1970 - 1979	na			
	1980 - 1989	na			
	1990 - 1999	9	4	1	
	2000 - 2004	3	3		
Negeri Sembilan	1970 - 1979	na			
	1980 - 1989	1	1		
	1990 - 1999	22	11		4
	2000 - 2004	6			
Pulau Pinang	1970 - 1979	na			
	1980 - 1989	4	3		1
	1990 - 1999	18	15		
	2000 - 2004	10	10		
Sarawak	1970 - 1979	na			
	1980 - 1989	2	2		
	1990 - 1999	6	4		
	2000 - 2004	4	3		
Perlis	1970 - 1979	1		1	
	1980 - 1989	na			
	1990 - 1999	1			1
	2000 - 2004	na			
Sabah	1970 - 1979	1	1		
	1980 - 1989	na			
	1990 - 1999	24	11		3
	2000 -2004	3	1		
Terengganu	1970 - 1979	na			
	1980 - 1989	1	1		
	1990 - 1999	5	2		3
	2000 - 2004	2	2		
Kuala Lumpur	1970 - 1979	3	2		
	1980 - 1989	12	8	2	1
	1990 - 1999	54	36		4
	2000 - 2004	14	6		

From the preliminary landslide distribution maps in **Figure 2.7** and **2.8**, it way found than landslides on the mainly and were concentrated at the foothills of the Titiwangsa Range, which forms the backbone of Peninsular Malaysia. These areas are subject to high and prolonged rainfall intensity, especially during the monsoon season. The occurrence of landslides in these areas is concentrated mainly in developed areas where in general, the slopes were disturbed or altered by human activities, i.e., housing development, agriculture or mining activities.

In East Malaysia, landslides were mainly reported in Sabah (refer to **Figure 2.8**). Human activities, such as uncontrolled cutting and burning of vegetation, are one of the main causes of slope disturbance. Geological factors, such as tectonic movement (at Ranau, Sabah) and geological formation, are also the main causes of slope instability in these areas.

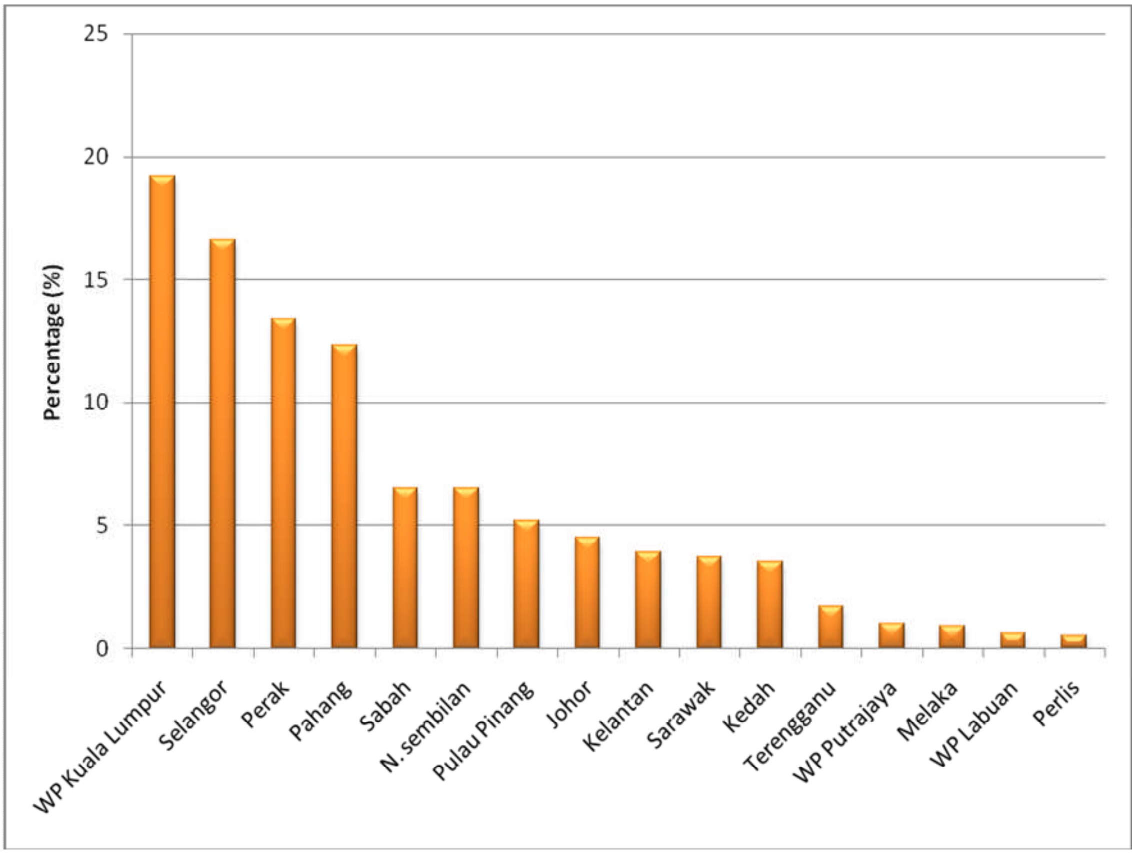


Figure 2.4: Landslide distribution in Malaysia (1973 – 2007)

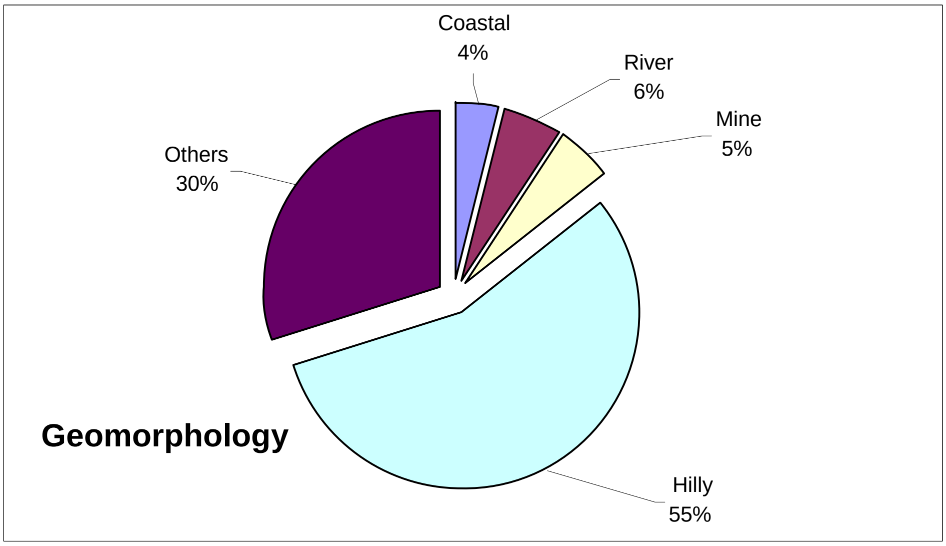


Figure 2.5: Landslide distribution based on geomorphology

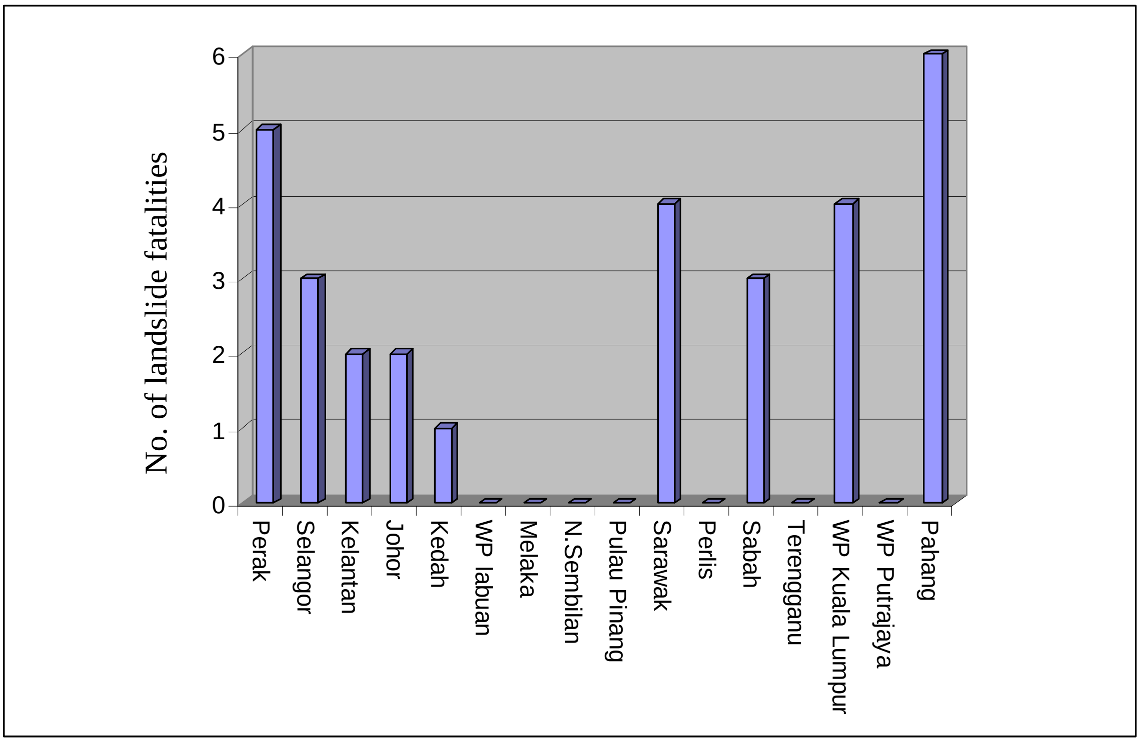


Figure 2.6: Landslide distribution based on landslide fatalities

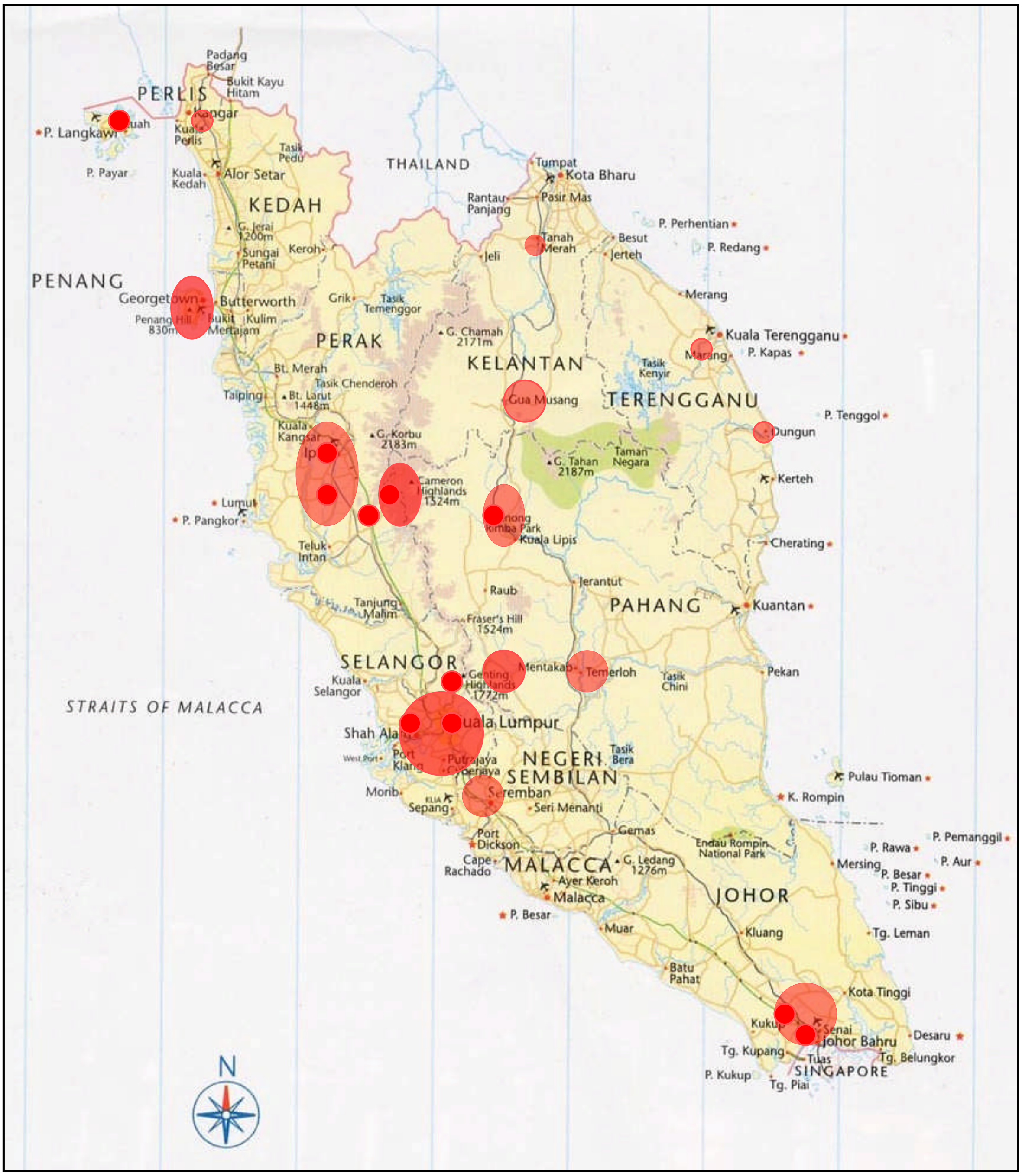


Figure 2.7: A landslide inventory map for Peninsular Malaysia

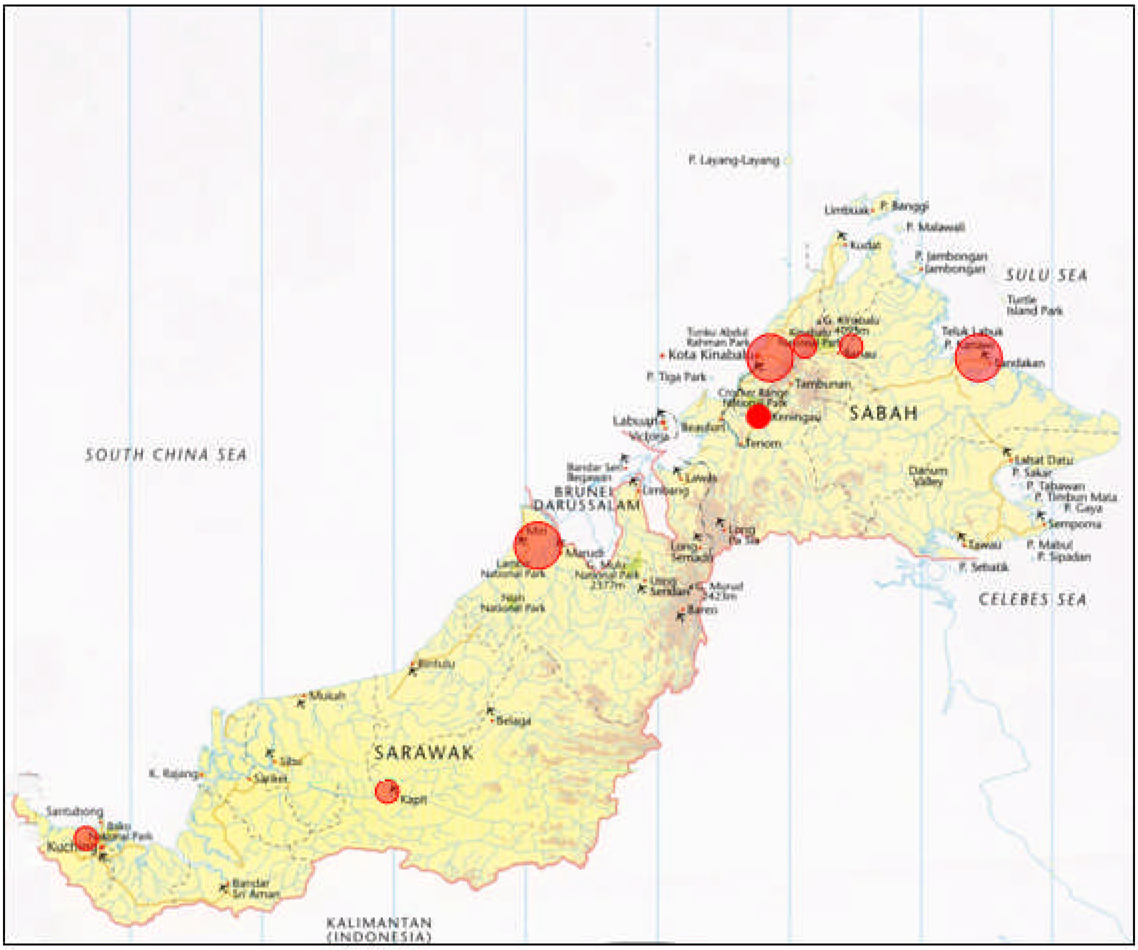


Figure 2.8: **A landslide inventory map for East Malaysia**

2.2.2. SWOT Analysis

SWOT analysis is a tool used in institutional assessments to capture and identify a hazard map and assessment scope of action. The analysis is broken down into Strengths, Weaknesses, Opportunities and Threats.

Table 2.3: SWOT analysis

SWOT	Description
Strengths	With the knowledge of landslide hazard assessment methods and the availability of known landslide hazard maps, fatality and landslide losses can be greatly reduced.
Weaknesses	Limited records on landslide incident in Malaysia. The accuracy of the landslide analysis is yet to be verified.
Opportunities	With the availability of landslide hazard maps, fatalities and losses due to landslide disasters can be reduced. Local authorities can make full use of the hazard maps to plan for their development.
Threats	The main threats from landslide incidents will be the loss of lives, property as well as adverse social-economic impact on the country.

2.2.3. Needs and Constraints

Needs

The main needs of landslide hazard assessment and mapping are records of landslide incidents. These records will be useful for conducing more accurate analysis.

Several landslide hazard assessment tools have been created for road safety and budgeting purposes by the Public Works Department (JKR) and highway concessionaires. These systems have to be verified for their effectiveness.

Landslide hotspots need to be identified. These hotspots should not be only limited to linear infrastructure such as roads and railways, but also areas with active hillside development.

Constraints

The main challenge in landslide hazard assessment is the luck of landslide specialists to carry out the works. An understanding of landslide mechanisms and the characteristics of soil and rocks in tropical areas are needed in landslide hazard formulation, and specialists with such knowledge are hard to find. Another challenge is luck of budget

Monetary allocation for the landslide hazard assessment is limited. The main priority is given to the development of infrastructure, and the landslide budget is only limited to slope repair works and occasionally for slope upgrading works.

2.3 Detailed Study

2.3.1 Introduction

For the purpose of this study slope inventory or management systems available in Malaysia were reviewed. Local and international landslide hazards assessment were also reviewed and detailed in this report.

2.3.2 Existing Slope Inventory and Management Systems

In general, various Government departments are involved directly or indirectly in slope management measures. The main government departments involved directly are the JKR and the Department of Mineral and Geosciences (JMG). These two departments provide advice to other government agencies. The practices of these agencies are summarised in **Figure 2.9**.

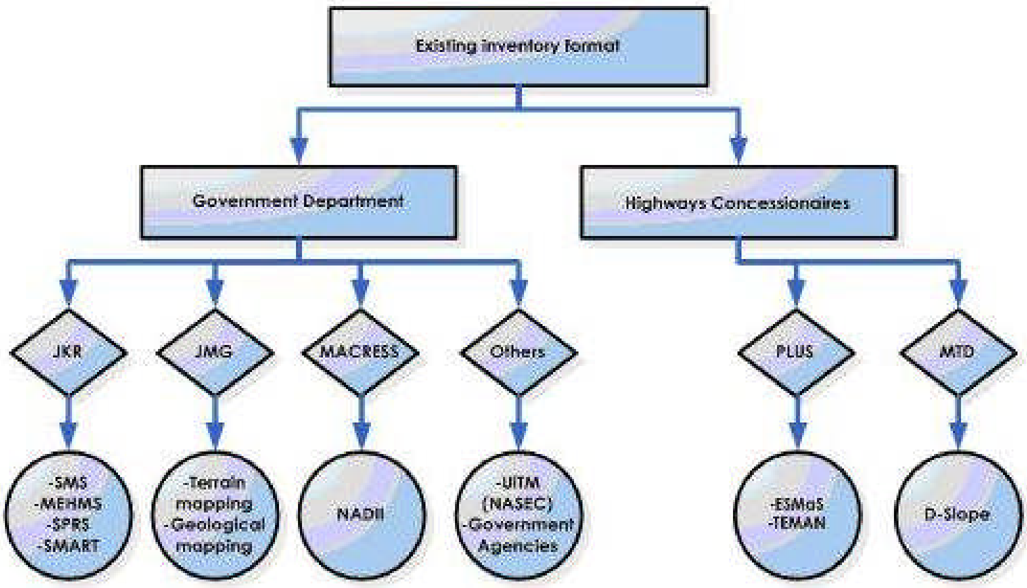
In the private sector, one organisation with a slope management system is PLUS Expressway Bhd., the major concessionaire of the North-South Expressway and several other expressways.

Several local universities have initiated research centres related to landslide hazards in Malaysia. This includes the National Soil Erosion Research Center (NASEC) by the Universiti Teknologi MARA (UiTM) and the Mountainous Terrain

Development Research Center (MTD-RC) by Universiti Putra Malaysia (UPM), funded by MTD Capital Bhd.

All the slope management systems listed below are designed specifically to suit the needs of the individual agency or site condition. Slope management systems from the highway concessionaire are designed mainly for road inventory records purposes. As for Government agencies, the slope management systems have evolved from a single hazard analysis tool (i.e., SPRS, MHEMS) to multi - analysis tools (i.e., SMART system). However, all the available slope management systems are limited to linear based only. In the National Slope Master Plan, a methodology for area - based hazard assessment and mapping will be introduced.

Figure 2. 9: Slope management/inventory systems in Malaysia



I) Slope Maintenance System

The slope management syatem (SMS) system uses the slope performa using the principal data set shown in **Table 2.4**. Data was collected from 1,123 slopes along the East-West Highway. Spatial data was also collected using Digital Video Geographic (DVG) survey which integrates helicopter positioning, video imagery and laser profiling. Discriminant analysis and the Factor Overlay method were used to analyse the slope variables that have significant contribution to the hazard value. The factors affecting consequence values used in the SMS system are described by Feiner & Ali (1999). Details of the SMS system have been described by Jamaluddin et al. (1999) and Lloyd et al. (2001).

Table 2.4: Principal data set in slope inventory form (Jamaluddin et al., 1999)

Type	Culvert condition
Location	Natural drainage type
Slope height	Natural drainage
Slope shape	Size
Slope angle	Natural flows
Slope strike	Erosion protection
No. of berms	
Berm geometry	
Crest length	Type of erosion
	Erosion severity
Distance to ridge/ gully	Erosion gully geometry
Topographic setting	Instrumentation
Catchments area	
Vegetation cover	Conditions of earthwork
Artificial cover	Failure modes
Logging activity	% Failure

II) Malaysian Engineered Hill Slope Management System

The Malaysia Engineered Hill Slope Management System (MEHMS) was the result of a slope stability study carried out along the Gunung Raya Road in Langkawi, Kedah. The slope inspection inventory form that was used in the study is similar to that used in SMS for the East-West Highway. Data on 224 slopes along the Gunung Raya road were inventoried. MEHMS is used together with Combined Hydrological and Stability Model (CHASM) for prediction of the factor of safety. CHASM is a commercially available integrated slope hydrology/slope stability software package that aids the assessment of slope stability conditions.

III) Slope Priority Ranking System

The Slope Priority Ranking System (SPRS) was developed in 1999 as a tool for quick assessment of all slopes in Malaysia so that repair work can be prioritized and carried out. The SPRS also identify budget requirements for slope repairs. The slope inventory form used in SPRS was developed from experience gained from the first two systems, SMS and MEHMS. Concepts and details of the systems are described by Hussein et al. (2000).

The slope variables include slope geometry, what percent uncovered, drainage condition, seepage, erosion severity and geology. Simple hazard score for both cut and fill slopes and consequence values are used as shown in **Tables 2.5 to 2.7**.

Table 2.5: Hazard Score used for Cut Slopes in SPRS

Category	Attribute	Value	Score
Cut slope	Slope angle	< 45°	0
		45° - 63°	1
		> 63°	2
	Slope height	< 12 m	0
		12 m – 24 m	1
		> 24 m	2
	Slope cover	> 20%	0
		≤ 20%	1
	Surface drain condition	good	0
		blocked	1
		repairs required	2
	Natural water path	none	0
		yes	2
	Seepage	none	0
		yes	2
	Ponding	none	0
		yes	1
	Erosion	slight	0
		moderate	1
		critical	2
	Slope failure	none	0
		yes	2
	Surrounding (upslope)	none	0
		yes	2
	Soil type	gravel/sand	0
		silt	1
		clay	2
	Weathering grade	Class I	0
		Class II and III	1
		Class IV, V, and VI	2
	Discontinuities	none	0
		yes	2

Table 2.6: Hazard Score used for Fill Slopes in SPRS

Category	Attribute	Value	Score
Fill slope	Slope angle	< 45°	0
		45° - 63°	1
		> 63°	2
	Slope height	< 12 m	0
		12 m – 24 m	1
		> 24 m	2
	Slope cover	> 20%	0
		≤ 20%	1
	Pavement fatigue cracks	none	0
		yes	2
	Tension cracks	none	0
		yes	2
	Surface drain condition	good	0
		blocked	1
		repairs required	2
	Culvert condition	good	0
		need cleaning	1
		repairs required	2
	Seepage	none	0
		yes	2
	Ponding	none	0
		yes	1
	Erosion	slight	0
		moderate	1
		critical	2
	Slope failure	none	0
		yes	2
	Settlement of road	none	0
		yes	2
	Soil type	gravel/sand	0
		silt	1
		clay	2
	Surroundings (downslope)	none	0
		yes	2

Table 2.7: Consequent Score used in SPRS

Category	Attribute	Value	Score
Consequent	Danger to building occupants	no	0
		yes	2
	Danger to vehicle occupants (in Annual Average Daily Traffic, AADT)	< 200 AADT	0
		200 – 1,000 AADT	1
		> 1,000 AADT	2
	Alternative roads exist	yes	0
		no	1
	By-pass possible	yes	0
		no	2
	Angle ß (road centre-line to crest or embankment toe)	< 19°	0
		19° - 27°	1
		> 27°	2

Table 2.8: Example of How Hazard Score and Risk Rating are Assigned to a Cut Slope in SPRS

Category	Attribute	Value	Score
Fill slope	Slope angle	55°	1
	Slope height	60 m	2
	Slope cover	75% bushes	0
	Surface drain condition	Bench drain crack (repairs required)	2
	Natural water path	none	0
	Seepage	yes	2
	Erosion	Severe gully (critical)	2
	Slope failure	Circular tension cracks	2
	Surrounding (upslope)	Logging activity	2
	Soil type	Silty clay	2
	Weathering grade	Residual Soil (Class VI)	2
	Discontinuities	Rilict	2
Hazard Score			**19**
Consequent	Danger to building occupants	no	0
	Danger to vehicle occupants	1,500 AADT	2
	Alternative roads exist	yes	0
	By-pass possible	no	1
	Angle ß	30°	2
Consequent Score			**5**
Risk Score	**Hazard Score x Consequent Score**	**19 x 5**	**95**

With a Hazard Score of 19 and a Consequence Score of 5, the Risk Score of assessed slope was 95, indicating that the slope is 'very high' in term of Risk Rating.

IV) Slope Information Management System

The Slope Information Management System (SIMS) was developed in 2003 as a collaborative effort between JKR and Japanese International Co-operation Agency (JICA) in order to enhance the previous SPRS system. The study also evaluated shortcomings of the previous three slope management systems in use, and these are listed in **Table 2.9.**

Table 2.9: Shortcomings of the three slope management systems (JICA- JKR, 2001)

Type of system	Shortcomings
SMS	-Data only for 7 geological types -Referencing system confusing -Part of hazard and risk analysis missing -No financial estimates for repair
MEHMS	-Data for 2 geological types only -Referencing system confusing -No form for data entry -Hazard analysis not automated -Cannot generate report -No financial estimates for repair
SPRS	-Data from earlier system cannot be entered -Accuracy of hazard and risk questionable -Estimates for repair not reliable No cost benefit analysis

SIMS uses a modified slope inventory form based on the previous three systems as well as experience gained by the JKR and JICA. Hazard scores used in the system vary from the previous systems and are shown in **Tables 2.10 and 2.11.**

Table 2.10: Hazard Score used in SIMS

Category	Attribute	Value	Score
Topography	Alluvium slope	no	0
		yes	2
	Trace of slope failure	no	0
		yes	1
	Clear knick point of overhanging	no	0
		yes	1
	Concave slope or debris slope	no	0
		yes	1
Geometry (select higher point of A or B???)	A. Soil slope (H is the height of the slope, and I is the angle of the slope)	H < 15 m	10
		15 m < H < 30 m I < 45°	20
		H < 30 m I ≥ 45°	24
		H > 30 m	30
	B. Rock slope	H < 15 m	10
		15 m < H < 30 m	20
		30 m ≤ H < 50 m	26
		H ≥ 50 m	30
Material (select A or B)	A. Soil characteristics (swelling clay contents)	none	0
		slightly	4
		conspicuous	8
	B. Rock quality, sheared rock, weathered rock	not available	0
		slightly	4
		conspicuous	8
Geological structure	Rilict structure (planar, wedge)	no	0
		yes	8
	Soft soil over base rock		6
	Hard rock over weak rock		4
	Others		0
Deformation	Slope deformation: erosion (gully, rill, sheet, fretting), rock fall, exfoliation etc.	none	0
		obscure	8
		visible	10
	Deformation at adjacent slope (rock fall, slope failure, crack, etc.)	none	0
		obscure	4
		visible	6
Surface condition	Surface condition	stable	0
		moderate	6
		unstable	8
	Ground water	dry	0
		water seepage	3
		natural spring	6
	Cover	available (good)	0
		structure	1
		grass and structure	3
		bare	4
	Surface drainage	not available	1
		available (need repairs)	2
Countermeasure effectiveness		effective	-20
		partially effective	-10
		not effective or no countermeasure	0

Table 2.11: Consequent values used in SIMS

Category	Attribute	Value	Score
Nature of probable consequence	Public utilities/services (if gas, oil, telecom, electric, water pipe line are available, mark 'yes')	no	0
		yes	2
	Danger to building occupants (mark 'yes' if distance from toe of slope < 2 x height of slope)	no	0
		yes	2
	Volume of traffic	< 200 AADT	0
		200 – 1,000 AADT	1
		> 1,000 AADT	2
	Angle ß	≤ 30°	0
		> 30°	1
	Failure size, where, A is cut slope (m^3), B is embankment (m^3)	A ≤ 3,000 or B ≤ 1,000	0
		A > 3,000 or B > 1,000	1
	Construction period of temporary diversion	≤ 1 day	0
		> 1 day	1
	Length of alternative roads	≤ 50 km	0
		> 50 km	1

Risk values are calculated as the sum of 0.9 of the total hazard and consequence values ($R = 0.9H + C$) and this is then translated to a qualitative risk rating for the slope ranging from very high, high, moderate to low. The risk rating used in SIMS is shown in **Table 2.12.**

Table 2.12: Risk Rating used in SIMS

Slope Management Level	Risk Score	Risk Rating
Level I	above 75	very high
Level II	between 75 and 66	high
Level III	between 65 and 50	moderate
Level IV	below 50	low

V) Slope Management and Risk Tracking System

The slope Management and Risk Tracking System (SMART) was developed by JKR for the Tamparuli-Sandakan Road in Sabah where there have been numerous slope failures (PWD, 2004). The system uses slope inventory forms similar to previous slope management systems such as SMS, MEHMS and SIMS with some slight modifications. The system also uses spatial data taken from LiDaR surveys. Statistical analysis was then carried out to determine the hazard and risk scores.

In SMART, the hazard score or instability score (IS) ranges between 0 and 1 and is derived through the integration of results from three assessment methods, which are the statistical method (stepwise discriminant function analysis converted into probability), deterministic method (factor of safety determined by CHASM and then converted to probability using Monte-Carlo simulation) and, where appropriate, expert knowledge (PWD, 2004). A twelve-parameter regression equation (Eqn 3.2) derived from stepwise discriminant function analysis, then converted into probability (P), is given as follows:

Y = 0.027(height) + 0.02(angle) + 0.163(shape) + 0.354(plan profile) + 0.278(cutting topography) + 0.202(structure) - 0.172(main cover type) + 0.472(cover) + 0.017(% rock exposure) – 1.266 (corestone boulders) + 0.249(rock condition profile) + 0.281(ground saturation) – 4.293   Eqn (3.1)

Where **Y** is a regression function representing 'instability score' of the assessed slopes. For calculation of **Y**, the slope parameters in the bracket should be replaced by value or classes of slope variables as listed in **Table 2.13.**

Table 2.13: Variables parameters for cut slope determined significant in SMART (JKR, 2004)

Category	Attribute	Value	Score
Cut slope	Height, V_{height}	any value from 0 to 200 meters	0 to 200
	Slope angle, V_{angle}	any value from 0° to 90°	0 to 90
	Slope shape, V_{shape}	simple	1
		planar	2
		asymmetrical	3
		compound	4
	Plan profile, $V_{profile}$	convex	1
		concave	2
		straight	3
	Cutting topography, $V_{cutting}$	top	1
		middle	2
		base	3
		basin/flat ground	4
		sidelong embankment	5
	Structure, $V_{structure}$	none	1
		crib wall	2
		piled wall	3
		surface netting	4
		soil nailing	5
		gabion wall	6
		rock bolts/stitching	7
		concrete wall	8
		masonary wall	9
		others	10
	Main cover type, $V_{covertype}$	grass	1
		shrub	2
		fern	3

		jungle	4
		plantation	5
		agriculture	6
		others	7
	Slope cover, V_{cover}	good (100%)	1
		average (80% to 99%)	2
		poor (< 80%)	3
	Percentage rock exposure, $V_{exposure}$	any number from 0% to 100%	0 to 100
	Corestone boulders, $V_{corestone}$	yes	-1
		no	0
	Rock condition profile, $V_{rprofile}$	majority < Grade III	1
		partly < Grade III and partly > Grade IV	2
		predominantly Grade IV to Grade VI	3
		predominantly Grade IV to Grade VI, but with corestone boulders	4
		predominantly colluviums	5
	Measure of ground saturation, $V_{saturation}$	low	0
		medium	1
		high	2
		very high	3

The equations used to transform the data from individual discriminant function scores (Y) to probabilities of group membership (i.e. failed or not failed) are derived through curve fitting. An example is shown in **Table 2.14**.

Table 2.14: Canversion of Y into probability, *P* (JKR, 2004)

Value of *Y*	Calculation of probability, *P*
$Y < 2$	$P = 0.05$
$-2 \leq Y < 0.5$	$P = 0.0037\,Y^3 + 0.0891\,Y^2 + 0.3195\,Y - 0.3531$
$0.5 \leq Y < 4$	$P = 0.0105\,Y^3 + 0.1275\,Y^2 + 0.5152\,Y - 0.2952$
$Y \geq 4$	$P = 1$

The probabilities are then grouped into groups of qualitative terms of instability category for the purpose of interpretation and action. The instability or hazard rating categories designated for this purpose are Very Low, Low, Medium, High and Very High, as shown in **Table 2.15**.

Table 2.15: Probability and instability category of SMART (JKR, 2004)

Probability, P	Instability Category
0.0 – 0.2	Very Low
0.2 – 0.4	Low
0.4 - 0.6	Medium
0.6 – 0.8	High
0.8 – 1.0	Very High

VI) National Disaster and Information Management (NADII)

The National Disaster and Information Management System (NADII) is developed by the Remote Sensing Centre (MARCER) with the objective of establishing a central system for collecting, storing, processing, analyzing and disseminating value-added data and information to support the National Security Division of the Prime Minister's Department and relevant agencies in the management of major disasters in the country. The system consists of three components early warning, detection and monitoring: and mitigation and relief.

VII) Total Expressway Maintenance Management Network

Projek Lebuhraya Utara Selatan (PLUS) has also developed their own slope ranking criteria to monitor slopes along the North-South Expressway which starts from Bukit Kayu Hitam in Kedah to Johore Baru in Johore. The slope ranking between AA and C ranges from very critical to critical but has no details on the range of values, (**Table 2.16**).

Table 2.16: Slope ranking criteria to monitor slopes along the North-South Expressway (PLUS, 2003)

Slope Ranking Criteria	AA (Very Critical)	A (Critical)	B (PartiallyCritical)	C (Not critical)
Hazard	Very large earthworks close to road A real risk exist	Most large earthworks Some risk to road users	Average size earthworks Quite unlikely but possibility of danger exists	Minor risk that can be ignored Most modest earthworks
Failure risk	Large with poor maintenance and defects Quite likely failure will occur at some stage	Moderate to large, impossible to say failure will not occur	Moderate size Major failure unlikely	Small and shallow, extremely unlikely and only minor failure
Deterioration	Varied cover, needs urgent attention Advanced deterioration due to poor maintenance, erosion	Non uniform cover with bare patches Deterioration significant	Generally good cover with isolated poor areas General deterioration noticeable	Slope that is not quite perfect Slope cover is good with minor deterioration
Cost/Nuisance	Investment is high/failure can cause serious problems	Fairly high investment, large slope on busy section of highway	Moderate slopes where failure would not cause significant effects to normal highway operations	Moderate slopes away from centre of attention Slopes that would not attract adverse publicity if fails
Size	Greater then 10 berms Very large earthworks or deep embankment	4 berms or more most modest sized slopes < 60 m high or moderate embankment	About 3 berms Modest sized slopes less than 20 m high	Small earthworks 2 berms or less

Risk assessment of slopes is carried out to determine the frequency of inspections and to prioritize repair works, according to a ranking in this system risk is defined as the

= Level of danger to road users and likelihood of failure

Where **AA** = maintenance carried out every 6 months; **A** = maintenance carried out every 6 months; **B** = maintenance carried out every 12 months; **C** = maintenance carried out every 18 months.

VIII) D-Slope

D-Slope is an expert system developed for evaluating of the potential failure of cut slopes, (Omar 2002). The system is composed of three major elements, which are field data, slope evaluation analysis and an expert system tool. Slope assessment system used in D-Slope is based on geological and , hydrogeological parameters and slope properties. New nine geological parameters which are geology, weathering, faults, joints, numbers or major sets, orientation, aperture, persistence and spacing.

The two hydrogeological parameters are. rainfall and hydraulic conditions. For the slopes properties, two attributes are selected in the assessment, namely slope height and previous instability. In developing the G-Rating, risk rating value is assigned to each of the 13 parameters for each slope based on the analysis of the collected field data. The rating structure is relatively simple with values of 0, 1, and 2 used according to the definition of each parameter. This simple rating was adopted from Mazzoccolla and Hudson (1996).

The total of individual ratings for the particular slope is determined by summing the individual rating (**Ri**) collected at the site. Thus,

$$\sum R_i = R_{i_g} + R_{i_w} + R_{i_f} + R_{i_j} + R_{i_{ms}} + R_{i_o} + R_{i_a} + R_{i_p} + R_{i_s} + R_{i_s} + R_{i_r} + R_{i_{hc}} + R_{i_{sh}} + R_{i_{pi}} \tag{3.2}$$

The maximum rating (***R**$_{max}$*) for each individual parameter is **2**. So, the total maximum rating was determined by summing the individual maximum rating, which gives the value **26**. Thus,

$$\Sigma \boldsymbol{R_{max}} = R_{maxg} + R_{maxw} + R_{maxf} + R_{maxj} + R_{maxms} + R_{maxo} + R_{maxa} + R_{maxp} + R_{maxs} + R_{maxr} + R_{maxhc} + R_{maxsh} + R_{maxpi}$$

$$= \mathbf{26}$$

For the geological rating, ***G*-Rating**, the formula is as follows;

$$\textbf{\textit{G}-Rating} = \Sigma R_i \ / \ \Sigma R_{max} \qquad (3.3)$$

where **G-Rating** = Risk hazard value of potential failure; ΣRi =Total individual rating; ΣRmax = Total maximum rating.

The potential instability (PI) of the assessed slope is then determined using stereographical plot or stereonet technique. The PI for slope potential to fail based on the analysis will be assigned a YES or NO value .

Using G-Rating and PI, the level of risk scale is shown in **Table 2.17.**

Table 2.17: Level of risk established for D-Slope (Omar, 2002)

Level of risk	G-Rating	PI
No risk	< 0.4	YES or NO
Low risk	0.4 - 0.5	YES
Medium risk	0.5 – 0.7	YES
High risk	> 0.7	YES

An example of how the rating is given to the assessed slope and how the risk level is assigned is shown in **Table 2.18** for example , if the G-rating is **0.54** and *PI* YES, the level of risk of assessed slope is 'Medium risk'. The level of risk for the assessed slope is '**No risk**' if the ***PI*** is NO.

Table 2.18: Example of risk assessment using D-Slope (Omar, 2002)

Parameter	Condition	Rating
Geology	Granite	0
Weathering grade	Moderately weathered	1
Faults	Not present	0
Joints	Major	2
Number of major sets	5	2
Number of orientation	4	1
Aperture	1 – 2 mm	0
Persistence	10 – 20 m	1
Spacing	2 mm	1
Slope height	36 m	1
Previous instability	Active	2
Rainfall	73 – 143 mm	1
Hydraulic condition	Flow	2
	Sum of individual rating	14
	G-Rating (14/26)	0.54

IX) Mineral and Geoscience Department

Chow & Mohamad (2002) describes the use of terrain classification maps by JMG Mineral and Geoscience Department of Malaysia, which are based on four attributes namely slope gradient, morphology, activity and erosion and instability, (**Table 2.19**). Derivative maps are then prepared using a GIS system (using Arc Info or TIN software). The various maps that are produced are the landform map, erosion map, physical constraints map, engineering geology map and land use suitability map (**Figure 2.10**).

Table 2.19: Terrain classification attributes (Zakaria & Chow, 2003; JMG, 2004)

SLOPE GRADIENT	TERRAIN CODE	ACTIVITY CODE	EROSION AND STABILITY
0º-5º 1	Hillcrest/Ridge: A	Natural slope: -rock 1	No apparent erosion: 0
		-soil 2	
6º-15º 2	Sideslope: -straight B	- soil & rock 3	Sheet erosion: -minor 1
	-concave C		-moderate 2
26º-25º 3	-convex D	Cut slope: -rock 4	-severe 3
		-soil 5	
26º-35º 4	Footslope: -straight E	-soil & rock 6	Rill erosion: -minor 4
	-concave F		-moderate 5
36º-60º 5	-convex G	Fill: -rock 7	-severe 6
	Drainage valley: H	-soil 8	
>60º 6		-soil & rock 9	Gully erosion: -minor 7
	Flood plain: I		-moderate 8
		Terrace: -rock a	-severe 9
	Coastal plain: J	-soil b	
		-soil & rock c	Well-defined landslip:
	Littoral zone: L	Reclamation: d	(diameter) <10 m a
			-10-50 m b
	Alluvial plain: X	Mined-out: e	>50 m c
	Wave cut platform: W	Water bodies:-natural f	Instability: -recent n
		-man-made channel g	-relict r
	Excavated platform: Y	-water storage h	
		-pond l	Coastal instability: w
	Undulating Hills P		
		Colluvial: m	

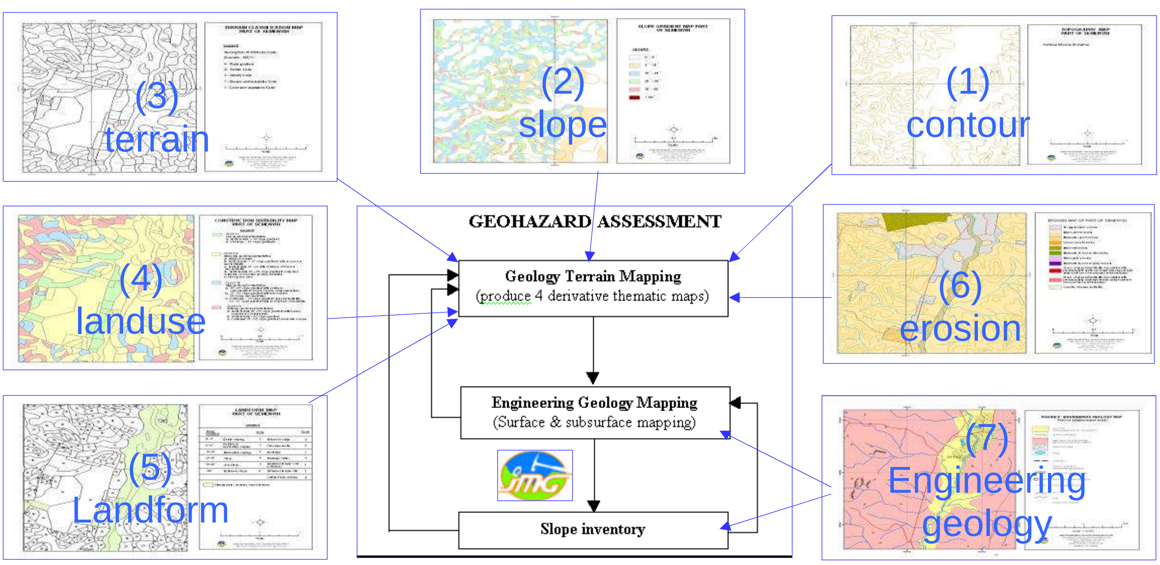


Figure 2.10: Various maps used to produce geology terrain mapping, (JMG,2007)

The classification of hazard and the corresponding hazard score is shown in **Table 2.20.**

Table 2.20: Classification of landslide hazards rating (Chow & Mohamad, 2002).

Class	Hazard rating	Hazard score
1	Low	< 0.25
2	Moderate	0.26-0.5
3	High	0.51-0.75
4	Very High	≥ 0.76

Landslide risk scores are then calculated using the standard equation as shown by Equation 3.4. The consequence and risk scores suggested by Chow & Mohamad (2002) are shown in **Tables 2.21** and **2.22.**

Table 2.21: Weightage for consequential score (Chow & Mohamad, 2002).

Type of risk	Land use/premises	Weight age
Risk of lives	Critical buildings affected	20
	Normal buildings affected	10
	Isolated building affected	5
	Very busy trunk road	10
	Busy trunk road	7
	Moderately used trunk road	5
	Seldom used trunk road	1
Economic loss	Damage to farm/park	3
	Business area (only access)	10
	Only access to housing	6
	area	3
	Temp. diversion (> 1 day)	0
	Temp. diversion (≤ 1 day)	3
	Alternative road (≥ 5km)	0
	Alternative road (< 5km)	
Public Utilities	Affected	10
	Not affected	0
Proximity of building to suspected landslide	Very close	10
	Close	5
	Possibly affected	2
	Unlikely to be affected	0
	Not affected	0

Table 2.22: Classification of landslide risk rating (Chow & Mohamad, 2002).

Rating	Total score
Low risk	< 12.5
Moderate risk	12.6-25
High risk	26-35
Very high risk	> 35

Normally Risk or *R* is calculated by multiplying the hazard values (*H*) with the consequence values (*C*) and is given by

$$R = H \times C \quad (3.4)$$

X) Malaysian Center for Remote Sensing (MACRES)

Ab. Talib (2001, 2004) carried out a study on the use of remote sensing data and GIS techniques for the development of hazard maps for slope instability and failure prediction in Cameron Highlands in Perak. The study used the Information Values method to indicate the most relevant factors influencing slope instability Ab. Talib 2001 and Napiah *et al*. 2004) also describes the use of the same method. to produce hazard zonation maps for Selangor . Parameter maps were generated from geological, land use, geomorphological, slope, landslide distribution and distance map. **(See Figure 2.11)**

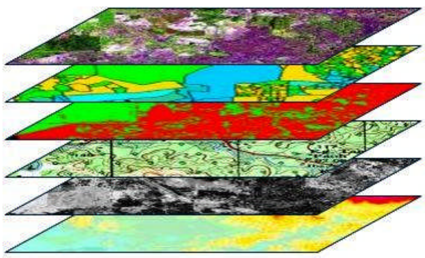
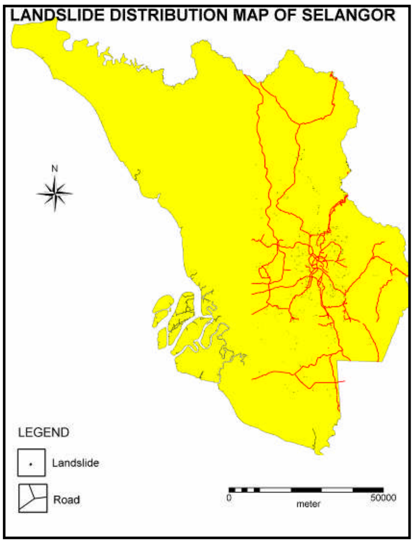
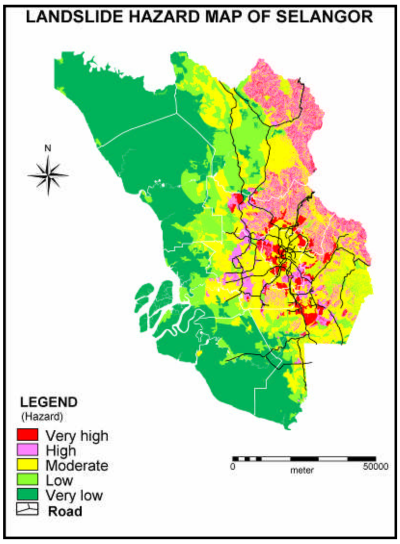


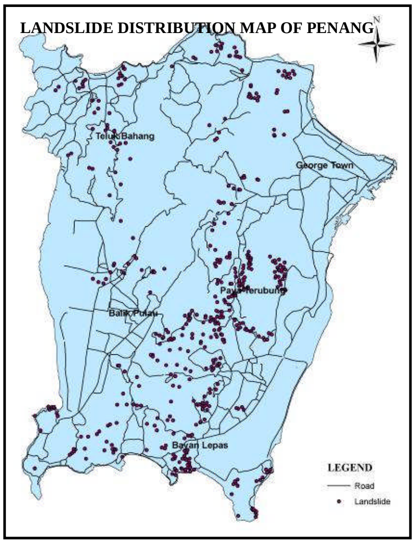
Figure 2.11: Parameters to generate hazard map

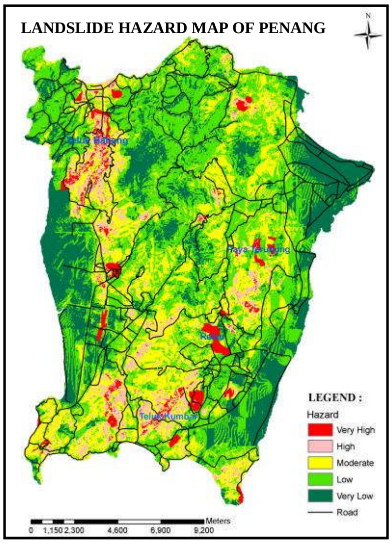
Macres also uses remote sensing and related techniques to produce technologies outputs e.g landslide hazards maps for Penang and Selangor at the scale of 1:50,000 for JKR and PLUS. **(See Figure 2.12.)**





Landslide Distribution map of Selangor — Landslide hazard map of Selangor





Landslide Distribution map of Penang — Landslide hazard map of Penang

Figure 2.12: Examples of hazard maps for Penang and Negeri Selangor (after Macres)

XI) Evaluation of Slope Assessment Systems

In 2006, Jamaludin *and his team undertook* a study to evaluate the accuracy of several slope assessment systems used in the country. The study evaluated five slope assessment systems for predicting landslides an large scale . The five systems were SMS, SPRS, SIMS, SMART, and LHRA. The first four system were developed by the JKR , while the fifth (LHRA) was developed by Fiener . Large-scale assessment refers of maps scale a between 1:5,000 and 1:15,000 (IAEG, 1976).

The study used slope inventory data from 139 cut slopes underlain by granitic formation and 47 cut slopes underlain by meta-sediment formation, which are the two most common rock and soil formations found in Malaysia . The cut slopes in granitic formations along three different sites, namely the Gunung Raya Road on Langkawi Island, the East-West Highway in Perak, and the Kuala Kubu Baru– Gap Road in Selangor were used in the evaluation of the slope assessment system for the granitic formations. Data from 47 cut slopes along the Gunung Raya road and the East-West highway were used for evaluating the SAS for the metasediment formation. The slope inventory data such as slope height, slope angle, soil type, and weathering grade were collected over a ten-year period, from 1994 to 2004. Data are obtained from previous records as well as through site visits (walkthrough survey). Only Landslide occurrences that have occurred after the initial slope data collection. Were recorded by differences seen on multi-date aerial photos, or differences between older sketches of the data collection performa and the current site performa and recorded from written historical records.

The study found that none of the existing slope assessment systems were satisfactory in predicting landslides of cut slopes in both granitic and meta-sediment formations with the exception of SMART for meta-sediment formations, as shown in **Table 2.23**. Satisfactory in this case is defined as percentage of prediction accuracy of greater than 70%. The reason for not achieving a might prediction accuracy could be due to use of hazard scoring developed from other countries, insufficient local data base, oversimplified approach methods and use of data base derived from rockand soil formations..

Table 2.23: Accuracy of the Slope assessment systems in predicting landslides

Prediction	SMS	SPRS	SIMS	SMART	LHRA
(1) Number of slopes assessed	139	139	139	139	139
(2) Number of recent landslides or failed slopes	44	44	44	44	44
(3) Number of slope classified as High and Very High Hazard	65	71	2	72	8
(4) Number of slopes classified as High and Very High Hazard that actually failed	17	23	1	27	1
(5) Percentage of (4) compared with (2)	39%	52%	2%	61%	2%
Cut slopes in meta-sediment formations					
Prediction	**SMS**	**SPRS**	**SIMS**	**SMART**	**LHRA**
(1) Number of slopes assessed	47	47	47	47	47
(2) Number of actual landslides or failed slopes	29	29	29	29	29
(3) Number of slopes classified as High and Very High Hazard	22	29	7	40	0
(4) Number of slopes classified as High and Very High Hazard that actually failed	13	17	5	26	0
(5) Percentage of (4) compared with (2)	45%	59%	17%	90%	0%

2.3.3 Landslide Hazard Assessment Method and Analysis

Methods that may be used to identify hazards include geomorphological map, and historical data on sites of similar topography, geology and climate (e.g, from maintenance records, aerial photographs, newspapers and reviews of stability analysis. When some form of geological and geomorphological mapping is recommended in the fieldwork stage of the site during inspection . Stapledon (1995) and Baynes & Lee (1998) provide further guidance on the role of geology and geomorphology in landslide investigations.

A list of possible hazards should be developed. Consideration must be given to hazards located off-site as well as on the immediate site as it is possible for landslides both upslope and down slope to affect a site. It is vital that the full range of hazards (e.g. from small, high-frequency events to large, low-frequency events) be included in the analysis. Often, the smaller, more frequent landslides pose higher risks. The effects of proposed development should also be considered, as these effects may alter the nature and frequency of possible hazards. The common landslide hazard assessment or classification falls into five main categories:-

a) Geomorphological method five
b) **Heuristic Method** (Expert judgment approach)
c) **Statistical Method** (Discriminant analysis)
d) **Deterministic Method** (Common slope stability analysis approach).
e) **Spatial Method** (GIS approach)

The application of these methods is dependent on the following conditions:-

a) **The scale of landslide assessment** – In general, if the scale of the hazard study is small, simple methods such as heuristic method and deterministic method can be adopted. Statistical methods will only be applied when there are sufficient slope failure records and slope numbers.

b) **Available of Information** - Some assessment methods such as discriminant analysis require sufficient failure records in order to obtain an accurate hazard classification. The failure records are required to segregate/discriminate failed and stable slopes based on landslide contributing factors.

c) **Type of landslide assessment** - In general, landslide assessment can be divided into two main categories: linear-based assessment and area-based assessment. Linear-based hazard assessment is for slope hazard assessment along linear infrastructures such as road, expressway, railway and electric transmission lines. Area-based assessment concentrates on development areas such as housing developments. Spatial method using the GIS approach is recommended for area-based hazard assessment.

The methods of hazard assessment will be reviewed. The best method of assessment is be recommended in the National Slope Master Plan for both linear and area-based assessment.

Hence landslide and slope engineering are not just limited to landslide hazard assessment. Slope management always involves some form of risk management, although it is seldom formally recognised . In order for the Government and local agencies to effeplan expenditure and development, it is indeed important to address both the landslide risk and hazard.

Before any landslide risk assessment is carried out, the elements at risk shall be identified first. Subsequently, risk evaluation is carried out to identify the risk tolerability or the consequences of the elements at risk. The landslide risk rating (R) can be produced from hazard rating (H) and consequences rating (C) where

Risk (R) = Hazard (H) x Consequences (C).

I) Geomorphological Method

In this section, a direct method using geomorphological approach is reviewed. This approach is a widely used approach to evaluate both landslide hazards and risks for a reasonably sized area.

To assess landslide hazards and risks, a geomorphological approach combines the analysis of sites specific and historical information. More precisely, the methodology involves the following steps:

1. Definition of the extent of the study area
   This involves identifying the location and extent of each area to be investigated (i.e. the "site"). This is not a trivial problem, because sites in different lithological and morphological domains have to be identified using the same criteria.
2. Production of a multi-temporal landslide inventory map, including a landslide classification

Landslides tend to occur (in time and in space), within the vicinity of other landslides area, or within the same slope or watershed. This suggests that knowledge of the location of past failures is the key to forecasting the future occurrence of landslides in the region.

Landslides are classified according to types of movement, estimated age, degrees of activity, depths and velocities. The level of certainty in the recognition landslides is also noted. Landslide type is defined according to the classifications of Varnes (1978), Cruden and Varnes (1996), and the WP/WLI (1990, 1993 and 1995). Landslide age, activity, depth, and velocity are ascertained according to the type of movement, the morphological characteristics and appearance of the landslide, the local lithological and structural settings, and, where available, the results of site-specific investigations carried out to solve local instability problems.

In general, the geomorphological landslide hazard assessment method can be subdivided into two main approaches, namely:-

i) Landslide frequency approach
ii) Landslide density approach or a combination of both approaches.

Landslide frequency approach

To assess hazards based on the landlside frequency appraoch, information on landslide frequency is needed. *Frequency* refers to the temporal occurrence of landslides and can be obtained through the analysis of historical data (Guzzetti et al., 1999). In general, a complete (or at least systematic) record of past landslides from which to derive the frequency of occurrence is difficult to obtain for a single landslide, slope, or small watershed (Ibsen and Brunsden, 1996; Glade, 1998; Guzzetti et al., 1999). Guzzetti argued that evidence of past movements on a slope might not necessarily indicate the possibility of future landslides.

For convenience, four classes of landslide frequency are identified:

- Low frequency (1), where only one landslide event was observed;
- Medium frequency (2), where 2 events were observed;
- High frequency (3), where 3 events were observed; and
- Very high frequency (4), where more than 3 events were observed.

<u>Landslide intensity approach</u>

In the landslide intensity approach, the size and speed of the landslide is important. In general, the intensity of the landslide is based on the volume of the slide and velocity. Contrary to other natural hazards such as earthquakes or volcanic eruptions, no unique or commonly recognised measure of landslide intensity is available (Hungr, 1997).

Table 2.24 shows the intensity of each landslide (or group of landslides) based on the estimated volume and the expected velocity.

Table 2.24: Landslide intensity, grouped into four classes: light (1), medium (2), high (3) and very high (4). Note that landslide intensity varies with the landslide type

Estimated volume (m^3)	Expected landslide velocity		
	Fast moving landslide (Rock fall)	Rapid moving landslide (Debris flow)	Slow moving landslide (Slide)
< 0.001	Slight (1)		
<0.5	Medium (2)		
>0.5	High (3)		
<500	High (3)	Slight (1)	
500–10 000	High (3)	Medium (2)	Slight (1)
10 000–50 000	Very High (4)	High (3)	Medium (2)
> 500 000		Very High (4)	High (3)
>> 500 000			Very High (4)

The expected landslide velocity depends on the type of failure, volume and estimated depth of movement. In tterms of landslide volume, fast moving rock falls have the highest landslide intensity, while rapidly moving debris flow exhibits intermediate intensity, and slow-moving landslides have the lowest intensity.

The landslide hazard (**H**) based on the frequency of landslide movements (**F**) and on the landslide's intensity (**I**) is as follows:-

$$H = f\,(F, I)$$

Table 2.25 shows the landslide hazard ranting for each landslide hazard zone (LHZ), combining frequency and intensity by F. Guzzetti. Landslide frequency was estimated using four classes, based on the number of landslide events (of the same type) observed within each LHZ. Landslide intensity was defined as four classes, based on the estimated volume and expected velocity.

Table 2.25: Landslide hazard for each LHZ: Landslide intensity, grouped into four classes: light (1), medium (2), high (3) and very high (4), and the estimated landslide frequency, grouped into four classes: low (1), medium (2), high (3) and very high (4) (after F. Guzzetti)

Estimated landslide Frequency	Landslide intensity			
	Light (1)	Medium (2)	High (3)	Very high (4)
Low (1)	1 1	1 2	1 3	1 4
Medium (2)	2 1	2 2	2 3	2 4
High (3)	3 1	3 2	3 3	3 4
Very high (4)	4 1	4 2	4 3	4 4

Levels of landslide hazard in **Table 2.25** are shown using a two-digit positional index. The right digit shows the landslide intensity (I) and the left digit shows the estimated landslide frequency (F). This allows a user to understand whether the hazard is due to a high frequency of landslides (i.e, high recurrence), a high intensity (i.e, large volume and high velocity), or both.

It is worth noting that values of the landslide hazard index shown in **Table 2.25** do not provide an absolute ranking of hazard levels. Whilst the extreme values are easily defined, intermediate conditions of landslide hazard are more difficult to rank. A landslide that exhibits low frequency and low intensity (H = 11) will certainly have a much lower hazard rating than one that exhibits very high frequency and high intensity (H = 44). Deciding whether the hazard of a landslide with very high frequency and low intensity (H = 41) is higher (or lower) than that of a landslide with low frequency and very high intensity (H = 14) is not straightforward and may be a matter of opinion.

Advantages, disadvantages and general comments

- The geomorphological method is empirical and subject to various levels of uncertainty, but has proven to be reliable and cost effective, allowing for a detailed definition of landslide hazard and risk in urban and rural areas.
- The method compares landslide hazards and risks in different (and distant) areas, and where different landslide types are present.

- Assessment of landslide hazards requires forecasts to be made in different settings in space and time, and with different types and dimensions. It can be carried out over a large area, such as a drainage basin , or for a single landslide or group of landslides (Cruden and Fell,1997; Guzzetti et al., 1999).
- The proposed method ascertains landslide hazard in the areas of (probable) evolution of the existing landslides, and for the various types of failures (i.e. slides, debris flow, rock falls) separately.
- The method says nothing about hazards outside a LHZ, even within the same elementary slope. In these areas, minor landslides and mostly superficial failures may occur with low frequency. For a regional, spatially distributed landslide hazard and risk assessment, other methods should be used (van Westen, 1994; Carrara et al., 1995, 1999; Guzzetti et al.,1999), possibly in combination with the method proposed here.
- The methodology requires extensive geomorphological judgment. For this reason it should only be used by skilled geomorphologists. If the extent, type, distribution and pattern of past and present landslides are not correctly and fully identified, serious errors can occur, and thus affect the estimate of landslide hazard and risk.

II) Heuristic Method

In the heuristic method, instability factors are ranked and weighted according to using decision rules and expenced reasoning.

This requires experts to evaluate the contributing factors to landslide and forecast landslide hazards (Barredo et al., 2000; Esmali and Ahmadi, 2003).

In heuristic methods, the expert opinion of the earth scientist making a surveyof a given area is used to classify the hazard. These methods combine the mapping of mass movements and their geomorphologic setting as the main input factors for hazard determination. This is called geomorphologic analysis.

The method of geomorphic analysis was developed outlined by Kienholz (1977), who produced a combined hazard map based on the mapping of "silent witnesses" (Stumme Zeugen). The geomorphic method is also known as the *direct mapping* method. The hazard is determined directly either in the field or by photo or satellite image interpretation by the earth scientist. The process is based on individual experience and the use of reasoning by analogy. The decision rules are, therefore, difficult to formulate because they vary from place to place and yield unformalized applicable rules that vary from polygon to polygon. This method is totally subjective and dependent on the skill and experience of the earth scientist.

III) Statistical Method

In the statistical (or probabilistic) method, the role of each factor is determined on the basis of observations in relation to past/present landslide distribution.

In statistical landslide hazard analysis, the combination of factors that have led to landslides in the past are determined statistically, and quantitative predictions are made for areas currently free of landslides but where similar conditions exist. The overlaying of parameter maps and the calculation of landslide densities form the core of the analysis. Most of the analyses are based on the relationship between the landslide density per parameter class compared with the landslide density over the entire area, and then the results are used to predict future landslides (Clerici et al., 2002; Dai and Lee, 2002; Donati and Turrini, 2002; Gupta and Joshi, 1990). This model is suitable for medium-scale landslides. Each method has its own specific rules for data integration required to produce the total hazard map. Two different statistical approaches are used in landslide analyses: bivariate and multivariate approaches.

<u>Bivariate Statistical Methods in Landslide Hazard Analysis</u>

In this method, the overlay of parameter maps and calculations of landslide densities form the core of the analysis. The importance of each parameter or specific combination of parameters can be analysed individually. Using normalized values (landslide density per parameter class in relation to the landslide density over the whole area), a total hazard map can be made by addition of the weights for individual parameters.

Bivariate statistical analysis deals with one dependent variable (in this case the occurrence of mass movements) and one independent variable. The importance of each factor is analysed separately. Specific combination of variables can also be tested by treating the combination map as a new variable. The methods are based on the assumption that the important factors leading to mass movements can be quantified by calculating the density of mass movements for each variable class.

The weight values can also be used for design decision rules, which are based on the experience of the earth scientist. It is also possible to combine various parameter maps into a map of homogenous units, which is then overlaid by the landslide map to give a density per unique combination of input parameters.

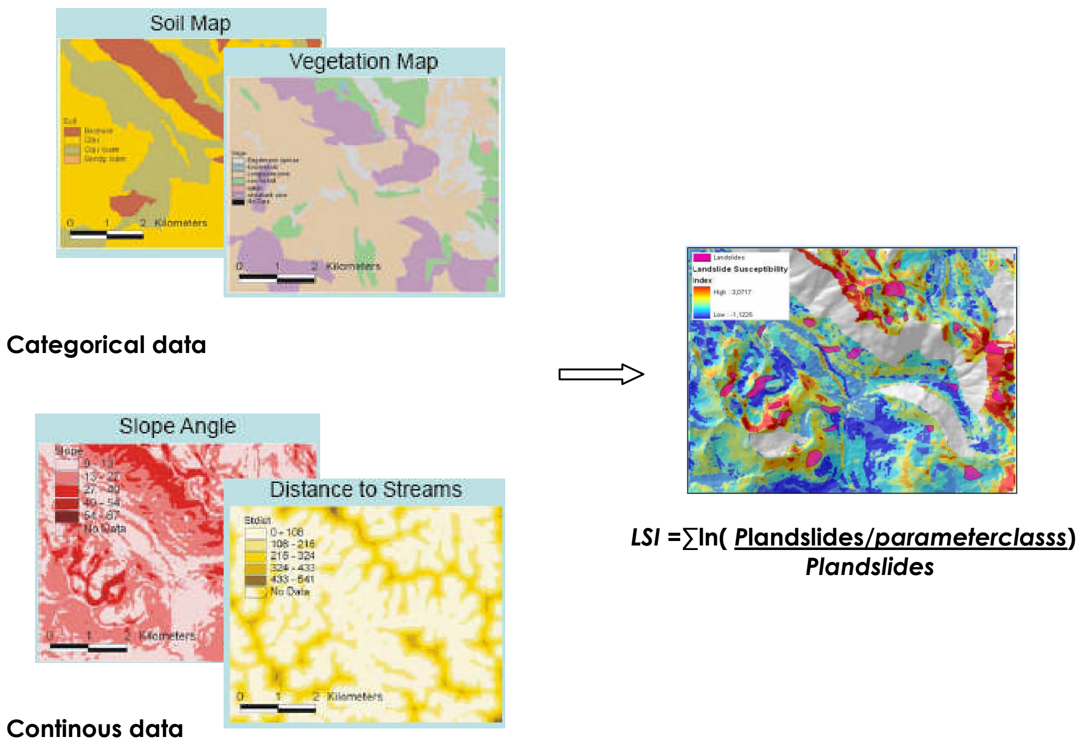


Figure 2.13: Example of bivariate statistical analysis

Advantages and disadvantages

i. Provides a good combination between expert-derived parameter choices and quantitative spatial analysis
ii. Gives quantitative and objective measure on landslide susceptibility
iii. Are independent of input parameters
iv. Requires complete landslide inventory maps
v. Possible drawbacks from up scaling of training areas

Multivariate Statistical Methods in Landslide Hazard Analysis

Multivariate statistical analyses of important causal factors controlling landslide occurrence may indicate the relative contribution of each of these factors to the degree of hazard within a defined land unit. The analyses are based on the presence or absence of stability phenomena within these units (Van Westen, 1993).

Multivariate statistical analysis models for landslide hazard zonation were developed in Italy, mainly by Carrara (1983, 1988) and his colleagues (Carrara et al.,1990, 1991, 1992). In their applications, all relevant factors are sampled either on a large-grid basis or in morph metric units. For each of the sampling units, the presence or absence of landslides is also determined. The resulting matrix is then analysed using multiple regression or discriminant analysis. With these techniques, good results can be expected in homogenous zones or areas with only a few types of slope instability processes. When complex statistics are applied, as was done by Carrara (1983, 1988) and his colleagues (Carrara et al., 1990, 1991, 1992) or by Neuland (1976) or by Kobashi and Suzuki (1988), subdivision of the data according to the type of the landslide should be also made. Therefore, large data sets are needed to obtain enough cases to produce reliable results. The use of complex statistics implies laborious efforts in collecting large amounts of data, because these methods do not use selective criteria based on professional experience. Multivariate statistical analyses of important factors related to landslide occurrence give the relative contribution of each of these factors to the total hazard within a defined land unit. The analyses are based on the presence or absence of mass movement phenomena within these land units, which may be catchments areas, interpreted geomorphic units, or other kinds of terrain units.

The most common and well-known multivariate statistical method used in earth sciences is **multiple regression**. It is used to correlate landscape factors and mass movements, according to the following linear equation.

$$Y=b_0 + b_1X_1 + b_2X_2 + \_\_\_\_\_\_\_\_\_ + b_nX_n$$

The dependent variable Y represents the presence (1) or absence (0) of a mass movement. It can also be expressed as the percentage of a terrain unit covered by landslides. The variables X_1-X_n are the independent variables, such as slope class, geological units, etc. The symbols b_0-b_n is the partial regression coefficients. The standardised partial regression coefficients, which are the partial regression coefficients expressed in units of standard deviation, indicate the relative contribution of the independent variables to the occurrence of landslides (Davis, 1986). The following statistics are used to evaluate the result of a calculation.

R^2: amount of variance accounted for by the model. It adjusts for the number of independent variables in the regression

SE: standard error of estimate. The square root of the residual mean square error. It measures the unexplained variability in the dependent variable.

MEA: absolute mean error. The average of the absolute values of the residuals, which is the average error one can expect in a prediction.

Terrain units are used for sampling of variables in multiple regressim analysis. However, there are a number of problems in using terrain units, namely:

1. Sampling method
2. Size of terrain unit
3. Resultant maps
4. Sample areas / prediction areas
5. Complexity of the study areas

In order to avoid these cited problems, a pixel -based approach is used. However, even with this approach, the data requirements of normal distribution can not be achieved. A series of assumptions made on the data normality which, degrades the efficiency of the whole system.

A second type of multivariate analysis is *discriminant* analysis. The objective of the analysis is to find the best discrimination between two groups: units or pixels with mass movement and those without . The analysis results in a discriminant function:

$$D_s = B_0 + B_1X_1 + B_2X_2 + \_\_\_\_\_\_\_\_ B_nX_n$$

Where X_1 are the values of the variables and B_1 the calculated coefficients. Before any further analysis can be performed, the success of the formula in separating the two groups must be tested. For this purpose three tests can be used.

1. The variability between the two groups and within the groups, and the total variability of the data, are calculated. The ratio of the variability between the two groups and the variability within the groups is called the eigenvalue. It should be maximized for a good discriminant function.
2. The ratio of the variability between the two groups and the total variability is called "Wilk's λ". A small value indicates strong variation between groups and less variation within groups. A Wilk's λ of 1 indicates that there is equally great variation within groups as between groups (i.e. the function does not discriminate)
3. Conducting a χ^2 test to determine if the two groups are significantly different.

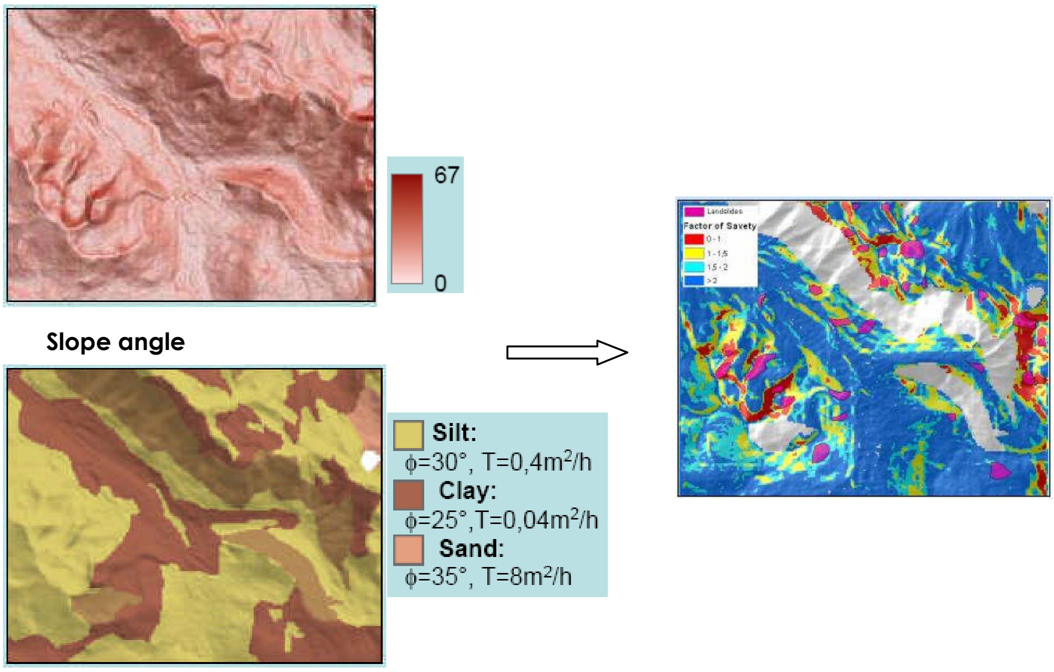
Furthermore, as the slope stability depends on several factors acting at the same time, some efforts have been directed towards the acquisition of simply and quickly determined parameters. Using scored factors, Stevenson (1977) proposed a method to evaluate relative landslide risk in clayey slopes.

Of the two multivariate analysis methods, Discriminant analysis provides a more accurate stability assessment. A classical work using statistical techniques is that from Jones et al. (1961) on landslides in the Pleistocene terrace deposits of Colombia River. A total of 160 slump earth flow movement and 60 stable slopes were considered. Qualitative and quantitative factors influencing sliding were searched. A final analysis using the discriminant - function method was performed, considering original slope (X1), submergence percentage (X2), terrace height (X3) and groundwater (X4) as influencing factors.

IV) Deterministic Method

The deterministic model is often used in a large scale area where the hazard in absolute values in the form of safety factors, or the probability of failure could be provided (Jibson et al., 2000; Luzi and Pergalani, 1996; Miles and Ho, 1999; Refice and Capolongo, 2002).

In deterministic analysis, the landslide hazard is determined using slope stability models, through the calculation of factors of safety. Deterministic models provide the best quantitative information on landslide hazard that can be used directly in the design of engineering works, or quantification of risk. However, they require a large amount of detailed input data derived from laboratory tests and field measurement, and can therefore only be applied over small areas at large scales.



Soil parameter map

Figure 2.14: Example of deterministic factors of safety mapping (e.g. SINMAP)

Advantages and disadvantages

A. Based on sound physical models

B. Capable of predictive landslide analysis

C. Requires high accuracy of input parameters

D. Predictive models difficult to evaluate

E. Complex modelling to perform at smaller scales

Monte Carlo simulation can also be adopted in this approach to obtain hazard output as probability distribution. Many different types of probability distribution may be use a depending on the nature of the input parameter. Monte Carlo simulation involves repeating the calculation of factor of safety (FS) many times using input parameters generated from their associated probability distributions. The resulting FS value will gradually build up their own probability distribution as the simulation is repeated. The advantage of Monte Carlo simulation is its simplicity and its ability to cope with complex calculations using a large number of input parameters.

V) Spatial Method

Aerial Photographs

Aerial photography is used in cartography (particularly in photogrammetric surveys, which are often the basis for topographic maps), land-use planning and other fields**.**

Stereographical aerial photography [Rengers (1986), Sissakian (1986) and Mollard (1986)] could be counted as single application manuscripts. However, studies with landslides and aerial photographs are as old as the applications of first stereographical aerial photographs.

Landslide information extracted from remotely sensed products is mainly related with the morphology, vegetation and hydrological conditions of the slope, (**Figure 2.15** Commission of Inquiry, 1980). The slope morphology is best examined with stereographical coverages. Generally the identification of slope instabilities is indirect, via associated elements with slope instability process.

The advantages of aerial photographs are that :

1. They provide older coverage before the digital world started
2. The flight coverages are flexible for new missions
3. The spatial and temporal resolution is very high
4. There is stereoscopic coverage
5. Most geoscientists are familiar with aerial photographs
6. Every country has at least one full coverage of their land for military reasons

The disadvantages are as follows:

1. Low spectral resolution
2. The nature of photograph as hardcopy
3. Presence of distortions in the images
4. Absence of coordinate information

3. Ortho rectification is needed to remove distortion and add co-ordinate information
4. The resultant map is dependent on the experience of the interpreter

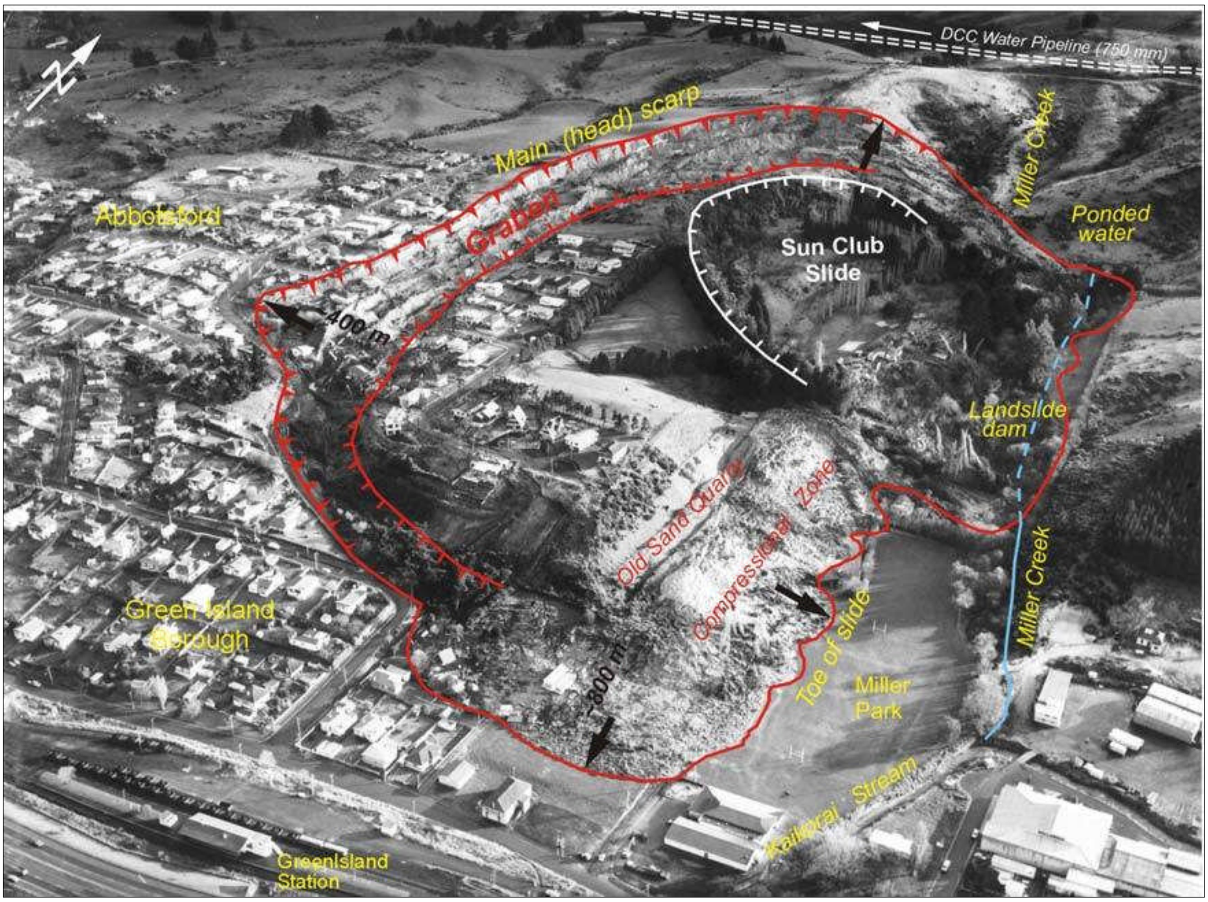


Figure 2.15: Example of an aerial photograph (Photo: Aeropix, Dunedin)

Satellite Images

The applications of space borne images are quite new. Furthermore, they generally define the landslides indirectly by mapping out other parameters such as land cover. Some examples mentioned in literature are Gagon (1975) Mc Donalds and Grubbs (1975) Sauchyn and Trench (1978) Stephens (1988) Huang and Chen (1991) and Vargas (1992).

There are many types of visible band satellite imagery that can help detect where slides have occurred or where they are about to occur. Change detection images can be taken before and after movements.

In general landslide studies can be organised into three phases:

1. Detection and classification of landslides
2. Monitoring activity of existing landslides
3. Analysis and prediction of slope failures in space (spatial distribution) and time (temporal distribution)

The importance of satelite photography in these studies cannot be overstared for example, it severity of the landslide hazards in Hong Kong has resulted in a comprehensive landslide database and a natural terrain landslide inventory (NTL). It is derived mainly from the interpretation of medium to large scale satelite photographs, and describes the location of landslides.

Figure 2.16: Satellite images of landslide on Lantau Island, Hong Kong a) 2002 and b) 2003

In comparison to aerial photographs, the advantages of satellite images are:

1. A bigger picture
2. Larger spectral range
3. Easily accessible
4. No distortion
5. Only georeference is needed to transfer the coordinates

The disadvantages are:

1. Low spatial resolution
2. More expensive than aerial photographs of the same resolution

3. Limited stereo capability
4. Few geoscientists are familiar with aerial photographs

Geographical Information System

A GIS is defined as a "powerful set of tools for collecting, storing, retrieving at will, transforming, and displaying spatial data from the real world for particular purposes" (Burrough, 1986). A more specific definition is given by Bonham-Carter (1996) as follows: "A geographic information system, or simply GIS, is a computer system for managing spatial data. The word geographic implies that the locations of the data items are known, or can be calculated, in terms of geographical coordinates. The word information implies that the data in GIS are organised to yield useful knowledge, often as coloured maps and images, but also as statistical graphics, tables and various on-screen responses to interactive queries. The word system implies that a GIS is made up of several inter-related and linked components with different functions. Thus, GIS has functional capabilities for data capture, input, manipulation, transformation, visualization, combination, query, analysis, modelling and output.

The GIS technique was used by Hassanzadeh(2000) for Landslide hazard zonation in conjunction with the multiple regression method involving lithology, slope angle, precipitation and land use as factors with successful results.

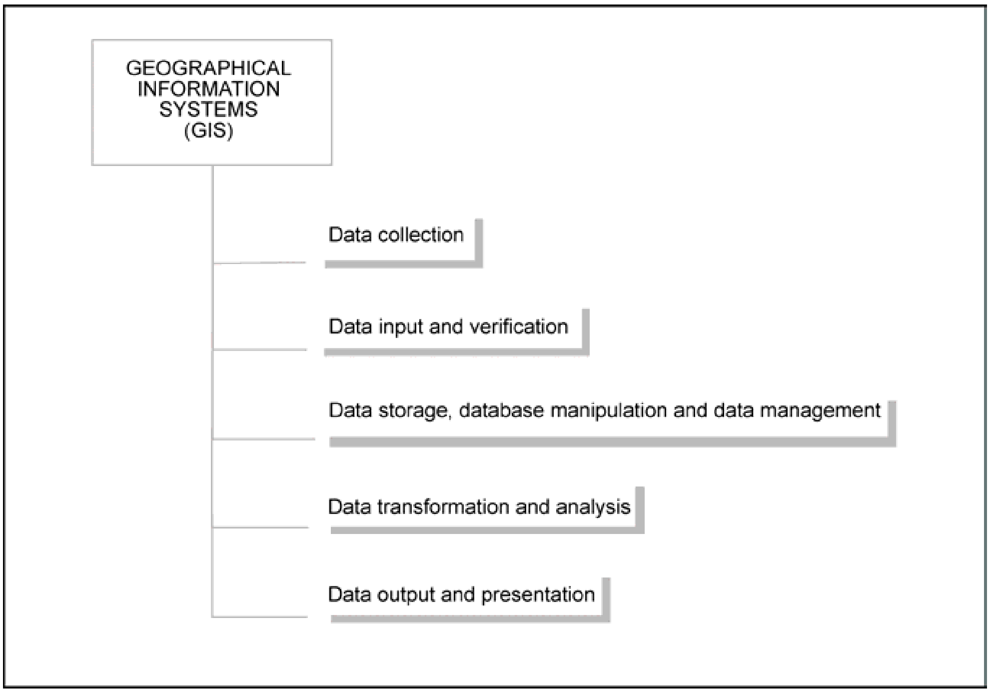


Figure 2.17: Phases of a GIS

The following steps outline the process of a hazard analysis using GIS (Van Westen, 1993. There is a logical order in the sequence although sometimes the steps may overlap. The time schedule of these phases is listed in **Table 2.26.**

1. Choice of the working scale and the methods of analysis which will be applied
2. Collection of existing maps and reports with relevant data
3. Interpretation of images and creation of new input maps
4. Design of the database and definition of the way in which the data will be collected and stored
5. Fieldwork to verify the photo-interpretation and to collect relevant quantitative data
6. Digitising of maps and attributing the data.
7. Validation of the entered data
8. Manipulation and transformation of the raw data to a form that can be used in the analysis
9. Analysis of data for preparation of hazard maps
10. Evaluation of the reliability of the input maps and inventory of the errors that

may have occurred during the previous phases

11. Final production of hazard maps and adjoining report

Table 2.26: Time schedule comparison of phases of landslide hazard assessment of conventional methods and GIS based methods based on scale

Phases	Regional Scale		Medium Scale		Large Scale	
	Conventional Methods	GIS Based Methods	Conventional Methods	GIS Based Methods	Conventional Methods	GIS Based Methods
1. Choice of scale and methods Of analysis	<5	<5	<5	<5	<1	<5
2 Collection of existing data	<5	<5	<5	<5	8	8
3. Image Interpretation	50	50	30	30	10	20
4. Database design	0	<5	0	<5	0	<5
5. Fieldwork	<5	<5	7	7	10	20
6. Data Entry	0	20	0	30	0	15
7. Data Validation	0	<5	0	5	0	5
8. Data Manipulation	0	<5	0	5	0	5
9. Data Analysis	30	10	48	10	61	10
10. Error Analysis	0	<5	0	<5	0	<5
11. Final Map Production	10	<5	10	<5	10	<5

(numbers are in percentage of the total project time) (Van Westen, 1993).

The advantages of GIS for assessing landslide hazards include the following:

1. A much larger variety of hazard analysis techniques is attainable. Because of the speed of calculation, complex techniques requiring a large number of map overlays and table calculations become feasible.
2. It is possible to improve models by evaluating their results and adjusting the input variables. Users can achieve maximum results by a process of trial and error, running the models several times. Therefore, more accurate results can be expected.

The disadvantages of GIS for assessing landslide hazards include the following:

1. A large amount of time is needed for data entry. Digitizing is especially time consuming.
2. There is the danger of placing too much emphasis on data analysis to the detriment of data collection. A number of different techniques of analysis are theoretically possible, but often, the necessary data are missing. In other words, the tools are available but cannot be used because of the lack of or uncertainty of data.

2.3.4 Landslide Risks

The previous sections have described hazards in detail. When hazards impact lives and activities, it is known as risk. This section provides definition of landslide risks and risk management.

Varnes (1984) describes risk as the expected number of lives lost, persons injured, property damaged, or economic activity disrupted because of a particular natural phenomenon. To quantify risk, Varnes (1984) gave the following factors and definitions:

1. Vulnerability – degree of loss to a given element or set of elements at risk resulting from the occurrence of a natural phenomenon of a given magnitude. For a property, the loss will be the value of the property; for persons, it will be a particular life (the element at risk), for those affected by landslides.

2. Element of risk – population, properties, economic activities and so on at risk in a given area.

3. Specific risk – expected degree of loss to a particular phenomenon.
   - (Rs): probability x vulnerability for a given element (Varns, 1984; Fell,1994; United Nations, 1991):
     Rs = P x Vrability
     Where P is probability and V is vulne

4. Element at risk – population, properties, economic activities including public services etc at risk in a given area.
5. Total risk – expected number of lives lost, person injured, property damaged or economic activity disrupted due to a particular phenomenon, which is a product of specific risk and element at risk. It is the product of specific risk (Rs) and elements at risk (E) over all landslides and potential landslide.
   - Rt = ∑ (E x Rs)
     = ∑ (E x P x V) (Fell & Hartford, 1997)

Risk is often estimated by the mathematical expectation of the consequence of an adverse event occurring (i.e.,the 'product of probability x consequences'). However, a more general interpretation of risk involves probability and consequences in a non-product form.

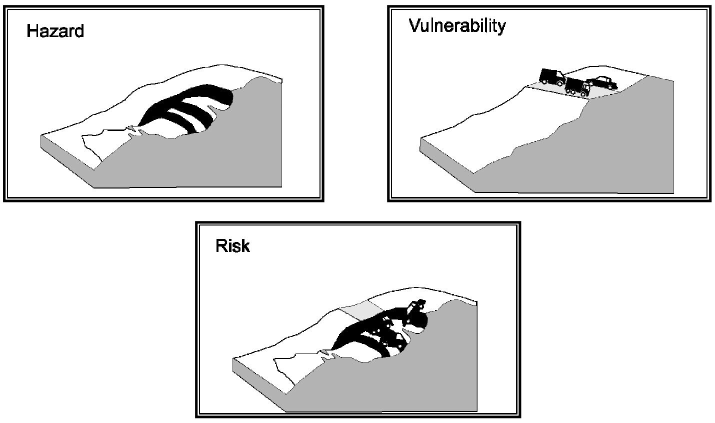


Figure 2.18: Graphical representation of hazard, vulnerability and risk

Risk analysis involves acquiring knowledge of the slope stability hazards, as well as consideration of the consequences of land sliding if person and/or property are impacted by failure. Firstly, a thorough study of the types, characteristics and frequency of landslide in a given study area is carried out in order to identify the hazard. Where the frequency of landslides cannot be determined directly from field evidence, or where engineered slopes are involved, analytical or numerical techniques are required to evaluate the probability of failure.

Secondly, consequence analysis is carried out to establish the element at risk (persons and/or property), which could be impacted by any failure, and to determine their vulnerability in the event of failure.

The assessment of landslide hazard and risk requires input from a number of disciplines and areas of knowledge such as geosciences, hydrogeology, geotechnical engineering, geomorphology, and meteorology and communications technology. Understanding geological processes and the development of landforms is always very valuable. Basic controlling factors for slope stability must be recognised, identified and, where feasible, quantified. Attention must be paid to the main triggering factors such as rainstorms and earthquakes.

Past events and processes may provide a basis for understanding the present and for projection into the future. However, predictions based solely on past events may prove to be inaccurate and even misleading. For example, past events may have occurred under climatic conditions very different from the present conditions or what is anticipated in the future. Changes of climate within a human or engineering time scale are now considered to be a realistic scenario, quite apart from the major climatic changes associated with nature. Thus improved assessments of hazard and risk would require that detailed knowledge of geology, ground conditions and triggering factors be obtained through investigation and observation before carrying out analyses and making appropriate interpretations. The importance of uncertainties in ground conditions and in the nature, and occurrence of triggering factors must be recognised. Temporal and spatial uncertainties must be included in hazard assessment and risk management.

I) Objective of Risk Management

The objective of risk management is to ensure that significant risks are identified and that appropriate action is taken to minimize these risks as much as is reasonably possible. Such actions are determined based on a balance of risk control strategies, their effectiveness and cost, and the needs, issues, and concerns of stakeholders. Communication among stakeholders throughout the process is a critical element in this risk management process **(Figure 2.18**). Decisions made with respect to risk issues must balance the technical aspects of risk with the social and moral considerations, [Guidelines for Decision Makers *document* developed by the Canadian Standards Association (1997)].

II) Risk Management

Risk management is a complete process involving all six steps in the decision-making framework and communication on risk issues.

Step 1: Initiation of Landslide Risk Management

- General recognition of landslide risk
- Identify element(s) present
- Identify stakeholders
- Select and retain professionals with expertise in landslide hazard and risk analysis

Step 2: Preliminary Analysis

- Confirm that risk exists; determine type of landslide(s)
- Identify study area, time frame of study
- Evaluate background information and constraints
  - Determine type and scope of landslide hazard/risk analysis

Step 3: Risk Estimation

- Determine potential landslide trigger mechanisms
- Estimate probability/likelihood of landslide occurrence
- Estimate probability/likelihood of landslide affecting element(s) at risk
- If within the scope, estimate potential loss and worth of element(s) at risk
- Estimate risk to element(s) from landslide(s)
- Clearly communicate results of risk analysis

Step 4: Risk Evaluation

- Compare analysis results with thresholds of acceptable or tolerable risk (legislative, public, corporate)
- Include issues relating to agency or stakeholder perceptions of risk

- If risk is within thresholds of acceptable or tolerable risk, control is not necessary
- Determine whether more accurate risk analysis is needed

Step 5: Risk Control (if necessary)

- If risk is unacceptable, develop options to reduce likelihood of landslide occurrence or to protect element(s) at risk
- Select preferred alternatives based on reduction in landslide risk and cost-effectiveness
- Develop implementation plan that contains preferred option for risk control

Step 6: Action/Monitoring

- Implement plan with preferred option to reduce landslide risk
- Carry out field reviews during/following site work, as needed
- Over extended periods of time, compare risk estimates with performance of site works(Land Management Handbook, 2004).

Once a risk has been identified, there are a number of options available to manage that risk, being:

- Ignore the risk - this should not be considered an option
- Mitigate the risk – engineer the risk to prevent the likelihood or consequence of an event
- Accept the risk – if the risk is accepted, emergency plans should be made to manage the consequences of an event and/or any residual risk
- Avoid the risk – avoid putting life and property at risk by not carrying out the function that would lead to the risk

  Transfer the risk – insure against any risk. However, the intrinsic value of life and treasures can not be compensated by insuring against the risk.

III) Acceptable Risk

The Geotechnical Engineering Office (GEO, 1998) categorized the risk acceptance criteria into two types:

1. Individual risk – the frequency of harm (fatal or major injuries) per year to an individual ex posed to a hazard.
2. Societal risk – the predicted number of fatalities per year, often expressed as the relationship between the frequency of an incident per year, *F*, and the associated numbers of fatalities, *N*.

For individual risk criteria, unacceptable risk was risk above 1E-04, (Hardingham *et al*., 1997), while the GEO (1998) revised the value for landslides and boulder (rock) falls from natural terrain to be 1E-05 for new development and 1E-04 for existing development. For societal risk criteria, **Figure 2.19** showns the societal risk criteria in 1995 while values above 1E-03 are considered unacceptable. **Figure 2.20** shows the modification made by GEO in 1998.

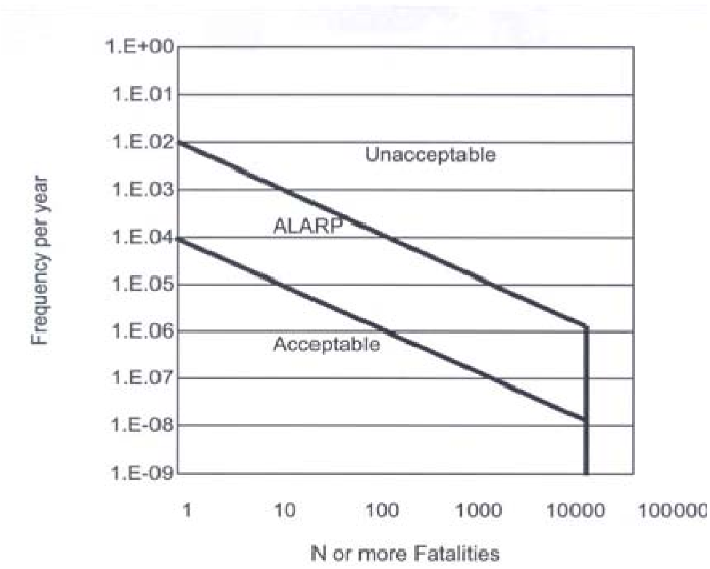


Figure 2.19: Societal risk criteria .

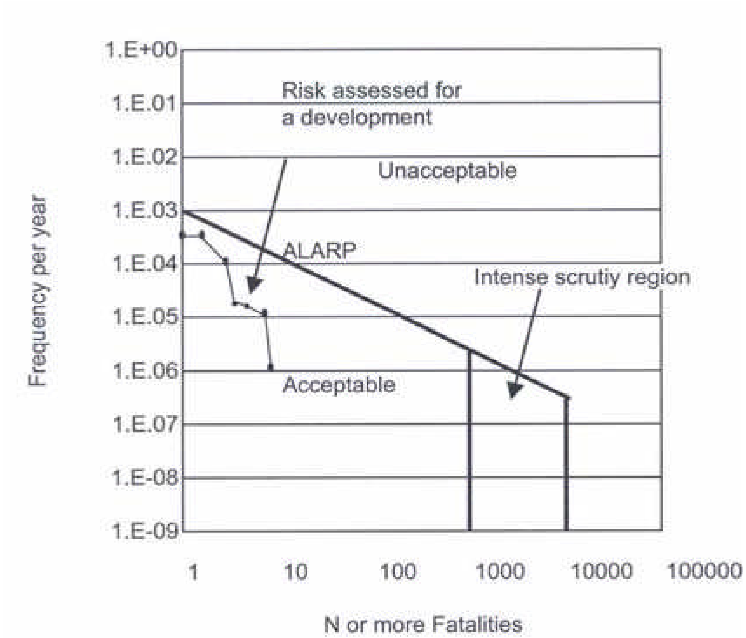


Figure 2.20: Modification of societal risk

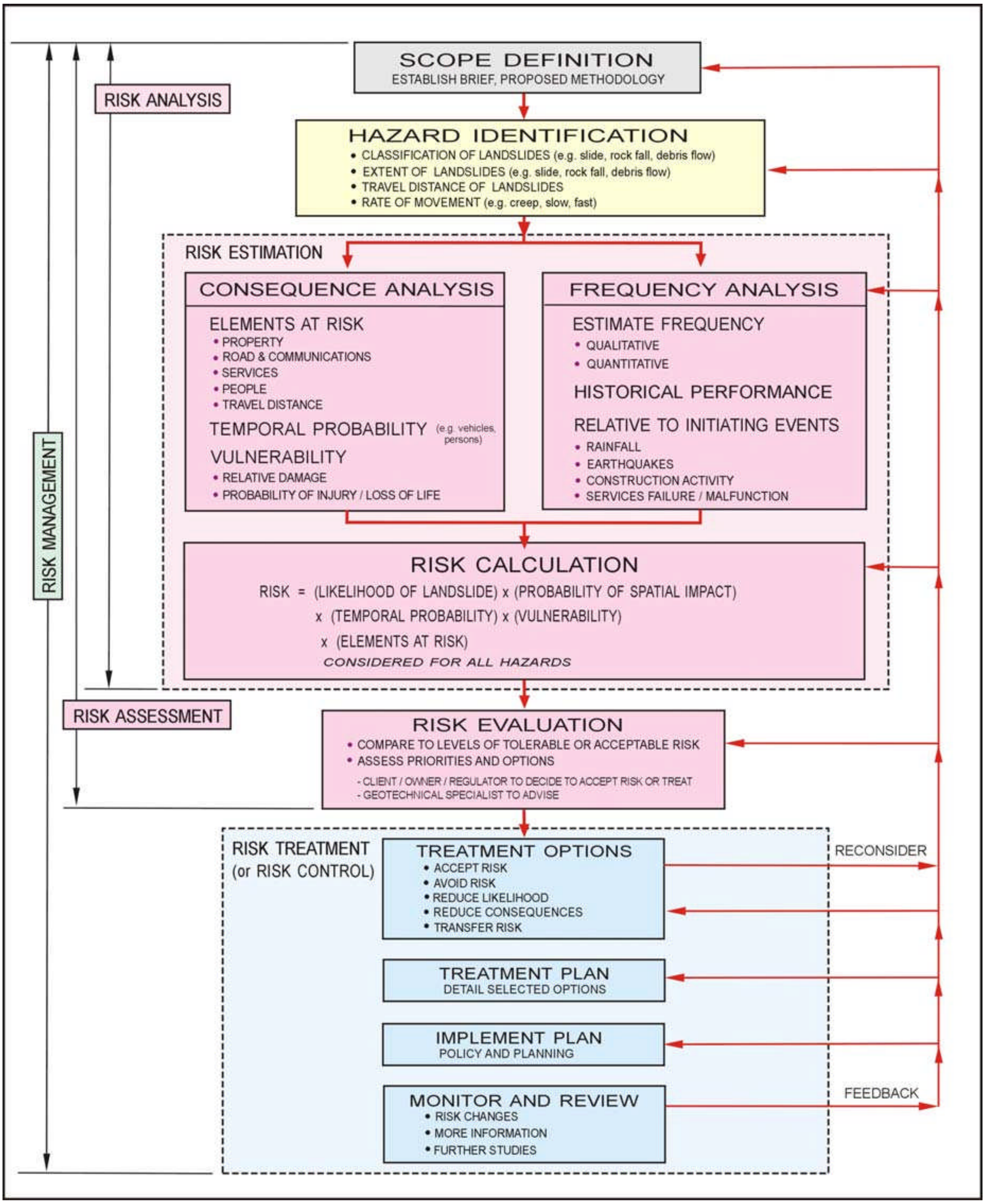


Figure 2.21: **Schematic flowchart showing the landslide risk assessment and management process developed by the Australian Geomechanics Society (after AGS, 2001)**

Risk values are usually classified into five types, i.e. through the following very high, high, moderate, low and very low risk. Landslide risk can be mitigated by four approaches (Kockelman, 1986):

1. Restriction of development in landslide-prone areas
2. Codes for excavation, grading, landscaping and construction
3. Physical measures (drainage, slope-geometry modification and structures) to prevent or control landslides
4. Development of warning systems

2.3.5 Guidelines and Methodology (Landslide Hazard Map Preparation)

This section presents techniques used to map each of the key factors associated with landslides. With these maps, a landslide hazard map can be prepared. Hazard zonation is a means of identifying areas with differing landslide hazards. The step-by-step approach or factor analysis used to prepare a landslide hazard map, is described. Factors can be of being mapped and specific combinations of these factors are associated with differing degrees of landslide hazards. The identification of the extension of these combinations over the area being assessed results in a landslide hazard map.

I) Base Map for Hazard Mapping

A base map is required before any hazard assessment can be carried out. For the base map, a topographic or photographic map can be used. The topographic map is more effective preparing information for a hazard map than ortho-photos. A photographic map has too much information to interpret. High resolution satellite images can also be used, especially for large area assessment. As for localized areas, the recent development in survey technology, i.e. the advancement of LiDAR (Light Detection and Ranging) technology with high-resolution digital ortho-rectified photographs has made base map preparation easier and more accurate.

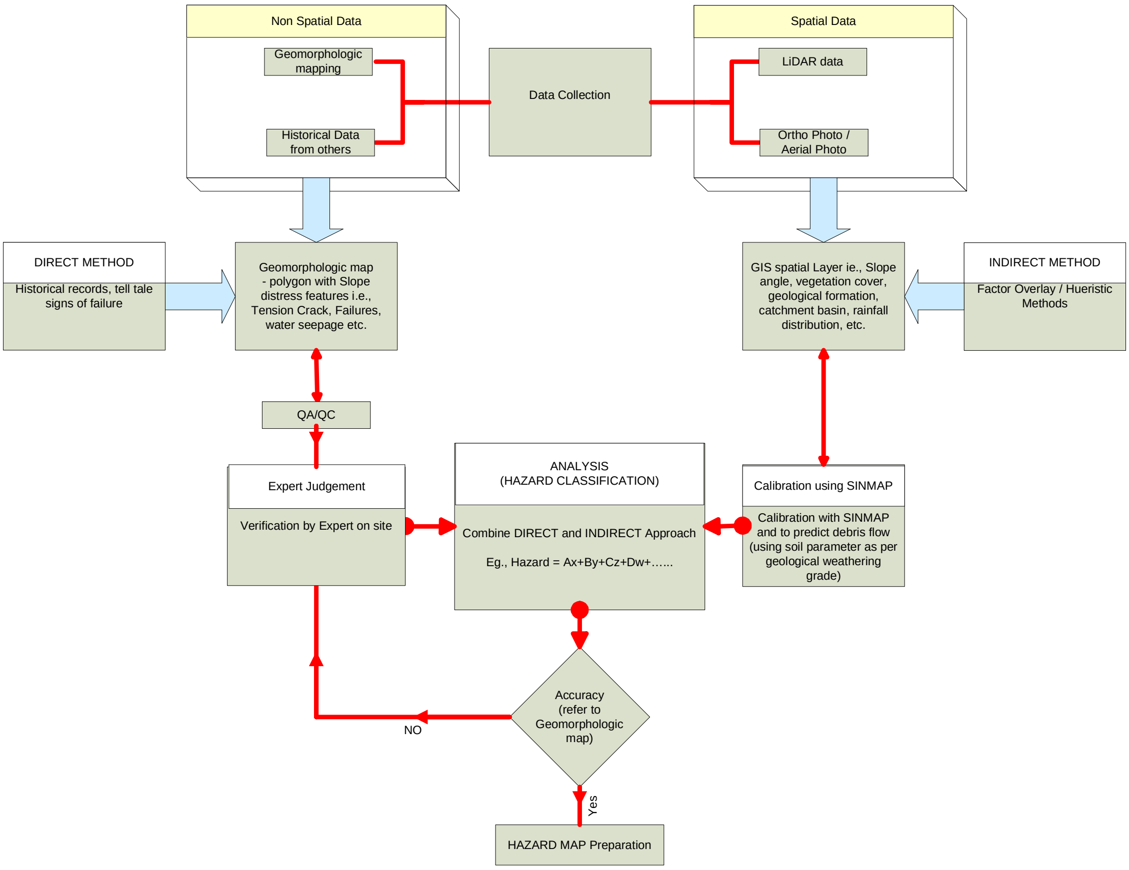


Figure 2.22: Hazard map and assessment flow chart

LiDAR is one the best techniques to produce geomatic data for any geographical purposes. This airborne laser system has its own unique solutions to deliver close-to -ground data accuracy at an airborne speed with little effect from bad weather. It eliminates the GCP need for imagery processing.

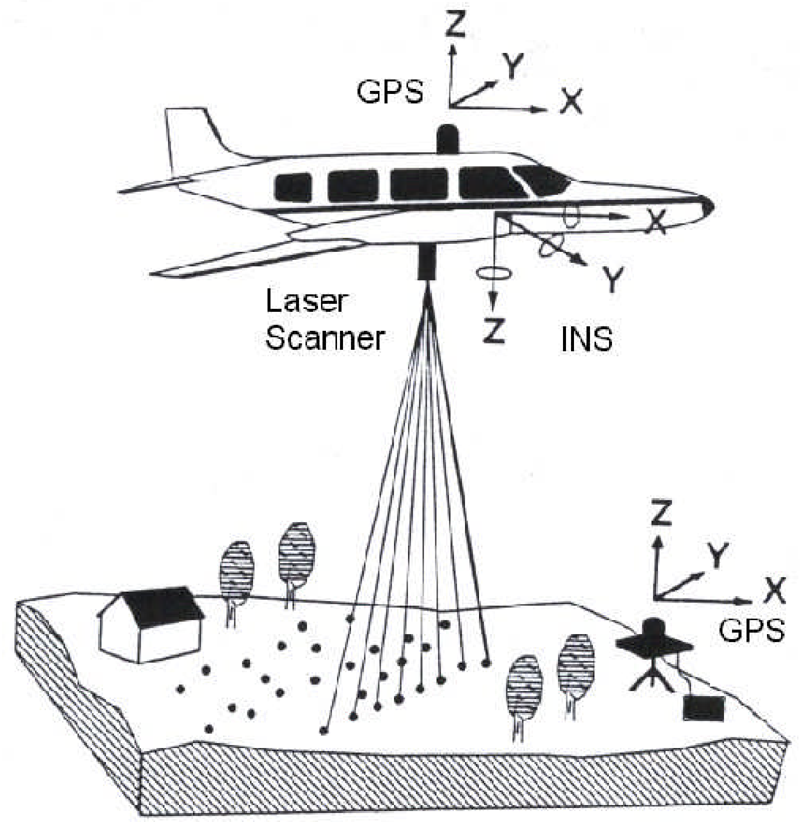


Figure 2.23: Illustration of how LiDAR sensing instrument captures elevation points

One disadvantage of this technology is the limitation to survey features that are hidden from airborne capture such as culverts and piers below bridges . But it is offset by the advantage of fast mapping of hostile grounds, densely forested jungles, non-accessible areas or huge areas that requires high accuracy and intensity of data.

At very high speed, the current LiDAR mapping technology can provide a very accurate terrain model to produce a contour map of terrain floor of any forest or cleared land to within 0.15m resolution. Three-dimensional spot heights are produced at 0.2m to 3m grids depending on flying height and skewing angle.

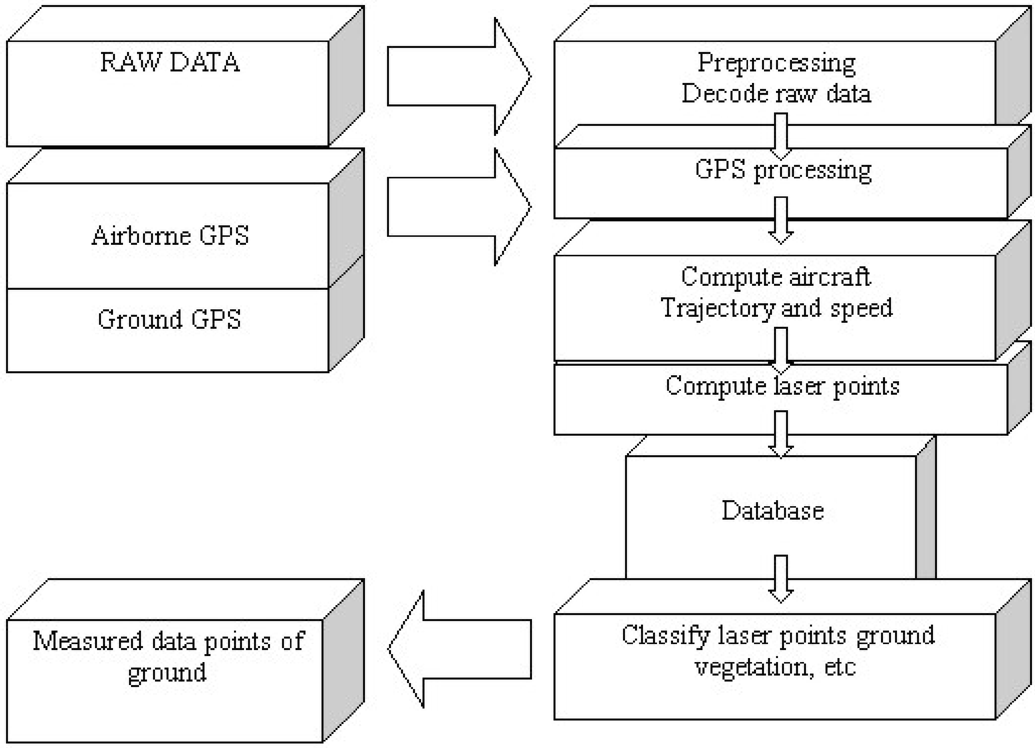


Figure 2.24: LiDAR processing stages

The airborne laser technique is one of the techniques that can accurately provide terrain information below tree canopies without interpolation other than a conventional ground topographical survey. In terms of time and precision over massive forested sites, LiDAR is the best technique to work with. The resulting high accuracy survey data with high-resolution ortho rectified photographs provide spatial information to be used in preparing the base map in GIS environment for landslide hazard assessment.

The use of LiDAR is suited to areas where high accuracy of works is required. LiDAR should not be applied for simple hazard mapping works in non-critical areas.

II) Mapping the Inventory of Existing Landslides

A map of existing landslides serves as the basic data source for understanding conditions contributing to landslide occurrence. Normally, such a map is prepared by the interpretation of aerial photography and field examination of selected locations. While this map could also be compiled by field methods alone, the time and expense involved would only be justified by the unavailability of photos. Either means of map preparation requires the skills of a geologist with experience in landslide or landform interpretation. Typically, large-scale photography is necessary to be useful for existing landslides.

There are several considerations to keep in mind when gathering data on existing landslides.

- First, the time and effort required to conduct an inventory varies with (1) geologic and topographic complexit; (2) size of an area and (3) desired level of inventory detail (Varnes, 1985).
- Second, more detailed inventories will require larger map scales to reveal the small features of added details.
- Third, additional data gathering can add detail to an existing inventory.

III) Mapping the Types of Bedrock Contributing to Instability

To produce a useable bedrock map for hazard assessment, bedrock unit boundaries should be traced to produce new, more suitable units. Existing standard geologic maps define units according to factors such as age, composition or lithology (rock type), and structure (such as faulting and folding etc). For example, a standard geologic map may show a series of volcanic ash deposits of similar mineral compositions, which vary slightly in age. In most instances, these different units will affect landslide occurrence in a similar way and should be delineated as a single bedrock unit in a revised map for hazard assessment work.

IV) Mapping Slope Steepness or Inclination

Slope steepness is a factor that associates the effectiveness of gravity acting on a slope to landslide susceptibility. A digital topographic map is the source for preparing a slope steepness map. The slope steepness map displays the steepness values associated with the majority of existing landslides . Steepness for landslide hazard assessment is commonly expressed as a percentage rather than in degrees. The categories or grouping of steepness values for use in analyzing landslide hazards should approximate those of the slopes present in the study area (Primer on Natural Hazard Management in Integrated Regional Development Planning). Too many classes will make it difficult to identify slopes critical to landslide occurrence, and too few will be equally useless.

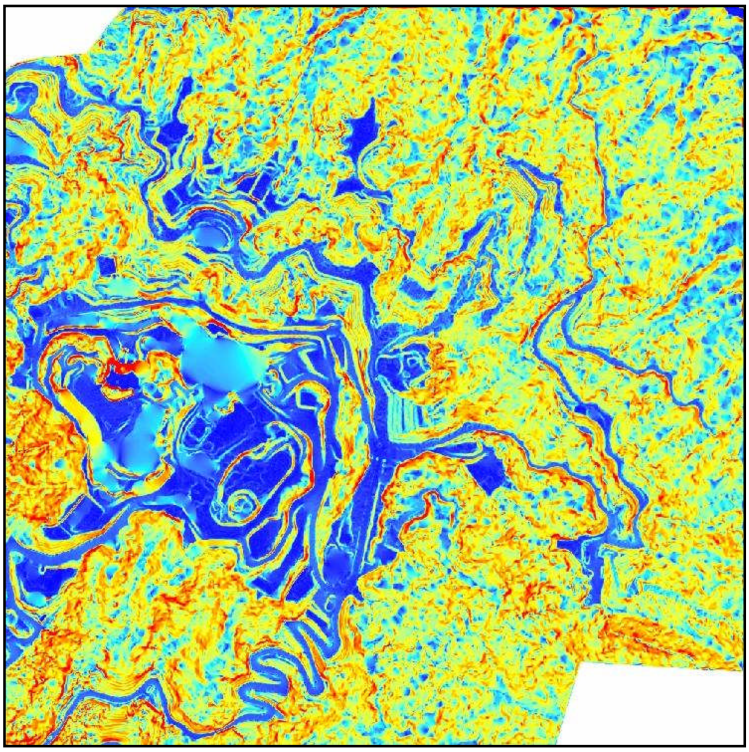


Figure 2.25: Slope steepness map

V) Optional Hydrologic Factor-Mapping Indirect Measures

As information on water table levels and fluctuations is rarely available, mapping indirect measures such as vegetation and slope orientation can reveal the influence of hydrology in an area. Any vegetation map used to represent the hydrologic factor in the landslide hazard assessment must employ units that are dependent on water. This may be as simple as representing phyreatic and non-phyreatic plant communities or as complex as distinguishing different forest types *(Primer on Natural Hazard Management in Integrated Regional Development Planning)*.

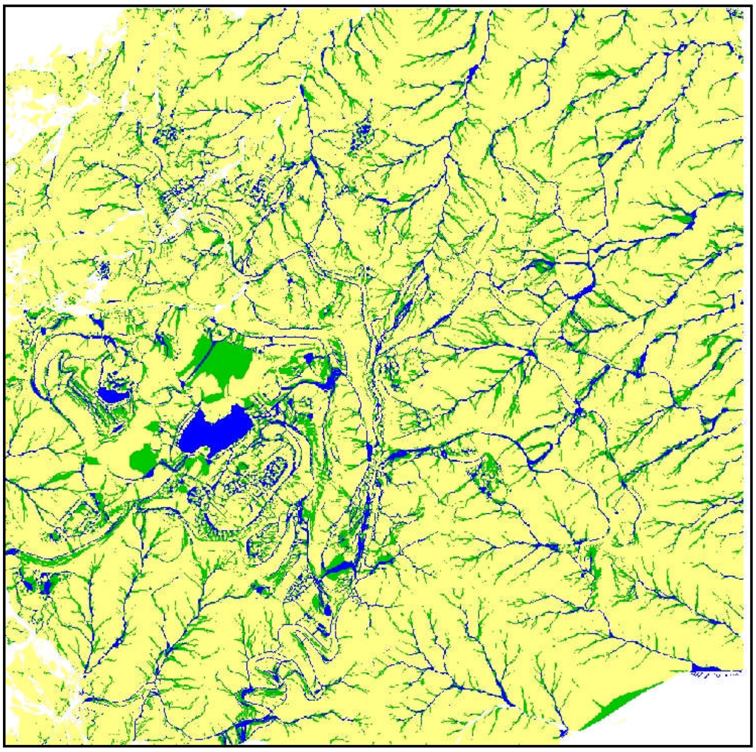


Figure 2.26: **Hydrology map**

Interpreting Landslide Hazards: The Landslide Hazard Map

A landslide hazard map is generated to identify areas with differing landslide hazards. A hazard map is produced for each stage of the planning process, from the more generalized map in the initial stage to a detailed zonation map for specific site use. As the name suggests, this map divides the entire study area into sub-areas based on the degree of a potential landslide hazard. The landslide hazard map is produced by interpreting data represented by the maps in the landslide inventories and the permanent factors found to influence the occurrence of landslides (*Primer on Natural Hazard Management in Integrated Regional Development Planning).*

As with any map, scale is an important consideration. There are two points to keep in mind concerning the scale of the landslide hazard map.

1. Such a map should be produced at a scale capable of representing the information needed at a particular planning level. Compatibility of scale

would be important when the hazard map is to be combined with other maps to yield a land capability map.

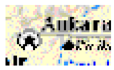
2. The landslide hazard map should be at a scale not markedly different from the data maps used to produce it. In other words, reliability may be questionable when a landslide hazard map produced at a scale of 1:50,000 have been based on a 1:250,000 slope steepness map.

Scales of analysis are were presented in an International Association of Engineering Geologists (IAEG) mMonograph on engineering geological mapping (IAEG, 1976, (**Figure 2.27).**

1.National Scale
<1:1.000.000
Inventory
Entire Country
Based on Records

2. Regional Scale
<1:100.000
Regional Planning
Large Areas
Simple Methods

3. Medium Scale
1:25.000 to 1:50.000
Local Planning
Areas up to 200 sqkm
Statistical Methods



4. **Large Scale**
> 1:10.000
Detailed Planning
Small areas
Stability analysis

Figure 2.27: Scales of analysis and (IAEG, 1976)

Table 2.27: Hazard analysis techniques in relation to mapping scales (after Soeters and Van Westen, 1996)

Type of Analysis	Technique	Characteristics	Scale of Use Recommended		
			Regional 1:100,000	Medium 1:25,000	Large 1:10,000
Inventory	Landslide distribution analysis	Analyze distribution and classification of landslides	Yes	Yes	Yes
	Landslide activity analysis	Analyze temporal changes in landslide pattern	No	Yes	Yes
	Landslide density analysis	Calculate landslide density in terrain units or as isopleth map	Yes	No	No
Heuristic	Geomorphologic analysis	Use in-field expert opinion in zonation	Yes	Yes	Yes
	Qualitative map combination	Use expert-based weight values of parameter maps	Yes	Yes	No
Statistical	Bivariate statistical analysis	Calculate importance of contributing factor combination	No	Yes	No
	Multivariate statistical analysis	Calculate prediction formula from data matrix	No	Yes	No
	Probabilistic (Magnitude/ Frequency)	Calculate prediction from inventory and time period using power law	Yes	Yes	No
Deterministic	Safety factor analysis	Apply hydrological and slope stability models	No	No	Yes

Table 2.28: The proposed scale of mapping

Planning Stage	Hazard Identification Need	Landslide inventory level	Suitable Scales For Hazard Maps
Preliminary Desk Study	Identify hazard issue	As available	As available
Overall landslide hazard map	Degree of hazard from all types of landslides	Simple	1:250,000 to 1:50,000
Overall landslide hazard map for specific area or road	Degree of hazard from all types of landslides supplemented by hazard from some specific types	Intermediate	1:50,000 to 1:10,000
Project Implementation especially for area based assessment for local development	Site-specific hazard based on geotechnical models	Detailed	1:12,500 to 1:500

Four levels of relative hazard are proposed on a landslide hazard map:

1. Low
2. Moderate
3. High
4. Extreme hazard

The level of landslide hazard is measured onan ordinal scale and is a quantitative representation of differing hazard levels that shows only the order of relative hazard at a particular site and not absolute hazard. Predicting absolute hazard is impractical with current capabilities.

As a consequence, there is no way to compare hazard zones at different sites or to determine the likelihood that a high hazard area, for example, is two or ten times more likely to fail in the future than low hazard areas. It should be stressed that these relative hazard zones are based on existing landslides and conditions influencing their occurrence in a specific area. The hazard zones which are determined for an area hold true only for the area for which they were prepared. Similar conditions found outside the assessed area may not produce the same degree of hazard.

The most important question to ask in any landslide hazard study relates to its degree of accuracy. The terms, accuracy and reliability, are used to indicate whether the hazard -map makes a correct distinction between landslide-free and landslide prone areas. The accuracy of landslide prediction depends on a large number of factors, the most important of which are:

1. Accuracy of the models
2. Accuracy of the input data
3. Experience of the earth scientist (geologist)
4. Size of the study area

Related to the problem of assessing the accuracy of hazard maps is the question of their objectivity. The terms, objective and subjective, are used to indicate whether the various steps taken in the determination of the degree of hazard are verifiable and can be reproduced by other researchers or whether they depend on the personal judgment of the earth scientist in charge of the hazard assessment.

2.3.6 Proposed Plan

The proposed hazard assessment components of the National Slope Master Plan are as follows:-

Term	Proposed Plan
Short term	▪ It is proposed that the slope engineering department be set up both atfederal and state level immediately for landslide hazard assessment. The setup and responsibilities for the regional office are outlined in section 2.3.7. ▪ It is important to verify all the available slope inventory and management systems in Malaysia. A more accurate analytical tool for landslide hazard and risk assessment shall be identified and proposed as the preliminary tools for hazard assessment nationwide. ▪ It is proposed that the government shall immediately carry out hazard assessment at landslide-prone areas such as the Hulu Klang area in Selangor and Penang Island to address the landslide problems in hillside development areas. ▪ Review existing systems, especially linear based such as the. SMART and system; propose upgrading, in particular the analytical tools in the system. This upgrading shall consider the findings from the management systems review mentioned above. ▪ Identify landslide hazard roads in order to plan landslide hazard and risk assessment works that require budgetingunder the 10th Malaysian Plan. ▪ Proposed training for hazard assessment in o Data collection, including forming a proper QA/QC plan for data collection works. The QA/QC plan is important to ensure consistency in collected data. o Landslide Hazard and Risk Assessment o Training shall be also carried out on landslide inventory

	data collection for regional engineers, geologists and technicians in order to update the landslide inventory database. o Propose landslide hazard and risk assessment as one of the syllabus in local universities and institutions (refer to R&D and Training Component)
Medium term	▪ Review and update existing database by including the data collected in the Short-Term Plan ▪ Carry out data collection works as indicated in the Short Term Plan
Long term	▪ Update landslide inventory database every five years. ▪ Revise assessment methodology by including the updated landslide inventory. This should not be limited to exploring the applications of new technology.

2.3.6.1 Proposed locations for Landslide Hazard and Risk Assessment.

The selection of locations (refer to **Table 2.29** and **Table 2.30**) for both linear - based and area based landslide hazard assessment are deduced using the following criteria:-

a) Terrain and topography of the location
b) Landslide- prone/susceptible areas
c) Social and economic importance

Table 2.29: Proposed linear based locations for landslide hazard assessment

Road (Linear Based)	Length (KM)	Short Term	Medium Term	Long Term
1) Gap – Fraser Hill (Old), FT 56	8			
2) Gap – Fraser Hill (New), FT 148	9			
3) Simpang Pulai – Pos Selim Lojing – Gua Musang – Kuala Berang	221			
4) Gunung Raya Langkawi, FT 278	14			
5) Federal Route 6, Penang	63			
6) Tapah – Cameron Highland, FT 59	65			
7) Kuala Kubu Baru – GAP – Raub, FT 55	64			
8) Kuala Lumpur – Bentong (Old), FT 68	60			
9) Route 8 (Bentong – Gua Musang)	224			
10) Seremban – Kuala Pilah, Negeri Sembilan, FT 51	38			
11) Kuala Klawang – Simpang Pertang, FT 86	15			
12) Kota Kinabalu – Keningau – Tenum, Sabah, FT 500	164			
13) Gerik – Pasir Puteh, FT4	204			
14) Gerik – Jeli (East West Highway)	112.6			
15) Jalan Tun Sardon, Penang	7.7			
16) Baling – Pengkalan Hulu	15.1			
17) KESBAN (Jalan Keselamatan Sempadan)	121.8			
18) Gerik – Kuala Kangsar	168.3			
19) Federal Route 1	848			
20) Updating slope inventory every 5 years				
Total		**1149**	**1273.5**	**2422.5**

Table 2.30: The proposed area -based locations for landslide hazard assessment

Location	Area (M^2)	Short Term	Medium Term	Long Term
1) Hulu Klang (On-going)	100	▭		
2) Penang Island	300	▭		
3) Cameron Highlang	300		▭	
4) Kundasang, Sabah	300		▭	
5) Kapit, Sarawak	200		▭	
6) Updating hazard map every 15 years				▭
Total		**400**	**800**	**1200**

2.3.6.2 Proposed Methodology for Landslide Hazard and Risk Assessment

Based on the methodology review carried out (refer section 2.3.3), deciding on a fixed methodology for landslide hazard assessment is impossible. Landslides are local phenomena controlled by a large variety of internal and external factors. The choice of appropriate techniques depends on the nature of the problem, the observation scale and data availability. Therefore, as a start, the landslide hazard assessment for the NSMP can be divided into two categories, namely:

a) Landslide hazard assessment for linear- based conditions, i.e, roads and highways

b) Landslide hazard assessment for area -based conditions i.e., hillside development, landslide hot spotssuch as. Penang island, Ampang Hulu Klang and Kundasang.

i) Linear- Based Landslide Hazard and Risk Assessment

For the past two decades, the Public Works Department Malaysia (JKR) has been investing great effort in linear-based slope hazard assessment works. Numerous slope management systems have been created to facilitate slope maintenance works along federal roads. The recent system developed was SMART (Slope Management and Risk Tracking) system. This system was designed to accommodate future upgrading in slope hazard analysis. The current hazard analysis methods adopted in the system is a DeterministicDesign Chart developed using Monte Carlo simulation and discriminant

Analysis. However, debris flow failure has not fully been addressed, and the system requires further upgrading. For a start in NSMP, the SMART system is recommended as the tool for slope hazard and risk assessment. It is proposed that analytical tools in the SMART system be upgraded as more data is made available in the future.

ii) Area- Based Landslide Hazard and Risk Assessment

A GIS is recommended as the base system in area-based landslide hazard assessment. A factor overlay method with landslide inventory can be adopted as the hazard analysis method, as currently adopted in Hulu Klang Ampang Slope Hazard Assessment Project. In the short term and mid term, qualitative risk assessment can be used. As more landslide information is made available from the data collected, quantitative risk assessment can be adopted.

2.3.7 Slope Engineering Agency

In order to effectively combat the problem of landslides and to effectively minimize landslide incidents, a Slope Engineering Agency (SEA)is proposed at both federal and state levels. The conceptual setup of the agency for hazard and risk management is shown in **Figure 2.28**.

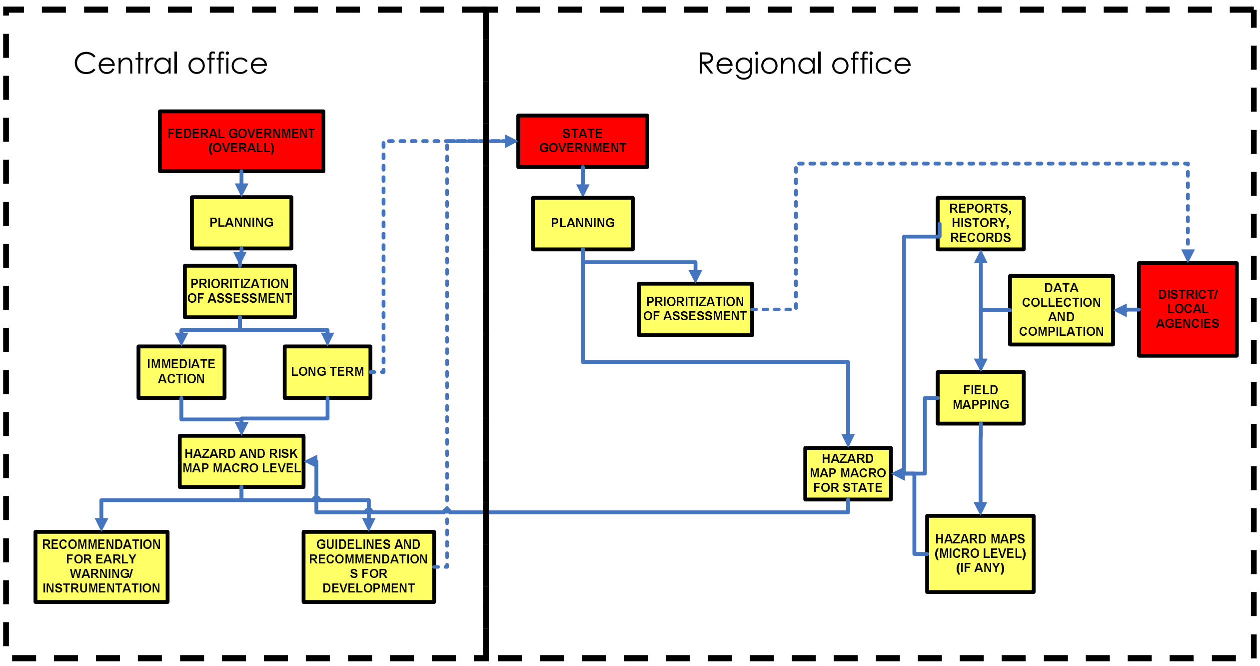


Figure 2.28: Proposed responsibility on planning and data collection

I) Central Office (Operation)

- A central office is set up at the federal government level.
- The central office should be adequately informed and involved in every hazard mapping and vulnerability assessment study undertaken in each region/state.
- In each region/state, the central office should be designated as a repository of hazard mapping, vulnerability assessment studies and digital mapping data.
- A national co-ordinator should be designated with the responsibility to specify, monitor and co-ordinate activities relating to hazard mapping, vulnerability assessment study and digital mapping among the region/state.
- Preventive maintenance involves all works associated with maintaining man-made slopes in the condition to which they were designed and preventing natural slopes along the roads from deteriorating due to instability. By understanding the risks associated with any given slope, attention can be focused on efficient day-to-day maintenance.
- For slopes identified as posing unacceptable levels of risk for slope failure, works to upgrade stability or reduce the consequences of slope failure can be proposed. The system allows not only the identification of high-risk slopes but also informed prioritization of these slopes such that budget allocation can be optimized.
- In cases where slopes are already failing, the system will allow identification of the number of failed slopes and the prioritization of remedial works on an informed risk basis. Monies can be allocated on a cost/benefit basis.

II) Regional office (Data Collection and compilation)

Regional offices are set up in key regions throughout the country office. The responsibility of the regional offices is to assist the central region in collecting all slope inventory records for hazard analysis.

The proposed responsibilities of the regional office are as follows:-

i) Record compilation

ii) Landslide inventory map preparation
iii) Conduct ground survey for data collection

Record Compilation

The records and data required are:-

- Landslide Identification Information (Number and data source)
  Sources of landslide information:
  - Jabatan Ukur dan Pemetaan Malaysia (Jupem)
  - Remote Sensing Agency (Macres)
  - Jabatan Mineral And Geoscience
  - Field mapping
  - Other geological mapping
- Landslide description (process, certainty, size, age)
- Landslide geomorphic setting (associated landforms, slope shape, gradient, delivery)
- Landslide triggers (land use, elevation/precipitation zone)
- Reference information (aerial photograph number)

The landslide inventory information should be entered on Form Landslide Inventory (A-1) **(Appendix 1).**

Landslide Inventory Map Preparation

In addition, the regional office is also required to compile all landslide incident records in a landslide inventory map format. The proposed format of the landslide inventory map shall include the following:-

- 1:2,000 scale base maps, showing elevation contours, streams, roads, township-section range information and known landslides. The GIS - generated base maps are critical for digitization of the final maps, so mapping must be done on this base map.

- Other possible information sources

- o LiDAR where available, may also be useful for identifying large deep-seated landslide features and other landforms that are obscured by vegetation.
- o As-built drawings (including topography and contour maps) for all constructed roads, highways and development. This information can be included as a layer in the map.
- o Other maps that may be helpful if available:
  Maps showing land use and vegetation cover , may be available from local planning agencies and/or landowners.

<u>Conduct ground survey for data collection</u>

All slopes within the jurisdiction of the particular regional office shall be recorded in the inventory. The slope data collection inventory shall start from slopes along linear infrastructures, i.e, roads, highways and railways . Area -based data collection shall only be concentrated at developed hillside areas. As for new developments, it is important for the regional office to request the developer to provide such data.

In order to construct the non-spatial and spatial database, a combination of aerial and ground surveys will be used. The aerial survey will involve the use of LiDaR to derive the topography, in conjunction with high-resolution digital aerial photographs.

- **Aerial Survey**

The base layer proposed for the GIS will consist of a high-resolution igital <u>E</u>levation <u>M</u>odel (DEM). An accurate representation of the topography is required to determine slope forms and extents, in addition to assessing the flow of surface and subsurface water. The model provides a critical tool for directing the location and extent of the ground survey in addition to enabling detailed risk-based analysis.

LiDaR technology is proposed for base map preparation. Where budget is limited and accuracy is not critical, digitised as-built drawings can be used as the base maps.

- **Ground Survey**

The DEM or DTM (Digital Terrain Model), representing the bare-earth ground surface, will be subjected to rigorous analysis to identify the extent and location of each slope feature. The aim here will be to co-ordinate the ground survey teams by producing detailed 1:5000 scale maps which include the slope features (in polygon form), the associated unique identifier, road kilometer marking and 5m contours. Where appropriate, features are identified (cuts, embankments, natural slopes and grades.

The ground survey information is proposed to be recorded using Form Primary Data Capture (A-2) **(Appendix 1)**. All possible slope features and conditions that may cause instability shall be recorded using this proforma. The types of information to be collected for each slope during the data collection are listed below, and subsequently discussed in more detail.

- General information
- Slope geometry
- Geology, soil or rock condition profile
- Drainage system
- Slope instability

Verification of the data entered into the database should be undertaken.

Analysis and Validation

The instability score (IS), which ranges between 0 and 1, can be derived through the integration of results from one or combination of these techniques - discriminant analysis, design charts and factor overlay method (Heuristic). The consequence scores (CS), which also ranges between 0 and 1, can be sourced from the Hong Kong GEO, Report No. 68: The New Priority Classification Systems for Slopes and Retaining Walls. Following the calculation of IS, it is possible to categorise the data in qualitative terms for the purpose of interpretation and action. The risk rating categories designed for this purpose are Very Low, Low, Medium, High and Very High.

Discriminant Analysis

Discriminant analysis is a statistical method that allows the identification of parameters that best segregate known failed and stable slopes into discrete groups from a database of individual slope attributes. The product of the analysis is the discriminant function, based on identified discriminating variables, which allow probability of the known stable or failed group to be assigned to each individual slope. This method shall be used if sufficient landslide records are made available.

Factor Overlay (Heuristic)

The hazard score for landslide can also be categorized using the factor overlay approach. Knowledge on landslides by specialists can be used to rank the parameters/attributes that affect landslides. The ISISand SPRS systems from JKR and MACRES can be applied.

III) Cost Estimate

The estimated cost of landslide hazard assessment works is based on: -

- Slope prioritization using SMART system – Rationalized from the previous TSR Project. The estimate is on a per kilometer basis (including the LiDar survey, ground data collection and analysis).
- Area-based assessment – Rationalised from the current area-based landslide assessment works in Hulu Klang Area. The estimate is on a per unit area (km^2) basis.

Table 2.31: Summary item from Tamparuli – Sandakan Road Project

Summary item from TSR project		
Length (KM)	**Time frame (Month)**	**Cost (RM)**
294	**30**	**11,638,170.50**
39,585.61 per KM		

A Linear based

Table 2.32: Proposed federal roads under preventive maintenance package

Road (Linear Based)	Length (KM)	Cost Estimated		
		Short Term	Medium Term	Long Term
1) Gap – Fraser Hill (Old), FT 56	8	221,679.44		
2) Gap – Fraser Hill (New), FT 148	9	249,389.37		
3) Simpang Pulai – Pos Selim Lojing – Gua Musang – Kuala Berang	221	6,123,894.53		
4) Gunung Raya Langkawi, FT 278	14	387,939.02		
7) Federal Route 6, Penang	63	1,745,725.59		
8) Tapah – Cameron Highland, FT 59	65	1,801,145.45		
9) Kuala Kubu Baru – GAP – Raub, FT 55	64	1,773,435.52		
10) Kuala Lumpur – Bentong (Old), FT 68	60	1,662,595.80		
11) Route 8 (Bentong – Gua Musang)	224	6,207,024.32		
12) Seremban – Kuala Pilah, Negeri Sembilan, FT 51	38	1,052,977.34		
13) Kuala Klawang – Simpang Pertang, FT 86	15	415,648.95		
14) Kota Kinabalu – Keningau – Tenum, Sabah, FT 500	164	4,544,428.52		
15) Gerik – Pasir Puteh, FT4	204	5,652,825.72		
16) Gerik – Jeli (East West Highway)	112.6		3,120,138.12	
17) Jalan Tun Sardon, Penang	7.7		213,366.46	
18) Baling – Pengkalan Hulu	15.1		418,419.94	
19) KESBAN (Jalan Keselamatan Sempadan)	121.8		3,375,069.47	
20) Gerik – Kuala Kangsar	168.3		4,663,581.22	
21) Federal Route 1	848		23,498,020.64	
22) Updating slope inventory every 5 years				
Total	**2535.1**	**31,838,709.57**	**35,288,595**	

B Area based

Location	Area (M^2)	Cost (RM)	Cost Estimated
1)Hulu Klang	100	6,000,000 (On going)	
2)Cameron Highland and others	300		12,600,000
3)Penang Island	300		12,600,000
4)Kapit, Sarawak	200		8,400,000
5)Kundasang	300		12,600,000
Sub Total	1,200		46,200,000
Total	1,200	46,200,000	

C Total Cost Estimate

	Total Cost (RM)
Short Term	**31,838,709**
Medium Term	**68,888,595**
Long Term	**12,600,000**
Total	**113,327,304**

It is proposed that the short-term cost of RM31.8 m for landslide hazard mapping be included in the initial set up budget of SEA.

2.3.8 Questionnaires

An awareness survey was conducted during the initial stage of the NSMP preparation. Questionnaires were sent to the relevant parties in both the government and private sectors. Relevant parties related to the hazard assessment component were chosen for interview. The questions for hazard assessment were streamlined to include the following subjects as per **Table 2.33**.

Table 2.33: HMA questionnaire

Hazard Mapping and Assessments		Yes	No
2.1	Is your organization involved in any landslide hazard assessment? If no, please go to item 2.17		
2.2	Has any hazard map been developed by your organization?		
2.3	Is the hazard map made available to the consultant(s) for reference?		
2.4	Was the hazard map developed by your own organization or others?		
2.5	Are your personnel involved in the development of hazard map?		
2.6	What is the minimum qualification required for personnel to be involved in data collection?		
2.7	Has any standard form been used in data collection works?		
2.8	Do you update your data periodically? If yes, please state the frequency.		
2.9	Have you identified all potential areas for your hazard assessment works?		
2.10	Has any hazard and risk rating been developed?		
2.11	Have you incorporated any GIS element in your hazard assessment works?		
2.12	How was the base map for hazard assessment developed?		
2.13	If no hazard map is available, how do you document your landslide hazard assessment?		
2.14	Do you intend to incorporate GIS element for your hazard assessment works in the future?		
2.15	Is there any previous landslides database available in your organization?		
2.16	Do you think that landslide hazard assessment is important in facilitating hill slope development planning? f yes, when do you plan to incorporate landslide hazard mapping in your organization? If no, why?		
2.17	***To be answered by State and Local Authorities, JKR and Highway Concessionaires only.*** Is it possible that landslide hazard assessment work be carried out by PWD Slope Engineering Branch even if the area is within your jurisdiction?		

In general, most of the federal agencies, e.g, JKR, Jabatan Mineral dan Geosains (JMG); and MACRES were aware of landslide hazards. Some government agencies such as. JKR and JMG produced their own hazard maps. Currently, the hazard maps are not made available to the public.

Landslide records are available from JKR and JMG. However, the availability of the landslide records for the NSMPlan has yet to be confirmed. Most of the agencies with hazard maps produced their own inventory forms/proforma to record slopes.

Two of the highway concessionaires were selected for interviews MTD and PLUS. MTD Prime Bhd, the concessionaire for Karak Highway, revealed that there are some forms of hazard maps available for Karak Highway. Information from the company was mainly extracted during the interview.

As for state agencies and local authorities, the response was not encouraging (refer to **Figure 2.29** and **Figure 2.30**). However, interviews and follow-up will be carried out at a later stage.

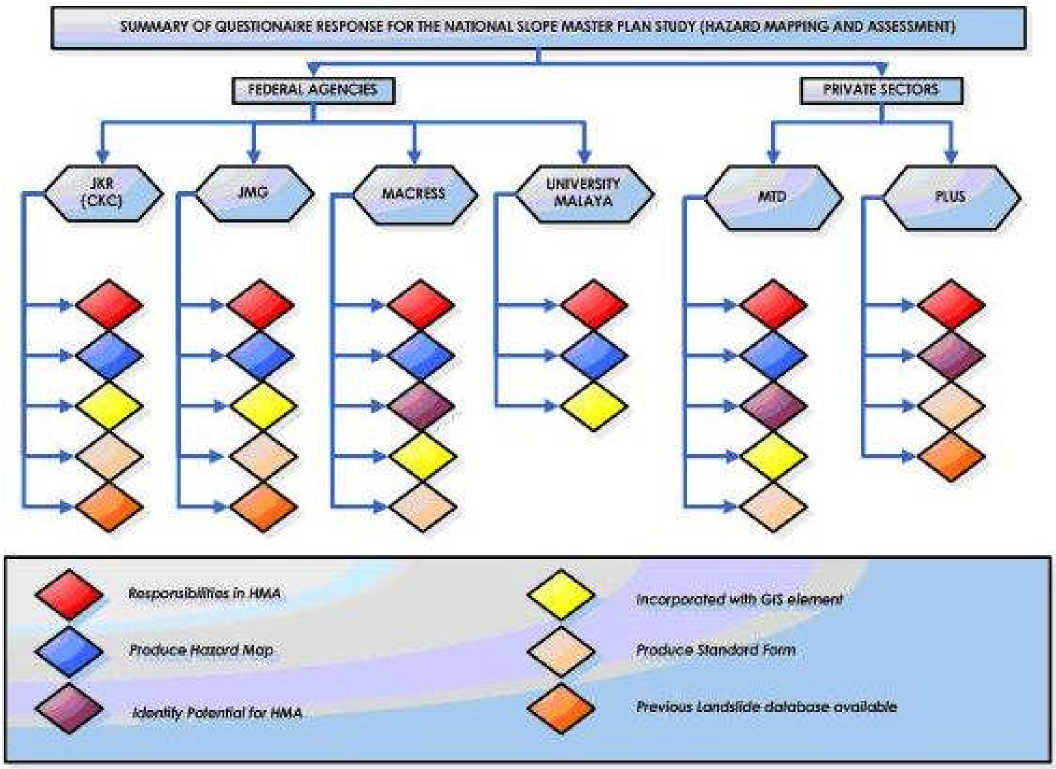


Figure 2.29: Summary of questionnaire responses from federal and private agencies for NSMP for landslide hazard component.

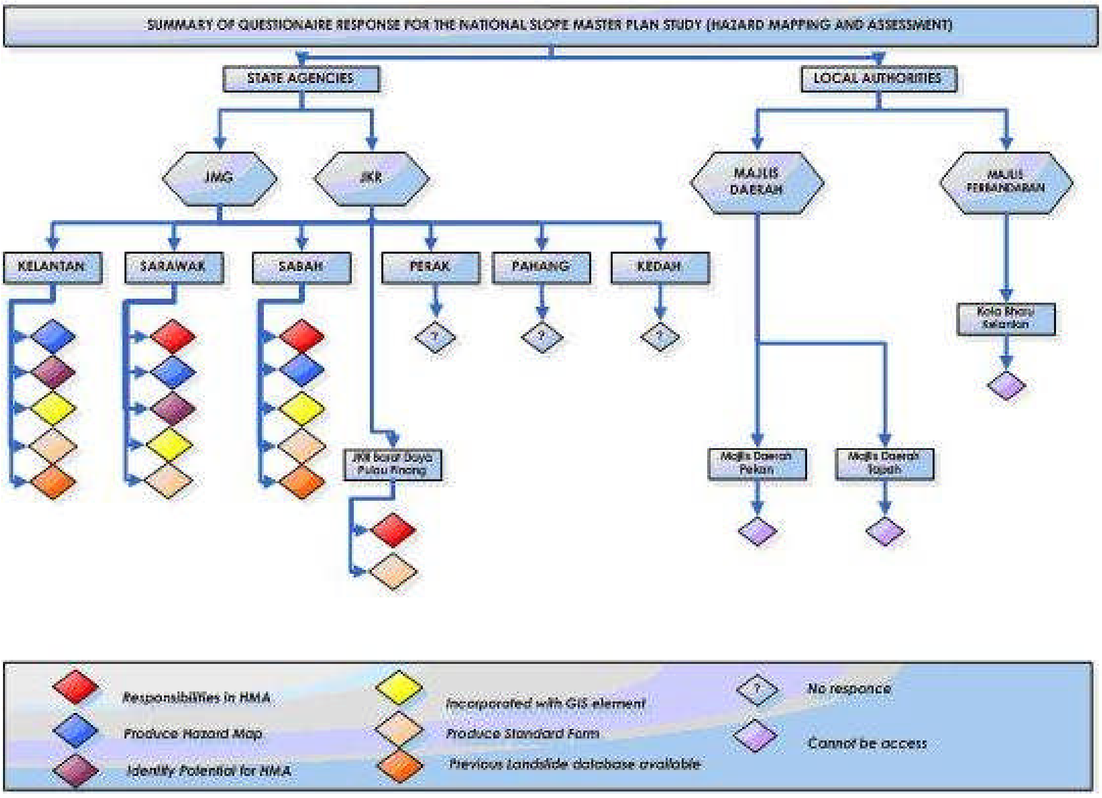


Figure 2.30: Summary of questionnaire responses of state agencies for NSMP for landslide hazard component

2.4 Recommended Strategies

2.4.1 Introduction

In order to develop a framework to establish an inventory for landslide hazard/risk mapping at a scale useful for planning and decision making, strategies towards the goal shall be outlined.

2.4.2 Strategic Thrust

The strategic thrust of the landslide hazard mapping and assessment component is to develop a frameworks to establish an inventory of susceptible areas and different types of landslide hazard/risk mapping and assessment at a scale useful for planning and decision-making. The strategies are listed in **Table 2.34**.

Table 2.34: Strategic thrusts

Strategic Thrust	Strategies
Develop a framework to establish an inventory of susceptible areas and different types of landslide hazard/risk mapping and assessment at a scale useful for planning and decision-making	Strategy 2.1 Develop an inventory of known landslides nationwide Strategy 2.2 Develop a plan for mapping and assessing landslide hazard and risk Strategy 2.3 Develop guidelines for landslide hazard and risk mapping and assessment

The demands of infrastructure development and building construction over the last two decades in Malaysia, especially in cities, have encouraged development into new areas of challenging terrains and encroachment into existing, otherwise stable, highland areas. As many development and housing projects are taking place in hilly terrain, the hillsides are not exempted from building platforms and excavation in the hilly areas around the city are rapidly increasing, amidst regulatory concerns. These have resulted in incidents of geotechnical instability, causing numerous landslips and several landslides catastrophes.

Notwithstanding advances in engineering solutions to handle such parameters as difficult topography and localized soil mechanics, emphasis on the needs for serious monitoring programs, continual reassessment and management of the associated risks involved in hill slope works is still lacking has yet to be and implementation of existing policies has been quite inconsistent.
In view of formulating medium-term and long-term measures for the NSMP, a framework for slope hazard assessment and mapping shall be established. A landslide inventory shall be established for susceptible areas. The landslide inventory shall be used in identifying landslide hazard.

To establish the framework for the Hazards Mapping and Assessment component in the NSMP, methodology for the hazard assessment and mapping shall be study in detailed. The assessment methodology shall consider for both area-based and linear-based conditions. It shall also consider the availability of information, budgets, existing and expertise and the current situation in Malaysia shall also be studied

The output of hazard assessment the hazard and risk maps are recommended to be used as development guides. Hazard maps can be used as planning and decision making tools for stakeholders such as local authorities in overseeing hillside development to avoid unwanted landslide disasters in the future.

2.4.3 Strategies

Strategy 2.1	Develop an inventory of known landslides nationwide

In this strategy, an inventory of known landslides is to be developed. This inventory database is useful as an accurate hazard analytical tool as historical records collected from the local media, JMG and MACRES were insufficient. Most of the data, especially from the media, did not record important information such as failure dimension and causal factors. The following are actions proposed to overcome this problem:

Action 2.1.1: Plan and carry out data collection

Data collection works can be divided into two main categories i) landslide inventory and ii) slope inventory for all newly slopes and locations identified in the NSMP. A standard landslide incident proforma and slope inventory proforma shall be created and used to record all failure incidents and slope inventory. Landslide inventory from MACRES and JMG shall be collected and compiled periodically to update landslide inventory.

Action2.1.2: Prepare landslide inventory map

The records collected from Action 2.1.1 can be translated into a landslide inventory map. The landslide inventory map can be used as a preliminary assessment and guide for landslide susceptibility before any landslide hazard and risk assessment is carried out.

Strategy 2.2	Develop a plan for mapping and assessing landslide hazard and risk

In this strategy, a plan for nationwide mapping and landslide hazard assessment is to be developed. The locations of landslide-prone areas, where the probabilities of landslide occurrence with direct impact to life, property and socio economy are high identified. Thresholds for parameters that cause slope instability and landslide types and mechanism are to be identified to category the slope hazard ratings. The consequences of a landslide are to be identified for risk assessment during the implementation of this strategy. With the hazard and risk classification developed, hazard and risk maps can then be produced for areas identified in **Strategy 2.1.**

The proposed action for the development of a plan for mapping and assessing landslide hazards nationwide are as follows:

Action 2.2.1: Develop slope hazard and risk maps for areas identified in Strategy 2.1

Slope data collected in Action Plan 2.1.1 shall be assessed and analysed to produce the hazard and risk map. In this action plan, a slope hazard model shall be developed based on the failure modes and soil parameter spectrum available in Malaysia. Risk model based on both qualitative and quantitative assessment shall be developed. Elements of risk and the impact shall be identified and modeled.These hazard and risk map shall be used as a guide for development, maintenance budget prioritization and planning for real-time monitoring and early warning system works.

Strategy 2.3	**Develop guidelines for landslide hazard and risk mapping and assessment**

In order to standardise the landslide hazard assessment and hazard map, a strategy shall be formulated. This includes a training program with a specially developed module and implement action procedure for landslide hazard assessment including data collection.

Action 2.3.1: Develop standard procedures for hazard and risk assessment and mapping

There are various methods available in formulating the hazard and risk models. Therefore, a standard procedure shall be established to ensure consistency in the data collected and method in assessing the hazard and risk of slopes.

2.4.4 Summary

Table 2.35: Action Plans

Strategy	Action Plans
Strategy 2.1 Develop an inventory of known landslide hazards nationwide	Action 2.1.1: Plan and carry out data collection o Conduct training for regional office for data collection o Develop a standard proforma for data collection Action 2.1.2: Prepare landslide inventory map o Translate historical landslide database to a landslide inventory map o Susceptibility inventory map into landslide susceptible map as the guide map for landslide assessment works
Strategy 2.2 Develop a plan for mapping and assessing landslide hazards nationwide	Action 2.2.1 Develop slope hazard and risk maps for areas identified in strategy 2.1. o Review landslide inventory maps developed in action Plan 2.12
Strategy 2.3 Develop guidelines for landslide hazard mapping and assessment	Action 2.3.1: Develop standard procedures for hazard and risk assessment and mapping

2.5 Implementation Framework and Plan

2.5.1 Introduction

This sectionpresents a framework for a comprehensive and coordinated 15 years plan to develop hazard and risk maps in Malaysia.

2.5.2 Implementation Process

The approach that will be undertaken to implement hazard and risk assessment consists of five key stages (**Figure 2.31**).

The first stage of the implementation process,data collection is necessary to collect basic data for creating landslide susceptibility, hazard and risk maps. The data includes landslide inventory and slope inventory crucial for hazard assessment and will be used to formulate landslide hazard and risk rating. Information on aerial survey, i.e. digitised topography map LiDAR developed DTM, contour and etc., (for priority areas) are also crucial as the base maps for Landslide Hazard Assessment.

Stage 2 consists of storing the information in a database for preparation landslide susceptibility map..

The third stage focuses on the preparation of the hazard map. Landslide susceptibility maps are important for the prioritization of hazard map preparation. All important linear infrastructures and landslide hot spots shall be identified in the short-term plan for budget planning.

Locations and areas subjected to high landslide hazard and hot spots shall be prioritized for landslide hazard assessment works. Prioritisation is important not only for budgetary purposes but also due to limitation of human resources. More specialists are required in assessment activities, and training (by training and education component) shall be carried out for the preparation of human capital under the NSMP.

Stage 4 comprises hazard/risk map preparation which under the jurisdiction of SEA. SEA shall ensure all maps prepared follow standards . Methods of assessment shall be consistent for compilation, archiving and future upgrading purposes.

The fith and stage in the final implementation process for the hazard assessment component is periodic data upgrading. Updated landslide data will enhance the slope hazard/risk score. Periodic updating of slope information I also enables monitoring hazard/risk conditions caused by the process of slope deterioration and the presence of unpredictable external landslide triggering factors.

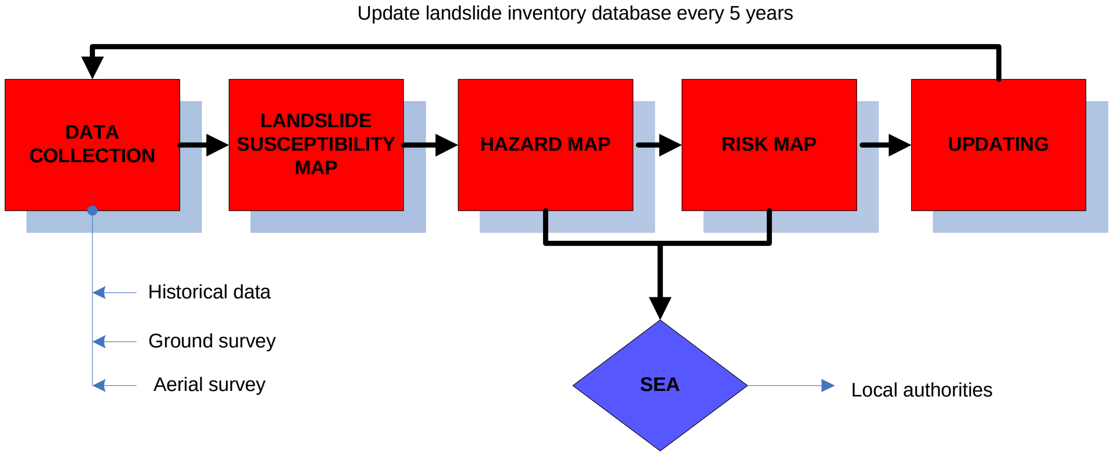


Figure 2.31: Flow chart for implementation process

2.5.3 Implementation Structure

Implementation of hazard and risk assessment is depicted in **Figure 2.32**. Due to the need for specialists in hazard assessment activities and the confidentiality of any hazard/risk maps produced, it is recommended that SEA be fully responsible for implementation. From the implementation process discussed, the structure of implementation for the hazard assessment component in SEA can be divided into two main categories, namely;

a) Monitoring and assessment

b) Implementation

It is proposed that monitoring and assessment be carried out by the SEA regional office. At the early stage of implementation, SEA can appoint specialised consultants to assist in the landslide hazard assessment and map preparation. However, standard guides and specifications shall be implemented to synchronise all the works carried out.

The SEA central office will be responsible for implementation works. The responsibility of central office will be the prioritization of mapping works and gathering information from other agency such as. MACRES, JMG, highway concessionaires and JUPEM to determine the landslide susceptibility or hot spot locations.

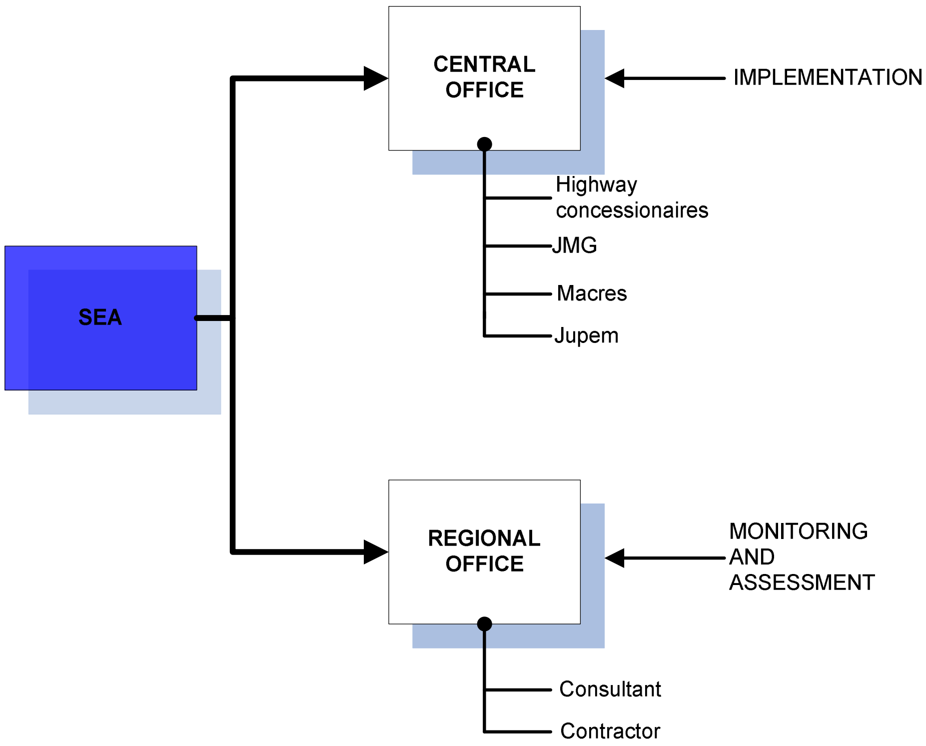


Figure 2.32: Implementation structure

2.5.4: Strategy Implementation Framework

The aim is to allow, as much as possible, a coherent and harmonious implementation of the framework directive. **Table 2.36** shows the strategy implementation framework proposed for the duration of 15 years. The implementation framework is divided into three phases taking into consideration short term,mid term and long term plans.

Table 2.36: Strategy implementation framework

	2008	2009	2010	2011	2012	2013	2014	2025	2016	2017	2018	2019	2020	2021	2022
	Phase 1					Phase 2					Phase 3				
2.1 Develop an inventory of known landslide hazards nationwide															
2.2 Develop a plan for mapping and assessing landslide hazards nationwide															
2.3 Develop guidelines for landslide hazard mapping and assessment															

2.5.5. Implementation of Action Plan

To successfully implement the proposed plan for hazard assessment, **Table 2.37** summarizes the proposed action plans to be taken, estimated costs and schedule of implementation.

Table 2.37: Implementation of action plan

No.	Action Plan	Who	When/Cost (RM Million)			
			Phase 1		Phase 2	Phase 3
			(2009 – 2010)	(2011 – 2013	(2014 – 2018)	(2019 – 2023)
2.1	**Developed an inventory of known landslide nationwide**					
2.1.1	Plan and carry out data collection	SEA JMG MACRES	2.2	35.0	12.5	5.6
2.1.2	Prepare landslide inventory map	SEA	0.3	3.0	1.0	1.0
2.2	**Developed a plan for mapping and assessing landslide hazard and risk nationwide**					
2.2.1	Prepare hazard and risk maps(For areas identified in Strategy 2.1)	SEA	5.5	17.5	6.0	6.0
2.3	**Developed a guidelines for landslide hazard and risk mapping and assessment**					
2.3.1	Developed standard procedures for hazard and risk assessment and mapping	SEA	0.1	3.8	0.5	
Sub-total			8.1	59.3	20.0	12.6
Total			**113.3**			

2.5.6. Critical Success Factors

With the implementation of landslide hazard and risk assessment, loses due to landslide incidents can be reduced. The success of the hazard and risk assessment and management on three outcomes :

- Less occurance of landslide disasters
- More slope sspecialists
- Proper development planning, particularly in hillside development

The critical success factor to enable these results are encapsulated in the level of innovation and professionalism displayed by the stakeholders. These two critical success factors are described in **Table 2.38.**

Development will be planned based on landslide hazard maps to avoid losses. The critical success factors are as follows:-

Table 2.38: Critical Success Factors

Critical Success Factors	Description
Innovation	The necessary information for the stakeholder to effectively develop the hazard maps. Focus should be given to using up-to-date technology, improved workflow and agency-wide information sharing.
Professionalism	The technical expertise available at the national level to develop and study the hazard maps.

2.5.7: Key Performance Indicators

A manifestation of the critical success factors are described as key performance indicators and for innovation to produce hazard map for landslide-prone areas. For professionalism to increase the accuracy of hazard classification. The target of the key for performance indicators in shown in **Table 2.39**

Table 2.39: Key Performance Indicators

Critical Success Factors	Key Performance Indicators	Target		
		Phase 1	Phase 2	Phase 3
Innovation	Produce hazard maps landslide prone areas. (	50%	70%	90%
Professionalism	Increase the accuracy of landslide hazards	65%	68%	70%

2.5.8 Expected Outcomes

In the hazard mapping and assessment component of the NSMP, the main outcomes of the plan are:-

Expected Outcomes	Identified Results
1. A better understanding of landslide occurrences	Accuracy in predicting of landslide occurrences.
2. Sufficient knowledge to identify potential landslide locations based on landslide hazard and risk criteria	Increase in technical expertise in developing hazard map. More local specialists local will be produce and this will had to an enhancement of human capital.

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APPENDIX 1

TECHNICAL TERMS AND LIST OF MAJOR LANDSLIDES

I) GLOSSARY

The ISDR Secretariat presents these basic definitions on disaster risk reduction in order to promote a common understanding on this subject, for use by the public, authorities and practitioners. The terms are based on a broad consideration of different international sources (*source: www.unisdr.org*).

Keyword	Description
Acceptable risk	The level of loss a society or community considers acceptable given existing social, economic, political, cultural, technical and environmental conditions. *In engineering terms, acceptable risk is also used to assess structural and non-structural measures undertaken to reduce possible damage at a level which does not harm people and property, according to codes or "accepted practice" based, among other issues, on a known probability of hazard.*
Building codes	Ordinances and regulations controlling the design, construction, materials, alteration and occupancy of any structure to insure human safety and welfare. Building codes include both technical and functional standards.
Capacity	A combination of all the strengths and resources available within a community, society or organization that can reduce the level of risk, or the effects of a disaster. *Capacity may include physical, institutional, social or economic means as well as skilled personal or collective attributes such as leadership and management. Capacity may also be described as capability.*
Capacity building	Efforts aimed to develop human skills or societal infrastructures within a community or organization needed to reduce the level of risk. *In extended understanding, capacity building also includes development of institutional, financial, political and other resources, such as technology at different levels and sectors of the society.*
Climate change	The climate of a place or region is changed if over an extended period (typically decades or longer) there is a statistically significant change in measurements of either the mean state or variability of the climate for that place or region. *Changes in climate may be due to natural processes or to persistent anthropogenic changes in atmosphere or in land use. Note that the definition of climate change used in the United Nations Framework Convention on Climate Change is more restricted, as it includes only those changes which are attributable directly or indirectly to human activity.*
Coping capacity	The means by which people or organizations use available resources and abilities to face adverse consequences that could lead to a disaster. *In general, this involves managing resources, both in normal times as well as during crises or adverse conditions. The strengthening of coping capacities usually builds resilience to withstand the effects of natural and human-induced hazards.*
Counter measures	All measures taken to counter and reduce disaster risk. They most commonly refer to engineering (structural) measures but can also include non-structural measures and tools designed and employed to avoid or limit the adverse impact of natural hazards and related environmental and technological disasters.
Disaster	A serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources. *A disaster is a function of the risk process. It results from the combination of hazards, conditions of vulnerability and insufficient capacity or measures to reduce the potential negative consequences of risk.*
Disaster risk management	The systematic process of using administrative decisions, organization, operational skills and capacities to implement policies, strategies and coping capacities of the society and communities to lessen the impacts of natural hazards and related environmental and technological disasters. This comprises all forms of activities, including structural and non-structural measures to avoid (prevention) or to limit (mitigation and preparedness) adverse effects of hazards.

Disaster risk reduction (disaster reduction)	The conceptual framework of elements considered with the possibilities to minimize vulnerabilities and disaster risks throughout a society, to avoid (prevention) or to limit (mitigation and preparedness) the adverse impacts of hazards, within the broad context of sustainable development.
Early warning	The provision of timely and effective information, through identified institutions, that allows individuals exposed to a hazard to take action to avoid or reduce their risk and prepare for effective response. *Early warning systems include a chain of concerns, namely: understanding and mapping the hazard; monitoring and forecasting impending events; processing and disseminating understandable warnings to political authorities and the population, and undertaking appropriate and timely actions in response to the warnings.*
El Niño-southern oscillation (ENSO)	A complex interaction of the tropical Pacific Ocean and the global atmosphere that results in irregularly occurring episodes of changed ocean and weather patterns in many parts of the world, often with significant impacts, such as altered marine habitats, rainfall changes, floods, droughts, and changes in storm patterns. *The El Niño part of ENSO refers to the well-above-average ocean temperatures along the coasts of Ecuador, Peru and northern Chile and across the eastern equatorial Pacific Ocean, while the Southern Oscillation refers to the associated global patterns of changed atmospheric pressure and rainfall. La Niña is approximately the opposite condition to El Niño. Each El Niño or La Niña episode usually lasts for several seasons.*
Emergency management	The organization and management of resources and responsibilities for dealing with all aspects of emergencies, in particularly preparedness, response and rehabilitation. *Emergency management involves plans, structures and arrangements established to engage the normal endeavours of government, voluntary and private agencies in a comprehensive and coordinated way to respond to the whole spectrum of emergency needs. This is also known as disaster management.*
Environmental impact assessment (EIA)	Studies undertaken in order to assess the effect on a specified environment of the introduction of any new factor, which may upset the current ecological balance. *EIA is a policy making tool that serves to provide evidence and analysis of environmental impacts of activities from conception to decision-making. It is utilised extensively in national programming and for international development assistance projects. An EIA must include a detailed risk assessment and provide alternatives solutions or options.*
Environmental degradation	The reduction of the capacity of the environment to meet social and ecological objectives, and needs. *Potential effects are varied and may contribute to an increase in vulnerability and the frequency and intensity of natural hazards.* *Some examples: land degradation, deforestation, desertification, wildland fires, loss of biodiversity, land, water and air pollution, climate change, sea level rise and ozone depletion.*
Forecast	Definite statement or statistical estimate of the occurrence of a future event (UNESCO, WMO).
Geological hazard	Natural earth processes or phenomena that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. *Geological hazard includes internal earth processes or tectonic origin, such as earthquakes, geological fault activity, tsunamis, volcanic activity and emissions as well as external processes such as mass movements: landslides, rockslides, rock falls or avalanches, surfaces collapses, expansive soils and debris or mud flows.* *Geological hazards can be single, sequential or combined in their origin and effects.*
Geographic information systems (GIS)	Analysis that combine relational databases with spatial interpretation and outputs often in form of maps. A more elaborate definition is that of computer programmers for capturing, storing, checking, integrating, analyzing and displaying data about the earth that is spatially referenced. *Geographical information systems are increasingly being utilized for hazard and vulnerability mapping and analysis, as well as for the application of disaster risk management measures.*
Greenhouse gas (GHG)	A gas, such as water vapour, carbon dioxide, methane, chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs), that absorbs and re-emits infrared radiation, warming the earth's surface and contributing to climate change (UNEP, 1998).

Hazard	A potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. *Hazards can include latent conditions that may represent future threats and can have different origins: natural (geological, hydrometeorological and biological) or induced by human processes (environmental degradation and technological hazards). Hazards can be single, sequential or combined in their origin and effects. Each hazard is characterised by its location, intensity, frequency and probability.*
Hazard analysis	Identification, studies and monitoring of any hazard to determine its potential, origin, characteristics and behaviour.
Hydrometeo-rological hazards	Natural processes or phenomena of atmospheric, hydrological or oceanographic nature, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. *Hydrometeorological hazards include: floods, debris and mud floods; tropical cyclones, storm surges, thunder/hailstorms, rain and wind storms, blizzards and other severe storms; drought, desertification, wildland fires, temperature extremes, sand or dust storms; permafrost and snow or ice avalanches. Hydrometeorological hazards can be single, sequential or combined in their origin and effects.*
La Niña	(see El Niño-Southern Oscillation).
Land-use planning	Branch of physical and socio-economic planning that determines the means and assesses the values or limitations of various options in which land is to be utilized, with the corresponding effects on different segments of the population or interests of a community taken into account in resulting decisions. *Land-use planning involves studies and mapping, analysis of environmental and hazard data, formulation of alternative land-use decisions and design of a long-range plan for different geographical and administrative scales.* *Land-use planning can help to mitigate disasters and reduce risks by discouraging high-density settlements and construction of key installations in hazard-prone areas, control of population density and expansion, and in the siting of service routes for transport, power, water, sewage and other critical facilities.*
Mitigation	Structural and non-structural measures undertaken to limit the adverse impact of natural hazards, environmental degradation and technological hazards.
Natural hazards	Natural processes or phenomena occurring in the biosphere that may constitute a damaging event. *Natural hazards can be classified by origin namely: geological, hydrometeorological or biological. Hazardous events can vary in magnitude or intensity, frequency, duration, area of extent, speed of onset, spatial dispersion and temporal spacing.*
Nowcasting	The detailed description of the current weather along with forecasts obtained by extrapolation up to about 2 hours ahead. Any area-specific forecast for the period up to 12 hours ahead that is based on very detailed observational data. *(Additional definition to ISDR's basic definitions)*
Preparedness	Activities and measures taken in advance to ensure effective response to the impact of hazards, including the issuance of timely and effective early warnings and the temporary evacuation of people and property from threatened locations.
Prevention	Activities to provide outright avoidance of the adverse impact of hazards and means to minimize related environmental, technological and biological disasters. *Depending on social and technical feasibility and cost/benefit considerations, investing in preventive measures is justified in areas frequently affected by disasters. In the context of public awareness and education, related to disaster risk reduction changing attitudes and behaviour contribute to promoting a "culture of prevention".*
Public awareness	The processes of informing the general population, increasing levels of consciousness about risks and how people can act to reduce their exposure to hazards. This is particularly important for public officials in fulfilling their responsibilities to save lives and property in the event of a disaster. *Public awareness activities foster changes in behaviour leading towards a culture of risk reduction. This involves public information, dissemination, education, radio or television broadcasts, use of printed media, as well as, the establishment of information centres and networks and community and participation actions.*
Public information	Information, facts and knowledge provided or learned as a result of research or study, available to be disseminated to the public.

Recovery	Decisions and actions taken after a disaster with a view to restoring or improving the pre-disaster living conditions of the stricken community, while encouraging and facilitating necessary adjustments to reduce disaster risk. *Recovery (rehabilitation and reconstruction) affords an opportunity to develop and apply disaster risk reduction measures.*
Relief / response	The provision of assistance or intervention during or immediately after a disaster to meet the life preservation and basic subsistence needs of those people affected. It can be of an immediate, short-term, or protracted duration.
Resilience / resilient	The capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organizing itself to increase its capacity for learning from past disasters for better future protection and to improve risk reduction measures.
Retrofitting (or upgrading)	Reinforcement of structures to become more resistant and resilient to the forces of natural hazards. *Retrofitting involves consideration of changes in the mass, stiffness, damping, load path and ductility of materials, as well as radical changes such as the introduction of energy absorbing dampers and base isolation systems. Examples of retrofitting includes the consideration of wind loading to strengthen and minimize the wind force, or in earthquake prone areas, the strengthening of structures.*
Risk	The probability of harmful consequences, or expected losses (deaths, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human-induced hazards and vulnerable conditions. *Conventionally risk is expressed by the notation* *Risk = Hazards x Vulnerability. Some disciplines also include the concept of exposure to refer particularly to the physical aspects of vulnerability.* *Beyond expressing a possibility of physical harm, it is crucial to recognize that risks are inherent or can be created or exist within social systems. It is important to consider the social contexts in which risks occur and that people therefore do not necessarily share the same perceptions of risk and their underlying causes.*
Risk assessment /analysis	A methodology to determine the nature and extent of risk by analyzing potential hazards and evaluating existing conditions of vulnerability that could pose a potential threat or harm to people, property, livelihoods and the environment on which they depend. *The process of conducting a risk assessment is based on a review of both the technical features of hazards such as their location, intensity, frequency and probability; and also the analysis of the physical, social, economic and environmental dimensions of vulnerability and exposure, while taking particular account of the coping capabilities pertinent to the risk scenarios.*
Structural / non-structural measures	Structural measures refer to any physical construction to reduce or avoid possible impacts of hazards, which include engineering measures and construction of hazard-resistant and protective structures and infrastructure. *Non-structural measures refer to policies, awareness, knowledge development, public commitment, and methods and operating practices, including participatory mechanisms and the provision of information, which can reduce risk and related impacts.*
Sustainable development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of "needs", in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and the future needs. (Brundtland Commission, 1987). *Sustainable development is based on socio-cultural development, political stability and decorum, economic growth and ecosystem protection, which all relate to disaster risk reduction.*
Vulnerability	The conditions determined by physical, social, economic, and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards. *For positive factors, which increase the ability of people to cope with hazards, see definition of capacity.*

II) DESCRIPTION OF LANDSLIDE FEATURES

The morphology of landslide were first described by Cruden & Varnes (1996) and are presented in **Figure 1**.

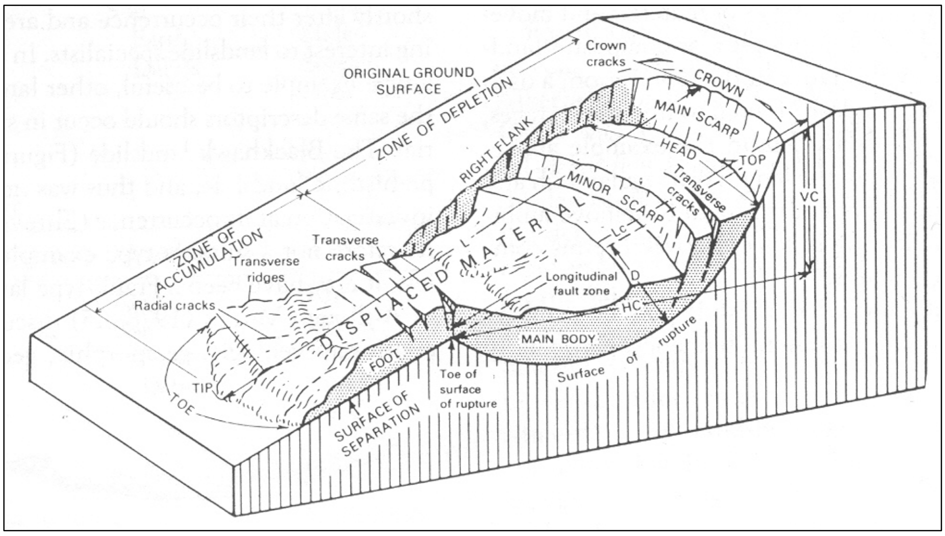
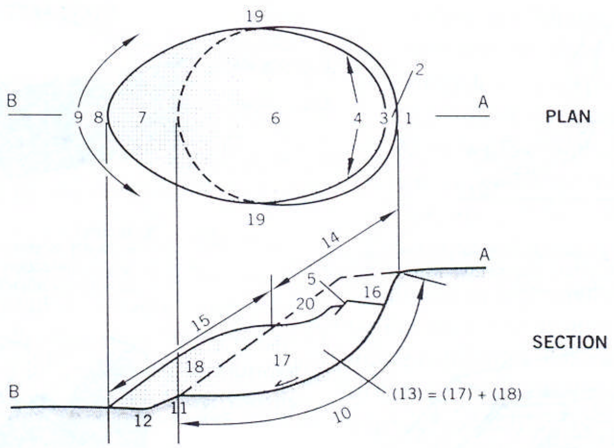


Figure 1: Terminology for Describing Landslide Features (Cruden & Varnes, 1996)

However, the International Association of Engineering Geologists (IAEG) created a Commission on Landslides that has subsequently made minor modifications and was reproduced in **Figure 2**. As can be seen from **Figure 2**, the elevation of the ground surface decreases as a result of landsliding in the *zone of depletion* while the elevation of the ground surface increases in the *zone of accumulation* (Cornforth, 2005).



No.	Name	Definition
1	Crown	Practically undisplaced material adjacent to highest parts of main scarp
2	Main scarp	Steep surface on undisturbed ground at upper edge of landslide caused by movement of displaced material (13, stippled area) away from undisturbed ground; it is a visible part of surface of rupture (10)
3	Top	Highest point of contact between displaced material (13) and main scarp (2)
4	Head	Upper parts of landslide along contact between displaced material and main scarp (2)
5	Minor scarp	Steep surface on displaced material of landslide produced by differential movements within displaced material
6	Main body	Part of displaced material of landslide that overlies surface of rupture between main scarp (2) and toe of surface of rupture (11)
7	Foot	Portion of landslide that has moved beyond toe of surface of rupture (11) and overlies original ground surface (20)
8	Tip	Point on toe (9) farthest from top (3) of landslide
9	Toe	Lower, usually curved margin of displaced material of a landslide, most distant from main scarp (2)
10	Surface of rupture	Surface that forms (or that has formed) lower boundary of displaced material (13) below original ground surface (20); also termed *slip surface* or *shear surface*; if planar, can be termed *slip plane* or *shear plane*
11	Toe of surface of rupture	Intersection (usually buried) between lower part of surface of rupture (10) of a landslide and original ground surface (20)
12	Surface of separation	Part of original ground surface (20) now overlain by foot (7) of landslide
13	Displaced material	Material displaced from its original position on slope by movement in landslide; comprises both depleted mass (17) and accumulation (18)
14	Zone of depletion	Area of landslide within which displaced material lies below original ground surface (20)
15	Zone of accumulation	Area of landslide within which displaced material (13) lies above original ground surface (20)
16	Depletion	Volume bounded by main scarp (2), depleted mass (17), and original ground surface (20)
17	Depleted mass	Volume of displaced material (13) that overlies surface of rupture (10) but underlies original ground surface (20)
18	Accumulation	Volume of displaced material (13) that lies above original ground surface (20)
19	Flank	Undisplaced material adjacent to sides of surface of rupture; if left and right are used, they refer to flanks as viewed from crown; otherwise use compass directions
20	Original ground surface	Surface of slope that existed before landslide took place

Figure 2: Description of Landslide Features (based on UNESCO Working Party,1993, with minor modifications) (Cornforth, 2005)

III) LANDSLIDE CLASSIFICATION

- **Type of Slope**

  - Natural Slope
  - Man-made Slope

- **Type of material**

  - Rock
  - Predominantly coarse material (debris): Material defined as having 20%-80% of particles in the gravel/boulder size (>2mm) (Huat et. al., 2008)
  - Predominantly fine material (earth)

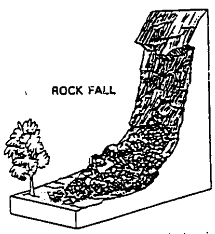
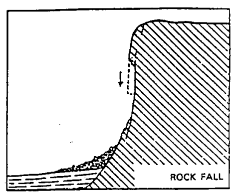
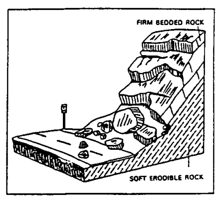
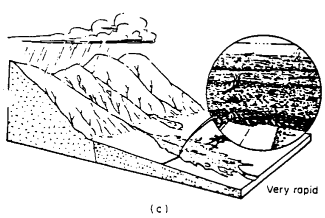
- **Type of Movement**

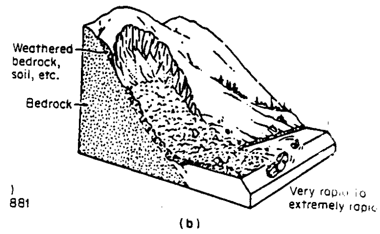
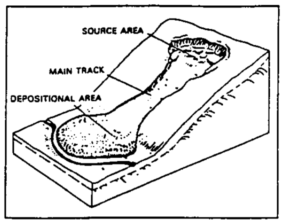
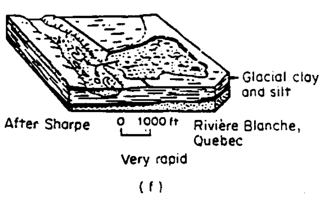
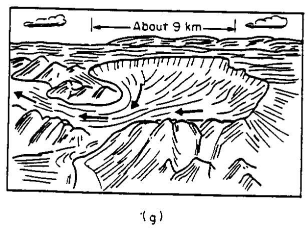
  In the original work by Varnes (1978), Varnes had generally categorized the landslide movement as follows:
  - Falls
  - Topples
  - Slides – rotational and translational
  - Lateral Spreads
  - Flows
  - Combination of types

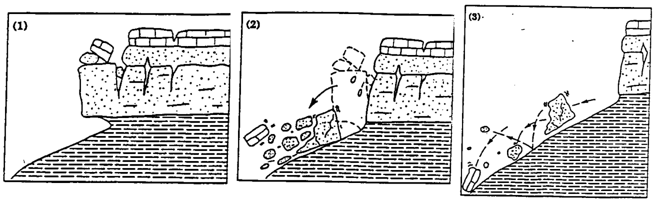
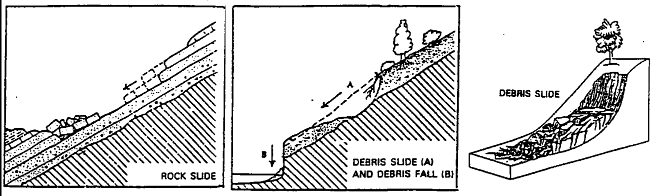
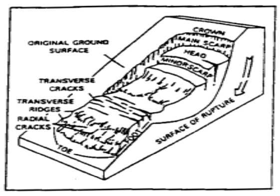
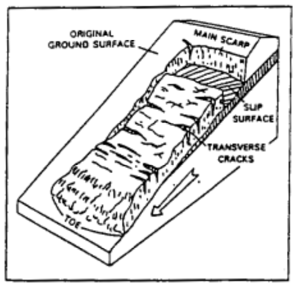
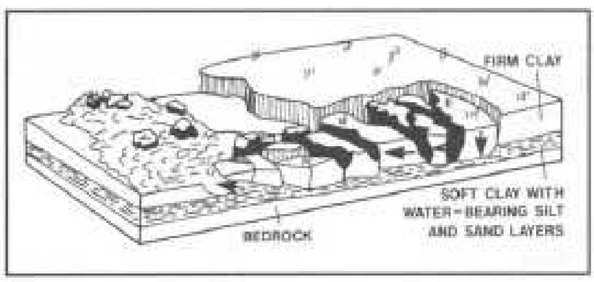
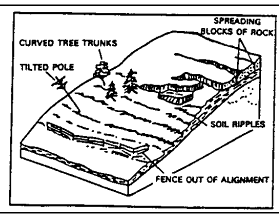
  The category was later updated and being further categorized by Hunt (1984) and Cruden & Varnes (1996).

Table 1: Type of Landslides Movement

(compiled and modified from Hunt (1984), Cruden & Varnes (1996))

Type Of Movement	Description	Examples
FALLS	Falls are abrupt movements of masses of geologic materials that become detached from steep slopes or cliffs (i.e., rock fall). Movement occurs by free fall, bouncing and rolling. Depending on the type of earth materials involved, the result is a rock fall, soil fall, debris fall, earth fall, boulder fall and so on. All types of falls are promoted by undercutting, differential weathering, excavation or stream erosion.	  
FALLS (Debris Flow)	A debris flow is a form of rapid mass movement in which loose soils, rocks and organic matter combined with entrapped air and water to form a slurry that then flows down-slope. Debris flow areas are usually associated with steep gullies. Individual debris flow areas can usually be identified by the presence of debris fans at the termini of the drainage basins.	

FALLS (Debris Avalanche)	A variety of very rapid to extremely rapid debris flow	
FALLS (Earth Flow)	Earth flows have a characteristic "hour glass" shape. A bowl of depression forms at the head where the unstable material collects and flows out. The central area is narrow and usually becomes wider as it reaches the valley floor. Flows generally occur in fine-grained materials clay-bearing rocks on moderate slopes and with saturated conditions. However, dry flows of granular material are also possible.	
FALLS (Mud Flow)	An earth flow that consists of material that is wet enough to flow rapidly and that contains at least 50% sand, silt- and clay- sized particles.	
FALLS (Lahar)	A mud flow or debris flow that originates on a slope of a volcano. Lahars are usually triggered by such things as heavy rainfall eroding volcanic deposits; sudden melting of snow and ice due to heat from volcanic vents; or by the breakout of water from glaciers, crater lakes, or lakes dammed by volcanic eruptions.	
FALLS (STURZSTROM / Rock Avalanche)	A sturzstrom is caused by a trigger, such as an earthquake or volcano. It moves rapidly, but does not necessarily require water to be present within it to move. Therefore, there is no definite explanation for their movement. The leading theory is that sturzstroms ride on "air cushions", or dust clouds generated by itself. This is called acoustic fluidization. Once moving, it can ride over nearly any terrain. It more often moves over horizontal ground, more than downward-sloped ground. Its momentum can carry it up small hills. Some characteristics of sturzstroms are: ▪ Mass movement of dry rock debris. ▪ Avalanche volume > about 106 cubic meters. ▪ Ratio of fall height to run out length < 0.6. ▪ Mobility of sturzstroms increases with avalanche volume. ▪ Observations suggest sturzstroms "flow" like a fluid *(source: www.en.wikipedia.org)*	

TOPPLES	A topple is a block of rock that tilts or rotates forward on a pivot or hinge point and then separates from the main mass, falling to the slope below, and subsequently bouncing or rolling down the slope.	
SLIDES	A more restrictive use of the term which refers to movements of soil or rock along a distinct surface of rupture which separates the slide material from more stable underlying material. The 2 major types of landslides are rotational slides and translational slides.	
SLIDES (Rotational)	One in which the surface of rupture is curved concavely upwards (spoon shaped) and the slide movement is more or less rotational about the axis that is parallel to the contour of the slope. "Slump" is an example of a small rotational slide.	
SLIDES (Translational)	The mass moves out, or down and outwards along a relatively planar surface and has little rotational movement or backward tilting. The mass commonly slides out on top of the original ground surface. Such a slide may progress over great distances if conditions are right. Slide material may range from loose unconsolidated soils to extensive slabs of rock. A "block slide" is a translational slide in which the moving mass consists of a single unit, or a few closely related units that move down-slope as a single unit.	
LATERAL SPREADS	A result of a nearly horizontal movement of geologic materials and are distinctive because they usually occur on very gentle slopes. The failure is caused by liquefaction, the process whereby saturated, loose, cohesionless sediments (usually sands & silts) are transformed from a solid into a liquefied state. Failure usually triggered by rapid ground motion such as that experienced during earthquake, or by slow chemical changes in the pore water and mineral constituents.	
FLOWS (Creep)	This is the imperceptibly slow, steady downward movement of slope-forming soil and rock. Creep is indicated by curved tree trunks, bent fences or retaining walls, tilted poles or fences, and small soil ripples or terracettes.	

- **Disturbance State of Slope Material (Huat et. al., 2008)**

  - Virgin Landslides: Occur in undisturbed slope materials operating with mobilized peak soil strength.
  - Reactivated Landslides: Occur in disturbed slope materials at a previous landslip area operating with mobilized residual shear strength.

- **Rate of Movement**

Table 2: Velocity Classes for Landslides (after International Geotechnical Societies UNESCO Working Parrty on World Landslide Inventory (WP/WLI, 1995)

Velocity Class	Description	Velocity Limit	Nature of Impact
7	**Extremely Rapid**	5 m/s	Catastrophe of major violence, exposed buildings totally destroyed and population killed by impact of displaced material, or by disaggregation of the displaced mass
6	**Very Rapid**	3 m/min	Some lives lost because the landslide velocity is too great to permit all persons to escape, major destruction
5	**Rapid**	1.8 m/hour	Escape and evacuation possible; structure, possessions and equipment destroyed by the displaced mass
4	**Moderate**	13 m/month	Insensitive structures can be maintained if they are located a short distance in front of the toe of the displaced mass; structures located on the displaced mass are extensively damaged
3	**Slow**	1.6 m/year	Roads and insensitive structures can be maintained with frequent and heavy maintenance work, if the movement does not last too long and if differential movements at the margins of the landslide are distributed across a wide zone
2	**Very Slow**	0.016 m/ year	Some permanent structures undamaged or, if they are cracked by the movement, they can be repaired
1	**Extremely Slow**		No damage to structures built with precautions

In addition, very slow or extremely slow slope movements are often termed as creep

- **Size**

Up to date, there is no available standard to categorize the landslide by size. However, it is relatively useful to provide some guidelines to describe the extent of a landslide. Cornforth (2005) suggested a guideline for such a purpose which is presented in Table 3.

Table 3: Classification of Landslides by Area in Plan (Cornforth, 2005)

Description	Area (sq.ft.)	Area (sq.m.)
Very Small	< 2000	**< 200**
Small	2,000 – 20,000	**200 – 2,000**
Medium	20,000 – 200,000	**2,000 – 20,000**
Large	200,000 – 2,000,000	**20,000 – 200,000**
Very Large	2,000,000 – 20,000,000	**200,000 – 2,000,000**
Huge	**> 20,000,000**	**> 2,000,000**

- **Drainage condition**

Table 4: Classification of Landslides by Drainage Condition (Huat et. al., 2008)

Drainage Condition	Description
Drained (long term)	No excess pore pressures are generated during shearing or they are fully dissipated
Partially drained (medium term)	Some excess pore pressures generated during shearing are partially dissipated
Undrained (short term)	Low permeability soils, excess pore pressures are generated during shearing

- **Style**

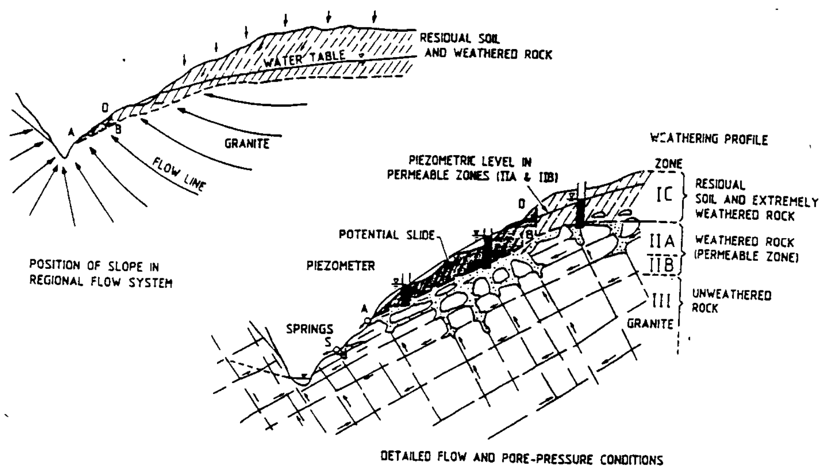
Landslides were classified as shallow or deep-seated because they generally present two distinct types of hazard. Most shallow landslides move downslope rapidly, and can mobilize into far reaching, life-threatening flow-type failures with addition of water at the source, or along the run out path, or when an advancing slide mass encounters a flowing stream. In contrast, deep-seated landslides such as rotational slumps, commonly move at a slower rate and cover a shorter distance. Thus, deep-seated landslides present a hazard primarily to the area on immediately surrounding the slide along the down slope, and some warning, such as the appearance of tension cracks at the crown or bulging at the toe, may precede significant landslide movement (Utah 2006)

Table 5: Classification of Landslides by Shallow or Deep-Seated Failure

Shallow Failure	o Depth to failure plane generally less than 10 feet - 3 m (Utah, 2006) o Depth to failure plane generally less than 4 feet – 1.2 m (Day, R. W., 2004) o Depth to failure surfaces lesser than 10m (Jaboyedoff et. al., 2004)
Deep-Seated Failure	o Depth to failure plane greater than 10 feet - 3 m (Utah 2006) o Depth to failure plane greater than 4 feet – 1.2 m (Day, R. W., 2004) o Depth to failure surfaces greater than 10m and large volume of material flow (i.e. 1,000,000 m^3) (Jaboyedoff et. al., 2004)

- **Geological environment**

Table 6 : Relationship between Geological Environment and Landslide (MacGregor et. al., (1990) and Stapledon (1992))

Granite	

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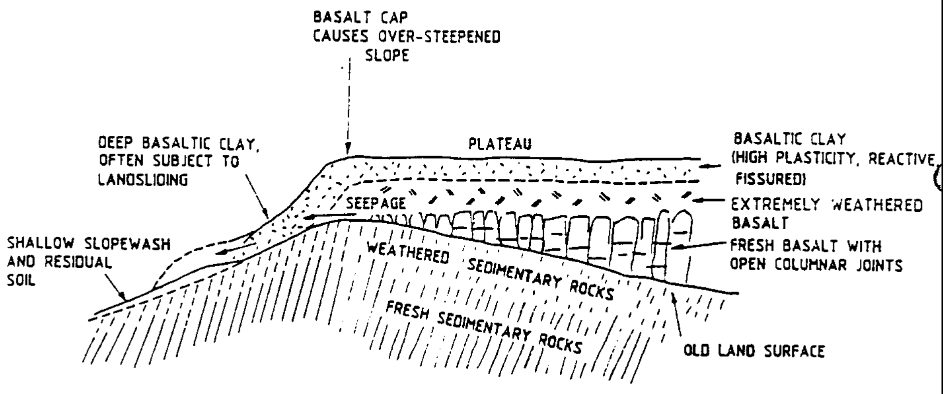
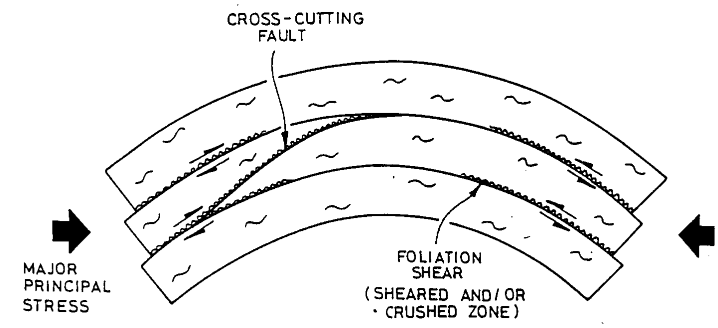
<tr><td>Volcanic</td><td>

Typical profile through margin of basalt plateau, showing conditions which lead to slope instability.</td></tr>
<tr><td rowspan="2">chistose Rocks (eg. schist, slate, phyllite)</td><td>
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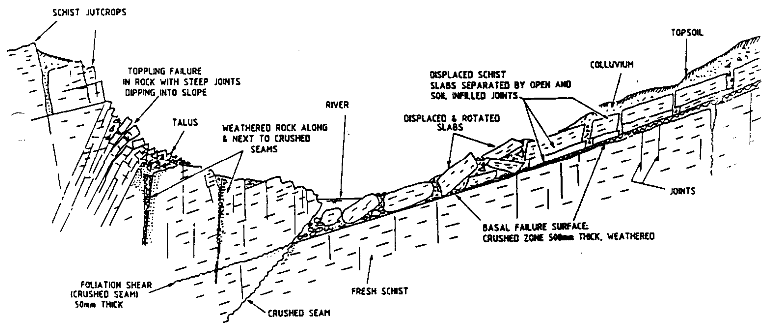
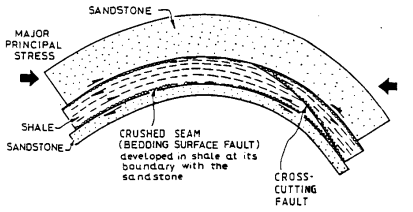
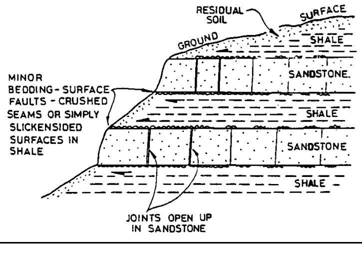
<tr><td>
</td></tr>
<tr><td>Mudrocks</td><td>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<table>
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<td>Sandstones,
Siltstones,
Conglomerates</td>
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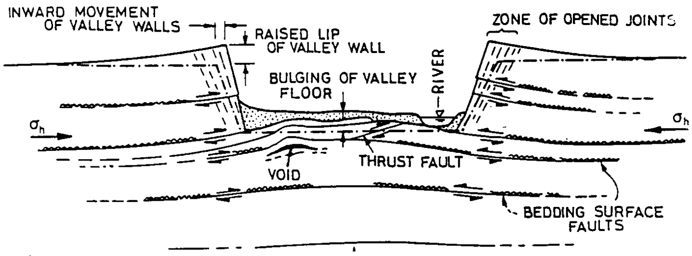

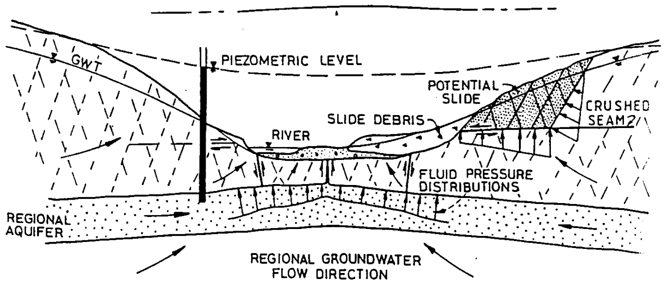

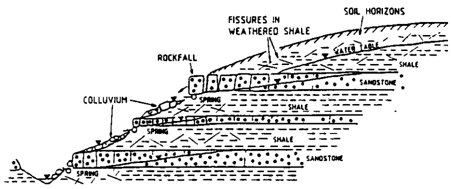

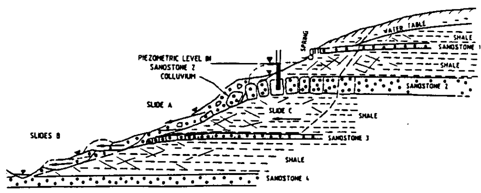

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</tr>
<tr>
<td>Carbonate Rocks</td>
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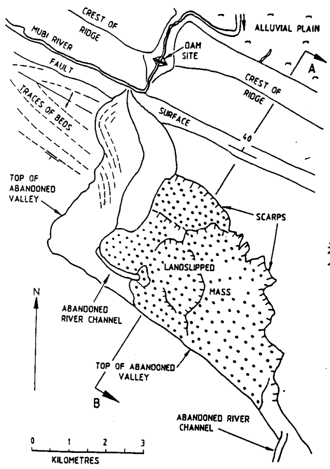

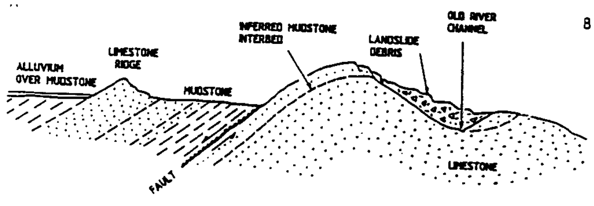

</td>
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</table>

IV) LANDSLIDE DATABASE IN MALAYSIA (TODATE)

Table7: Series of major landslide occurrences in Malaysia

No.	Date	Location	Type and Nature of Landslide/Slope Failure. Size/Volume	No. of Death	Notes	Main Causes/ Triggering Factors	Policy Impact	Rehabilitation Measures
1	Oct. 1993	Kuala Lipis-Gua Musang	Part of the road collapse due to failure of fill slope following a period of continuous rain	1	-	*	*	*
2	Nov. 1993	Karak Highway	Shallow rotational slide. Failure of cut slope at the side of the highway occurred at dawn - buried in motorcycle rider and its pillion	2	Cut slope in granitic formation	*	*	*
3	Dec. 1993	Ulu Klang, Selangor	Shallow rotational slide. Prolonged and heavy rain triggered retrogressive failure of cut slope behind the Highland Tower apartment - toppled Block A	48	Cut slope in granitic formation	Inadequate design, improper construction, triggered by rainfall	*	*
4	March 1994	Fraser Hill	Collapse of balconies of Fraser's Pine Resort due to landslide	-	Natural slope	*	*	*
5	June 1995	Karak Highway - Genting Highland slip road, Selangor – Pahang border	Debris flow. Failure of upstream natural dam during heavy rain triggered 'snowball effect' debris avalanche	22	Natural slope in meta-sediment formation	Triggered by heavy rainfall	*	*
6	Jan. 1996	Gunung Tempurung, Kampar, Perak	Deep-seated rotational slide. Failure of cut slope (strengthened by anchor and guniting) at the side of North-South Highway	1	Cut slope in granitic formation	Adverse geological, Triggered by rainfall	*	*
7	Aug. 1996	Orang Asli settlement, Post Dipang, Kampar, Perak	Debris flow from erosion and logging activities along upstream of Sungai Dipang occurred during heavy rain	44	Natural slope in granitic formation	Inadequate FOS Triggered by rainfall	*	*
8	Nov. 1998	Bukit Saujana, Paya Terubung, Penang	Massive rockslide	-	Cut slope in granitic formation	Inappropriate design , triggered by rainfall	*	*
9	Jan. 1999	Squatters settlement, Sandakan, Sabah	Shallow rotational slide. Heavy rain triggered landslide - buried a number of houses/huts	13	Natural slope in meta-sediment formation	Inadequate FOS, Triggered by rainfall	*	*

10	May 1999	Bukit Antarabangsa, Ulu Kelang	Massive landslide	-	-	Inadequate design, improper construction, triggered by prolonged rainfall	*	*
11	Jan. 2000	Vegetable farm, Cameron Highlands, Pahang	Debris flow from upstream landslide and erosion washed away workers squatters	6	Vegetable farm on sloping land in meta-sediment formation	*	*	*
12	Jan. 2001	Simunjan, Sarawak	Shallow rotational slide. Landslide occurred on vegetable farm - buried a number of houses at the toe of slope	16	Vegetable farm on sloping land in meta-sediment formation	*	*	*
13	Dec. 2001	Gunung Pulai, Johor	Debris flow. Heavy rain triggered debris flow resulting from a number of small landslides along upstream of Sungai Pulai - washed away settlements along the river bank	5	Natural slope in granitic formation	*	*	*
14	Nov. 2002	Hillview, Ulu Kelang, Selangor	Debris flow. Sliding/flowing of debris soil during heavy rain - toppled a bungalow at the toe of the hill	8	Dumping area of abandoned project in granitic formation	Inadequate design of the adjacent slope, triggered by rainfall, old landslide location	*	*
15	Oct. 2003	Gunung Raya Road, Langkawi	Deep-seated rotational slides. Landslide triggered by heavy and prolonged rain - buried a machine and its operator while clearing the debris.	1	Cut slope in granitic formation	*	*	*
16	Nov. 2003	Bukit Lanjan, North Klang Valley Expressway	Rock Slide/rock debris	-	Cut slope in granitic formation	Adverse geological condition, long term weathering , prolonged rainfall	*	*
17	Nov. 2004	Taman Harmonis, Gombak, Selangor	Debris flow. Sliding/flowing of debris soil from uphill bungalow project - toppled the back-portion of neighboring down slope bungalow after weeklong continuous rain.	1	Dumping area of ongoing project in meta-sediment formation		*	*

18	Dec. 2004	Bercham, Ipoh, Perak	Rock fall - buried back portion of illegal factory at the foot of limestone hill.	2	Natural limestone cliff in karsts formation	*	*	*
19	May 2006	Ulu Klang, Selangor	Landslide due to collapse of retaining wall and retrogressive slope failures. Buried 3 blocks of longhouses.	4	Cut slope in granitic residual soil. The area is also known to be highly susceptible to severe erosion	*	*	*
20	Oct. 2006	Wangsa Maju	Landslide to near the residential Flat Block B4 and Block B5.		Cut slope in granitic residual soil. The area is also known to be highly susceptible to severe erosion	Triggered by heavy rainfall	*	*
21	Oct. 2006	Jalan Sepanggar, Sabah	15 houses were crushed by mudslide*	1	The monsoon rains had loosened soil on hillsides*	Triggered by heavy rainfall *	*	*
22	March 2007	Presinct 9, Putrajaya	Landslide occurred on height hill slope at Taman Rimba Desa, which is also behind the phase 11 Apartments in Precinct 9, Putrajaya.	*	Cut Slopes in meta-sediment formation	Triggered by heavy rainfall	*	*

**Note :* - Still searching for information*

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APPENDIX A

Perak

No	Date	Location	State	District:	Rain fall			Fatalities
					Rare	Seldom	Heavy	
1	18-Oct-1973	Kg Kachang Putih, Gunung Cheroh	Perak	Ipoh		X		42
2	4-Nov-1975	Lombong Merah Emas	Perak	Kampar				
3	27-Oct-1976	Jalan Maharajalela	Perak	Ipoh				
4	28-Aug-1976	Kampung Pulau Attap	Perak	Ipoh				
5	24-Feb-1980	Batu Gajah	Perak	Batu Gajah				
6	25-Feb-1980	Kampong Sekolah Menengah Rendah (SMR)	Perak	Batu Gajah				
7	26-Mar-1981	Batu 22 Jln Ipoh-Kampar	Perak	Kampar				
8	31-Mar-1981	Jalan Tanjung Tualang	Perak	Batu Gajah				
9	27-Dec-1983	Padang Rengas	Perak	Lubuk Merbau			X	
10	29-May-1984	Lombong Bijih Timah Kim Poh	Perak	Sungai Siput				
11	7-Nov-1985	Jalan Tapah-Cameron Highlandss	Perak	Tapah				
12	5-May-1992	KM11,Jalan Lahat	Perak	Ipoh				
13	7-Dec-1992	Jln Tapah-Tanah Rata	Perak	Tapah		X		
14	25-Nov-1993	Kilometer 20,24,27,32	Perak	Cameron Highlands				
15	17-Oct-1993	Jalan Tapah	Perak	Cameron Highlands				
16	15-Dec-1993	Jln. Kekwah	Perak	Alor Gajah				
17	31-Dec-1993	KM 59.5, Lebuh Raya Timur - Barat	Perak	Grik				1
18	19-Jun-1994	Kampar	Perak	Kampar				
19	31-May-1994	Kampar	Perak	kampar				
20	17-Nov-1995	Jalan Sumpitan,ljok	Perak	Taiping				
21	17-Oct-1995	Bukit Raja, lenggong	Perak	Lenggong			X	
22	31-Oct-1995	Tapah -Cameron Highlands	Perak	Tapah				
23	1-Apr-1995	Kuala Kubu Baru	Perak	Kuala Kubu Baru			X	
24	6-Nov-1995	Tapah	Perak	Tapah			X	
25	1-Nov-1995	Tapah-Ringlet	Perak	Tapah		X		
26	16-Aug-1995	Sungai Kinta	Perak	Ipoh			X	
27	15-Nov-1995	Tanah Rata	Perak	Cameron Highlandss			X	
28	14-Mar-1995	Tapah	Perak	Cameron Highlandss			X	
29	7-Jan-1996	Gua Musang	Perak	Gopeng				
30	6-Jan-1996	Km 303.8 Lebuh Raya Utara -Selatan (Gua Tempurung)	Perak	Ipoh			X	1
31	9-Oct-1996	Kampung Raja	Perak	Cameron Highlandss				
32	4-Sep-1996	Lata Iskandar	Perak	Cameron Highlands				
33	19-Jun-1996	Jalan Ringlet Tanah Rata	Perak	Cameron Highlands				
34	25-May-1996	263.7km of North South Highway	Perak	Jelapang				
35	5-Feb-1996	Kampung Tersusun Tekah Tiga	Perak	Taiping				
36	7-Jan-1996	N-S Highway	Perak				X	
37	29-Aug-1996	Pos Dipang (Perkampungan Orang Asli)	Perak				X	44
38	31-Aug-1996	Taman Mewah	Perak	Taiping			X	
39	9-Oct-1996	Cameron Highlands-Kampung Raja	Perak	Cameron Highlands			X	
40	20-Jun-1996	Jalan Tapah	Perak	Camerom Hignland				
41	9-Oct-1996	Jalan Ipoh, Kuala Terla, Cameron Highlands	Perak	Cameron			X	

				Highlands			
42	3-Sep-1996	Lata Iskandar	Perak	Cameron Highlands		X	
43	16-Feb-1996	Mambang Diawan	Perak	Kampar		X	
44	17-Oct-1996	Cameron Highlandss	Perak	Cameron Highlandss		X	
45	31-Aug-1996	Ipoh	Perak	Ipoh		X	
46	6-Jan-1996	Gopeng-Tapah	Perak	Ipoh			
47	2-Sep-1996	Kampar	Perak	Kampar		X	
48	10-Jan-1997	Pondok Quin	Perak	Kuala Kalai			
49	19-Dec-1999	Batu 24-26 Jln Tapah-Cameron Highlandss	Perak	Tapah	X		
50	7-Dec-1999	Jln Tapah-Cameron Highlandss	Perak	Tapah	X		
51	8-Jan-2000	Kampung Raja and Blue Valley	Perak	Cameron Highlandss	X		
52	6-May-2000	Bukit Berapit	Perak			X	
53	5-Jan-2000	Cameron Highlands	Perak	Cameron Highlands		X	
54	1-Mar-2004	Loji Jana Kuasa Lumut, Segari	Perak	Manjung			
55	10-Nov-2004	KM 302 Plus Gunung Tempurung	Perak	Gopeng		X	
56	23-Oct-2004	Menora Tunnel Jelapang Plus	Perak	Ipoh		X	
57	2-May-2004	Gunung Cheroh	Perak	Ipoh			
58	3-Dec-2004	Tmn Bercham Utama, Ipoh perak	Perak	Ipoh			2
59	8-Mar-2005	Batu 19, Jalan Tapah Cameron	Perak	Tapah		X	
60	7-Jan-2006	Taman Pusing, Pusing	Perak	Ipoh	X		
61	15-Nov-2007	Tasik Banding (Perak State Coorporation's)	Perak	Gerik		X	
62	22-Nov-2007	Km 231.6 PLUS , Kuala Kangsar	Perak	Kuala Kangsar	X		

Selangor

No	Date	Location	State	District:	Rain fall			Fatalities
					Rare	Seldom	Heavy	
1	29-Jan-1974	Kampung Medan	Selangor	Petaling Jaya				
2	14-Dec-1976	Sungai Kuyoh	Selangor	Puchong			X	
3	22-Apr-1978	Batu 23 1/2	Selangor	Serendah	X			
4	24-Nov-1980	Taman Tenaga	Selangor	Puchong			X	
5	24-Mar-1981	Batu8.5	Selangor	Puchong				
6	12-Jan-1981	Jalan Miri-Pujut	Selangor	Puchong				
7	26-Apr-1984	KM14.4 Puchong	Selangor	Puchong				
8	9-Nov-1986	Kg. koskan, Sungai Coh	Selangor	Rawang				
9	3-Oct-1990	Jalan Tropika Utara	Selangor	Damansara, Petaling Jaya		X		
10	3-Oct-1990	Damasara, Petaling Jaya	Selangor	Damasara, Petaling Jaya			X	
11	21-Oct-1990	Kuala Kubu Baru	Selangor	Kuala Kubu Baru			X	
12	16-Oct-1991	Kpg Berembang	Selangor	Kuala Ampang				
13	8-Mar-1992	Taman Bukit Intan	Selangor	Petaling Jaya			X	
14	29-Nov-1993	Bdr. Baru Salak Tinggi	Selangor	Sepang				
15	12-Nov-1993	Hulu Yam	Selangor	Selayang			X	
16	11-Dec-1993	Highlands Tower, Hulu Kelang	Selangor	Hulu Kelang			X	48
17	21-Dec-1993	Jalan Puchong	Selangor	Puchong			X	
18	13-May-1993	Kg. Sri Serendah	Selangor	Serendah		X		
19	2-Mar-1994	Klang Valley Expressway	Selangor	Klang				
20	13-Oct-1994	Kpg Kandan Dalam, KM 12 Jln Puchong	Selangor	Punchong			X	
21	18-Mar-1994	Bandar Baru Klang	Selangor					
22	27-Jan-1994	Bkt Gasing	Selangor	Petaling Jaya			X	
23	2-May-1994	Puchong Perdana	Selangor	Puchong			X	3
24	22-Mar-1994	Bukit Fraser	Selangor	Fraser			X	
25	14-Feb-1994	Jln. Ampang Hulu Langat	Selangor	Ampang				
26	14-Aug-1995	SS3/26A	Selangor	Petaling Jaya			X	
27	6-Oct-1995	Gombak- Bentong	Selangor	Gombak				
28	19-Mar-1995	Jln. Semenyih	Selangor	Kajang				
29	15-May-1995	Keramat Permai	Selangor	Hulu Kelang			X	
30	8-Aug-1995	Tmn. Damai Indah	Selangor	Kajang			X	
31	28-Apr-1995	Lrg 10/3m Taman Sri Gombak	Selangor	Gombak			X	
32	2-Jul-1995	Km 12 Jln. Gombak	Selangor					
33	22-Oct-1995	Kuala Kubu Baharu	Selangor	Hulu Selangor				
34	1-Jan-1996	Bandar Baru Selayang	Selangor	Selayang				
35	24-Jan-1996	Bukit Gasing	Selangor	Petaling Jaya				
36	25-Apr-1996	Lorong Bistari, Bukit Damasara	Selangor	Jitters			X	
37	7-Jan-1996	Rawang	Selangor	Rawang			X	
38	1-Jul-1996	Tanjung Malim	Selangor	Tanjung Malim			X	
39	17-Feb-1996	Bukit Fraser	Selangor	Fraser			X	
40	30-Apr-1996	SS22A/1	Selangor	Petaling Jaya			X	
41	2-Jan-1997	Jln Tiong	Selangor	Puchong				
42	30-Apr-1997	Taman Sri Sentosa	Selangor	Petaling Jaya			X	
43	29-Dec-1997		Selangor	Hulu Langat	X			

44	3-Sep-1998	Jln Kuala Lumpur-Rawang	Selangor	Gombak			X	
45	27-Aug-1998	Puchong Jaya	Selangor	Puchong			X	
46	1-Feb-1999	Sunway Interchange	Selangor	Bandar Sunway				
47	8-Dec-1999	Tmn. Sri Timah	Selangor	Balakong				
48	4-Apr-1999	Laluan Bukit Fraser-Raub	Selangor	Bukit Fraser	X			
49	19-Oct-1999	Jln. Intan Baiduri	Selangor	Kepong				
50	15-May-1999	Bukit Antarabangsa, Ampang	Selangor					
51	3-Dec-1999	KM449.6 Plus Sg. Buluh	Selangor					
52	16-Nov-2000	Seksyen 9	Selangor	Shah Alam			X	
53	27-Aug-2000	200 m from Station Komuter Subang Jaya	Selangor	Subang Jaya		X		
54	13-Feb-2000	Kawasan Industri Balakong	Selangor	Serdang			X	
55	12-Jan-2001		Selangor					
56	26-Jan-2001	Taman Perumahan Rawang Perdana	Selangor	Rawang			X	
57	2-Jan-2001	KM 28 Jln Ulu Yam Lama	Selangor	Gombak		X		
58	30-Apr-2002	Taman Kajang Jaya	Selangor	Kajang			X	
59	16-Oct-1991	Kpg Berembang	Selangor	Kuala Ampang			X	
60	14-Feb-1994	Jln. Ampang Hulu Langat	Selangor	Ampang				
61	26-Nov-2003	KM 21.8 Lebuhray NKVE (26/11/2003)	Selangor					
62	28-Nov-2003	Bkt Lanjang North Klang Valley Expressway	Selangor	Kota Damansara			X	
63	10-Feb-2004	Jalan 18&19 ,Taman Putra Selangor	Selangor	Ampang			X	
64	5-Nov-2004	Taman Harmonis , Gombak	Selangor	Gombak			X	
65	14-Apr-2005	Kpg Melayu Batu 11	Selangor	Puchong				
66	23-Nov-2005	Jalan Anggerik 5D/2 BS7 , Bandar Bukit Sentosa	Selangor	Bukit Beruntung			X	
67	27-Feb-2006	Bandar County Homes	Selangor	Rawang		X		
68	10-May-2006	Jalan Sg Long 12/1	Selangor	Kajang		X		
69	9-Oct-2006	Wangsa Maju ,Hulu Klang	Selangor	Ampang				
70	14-Apr-2006	Kolam Simpanan Air (Syabas) Sg Chua, Kajang	Selangor	Kajang				
71	13-Apr-2006	Jalan Niah 1	Selangor	Jinjang Utara				
72	5-Nov-2006	Taman Belimbing	Selangor	Balakong				
73	11-Nov-2006	Kg Bukit Sungai Seputeh, Lembah Jaya.	Selangor	Ampang				1
74	17-Nov-2006	Puchong Jaya	Selangor	Puchong				
75	22-Nov-2006	Taman Bukit Serdang	Selangor	Serdang				
76	27-Feb-2007	Tmn pelangi , Rawang	Selangor	Rawang				
77	9-Jun-2007	Taman Sri Hartamas Puchong	Selangor	Puchong				

Kelantan

No	Date	Location	State	District:	Rain fall			Fatalities
					Rare	Seldom	Heavy	
1	14-May-1974	Tanah Merah	Kelantan	Tanah Merah		X		
2	27-Nov-1979	Kuala Balah	Kelantan	Kuala Balah			X	
3	2-Nov-1984	Kuala Kerai	Kelantan	Kota Bharu			X	
4	15-Oct-1984	Kampung Tanjung Kuala Kerai	Kelantan	Kota Baru			X	
5	15-Nov-1993	Kampung Tok Nik	Kelantan	Pasir Puteh				
6	22-Dec-1993	Kelantan	Kelantan	Kelantan				
7	24-Oct-1993	Km 58 , Kuala Lipis-Gua Musang Road	Kelantan	Gua Musang			X	1
8	31-Dec-1993	KM 59.5 Lebuhraya Timur- Barat	Kelantan	Jeli				1
9	11-Nov-1994	Jeli	Kelantan	Jeli				
10	16-Mar-1995	Tanah Merah	Kelantan	Tanah Merah				
11	4-Jan-1999	Lebuh Raya Timur Barat Grik Jeli	Kelantan	Jeli	X			
12	18-Jan-2001	Lebuh Raya Kuala Krai-Gua Musang	Kelantan	Kuala Krai		X		
13	1-May-2002	Section 1/700 (KM 1.7) Jln Jeli-Dabong	Kelantan	Dabong	X			
14	1-May-2002	Section 1/900 Jln Jeli-Dabong	Kelantan	Dabong	X			
15	1-May-2002	Section 312/840 FT08 Jln Kuala Krai-Gua Musang	Kelantan	Gua Musang		X		
16	25-Dec-1993	Kuala Krai Gua Musang KM 62	Kelantan	Gua Musang				
17	15-Nov-1994	KM 32 Jeli Kelantan	Kelantan	Jeli				
18		KM 45 , Jln Gua Musang - Jeli (Rancangan Kemajuan Tanah (RKT) kesedar Meranto)	Kelantan	Jeli			X	

Johor

No	Date	Location	State	District:	Rain fall			Fatalities
					Rare	Seldom	Heavy	
1	6-Jul-1988	Kg. Parit	Johor	Pontian				
2	14-Dec-1991	Taman Ungku Tun Aminah	Johor	Johor Baru	X			
3	30-May-1992	Kampung Sri Bahagia	Johor	Plentong			X	
4	21-Dec-1993	Tmn. Ungku Tun Aminah	Johor	Johor Bahru	X			
5	29-May-1994	Taman Kluang Baru	Johor	Kluang	X			
6	4-Aug-1995	Jalan Tebrau	Johor	Johor Baru			X	
7	5-Jul-1995	Bukit Botak	Johor	Batu Pahat			X	
8	17-Oct-1996	Kampung Baru	Johor	Gelang Patah			X	1
9	31-Aug-1996	Tebing Sungai Muar	Johor	Panchor			X	
10	27-Mar-1996	Jalan Abdullah,Panchor Village	Johor	Muar			X	
11	9-Jul-1996	Lima Kedai, Gelang Patah	Johor	Johor Bahru			X	
12	15-Mar-1997	Jalan Trus	Johor	Johor Bahru	X			
13	22-Dec-2000	KM 93 near Jemaluang, Mersing	Johor	Mersing		X		
14	17-Jan-2001	KM 16.1 North South Highway	Johor	Johor Bahru		X		
15	28-Dec-2001	Gunung Pulai	Johor	Gunung Pulai			X	
16	3-Jan-2002	Hutan Lipur Gunung Pulai	Johor	Gunung Pulai			X	5
17	9-Nov-1979	Jalan Abdul Samad	Johor				X	
18	13-Dec-1999	KM 52 JB Ayer Itam	Johor	Simpang Renggam			X	
19	18-Jan-2001	KM 16.1 North South Highway Skudai (18/01/2001)	Johor	Skudai				
20	23-Nov-2003	KM 24.5, Parit Benos road	Johor					
21	14-Jan-2006	KM 19.3	Johor	Senai				

Kedah

No	Date	Location	State	District:	Rain fall			Fatalities
					Rare	Seldom	Heavy	
1	3-Nov-1993	Gerik	Kedah	Gerik			X	
2	24-Nov-1993	Kulim	Kedah	Kulim			X	
3	5-Jul-1996	Kampung Mambong	Kedah	Sik			X	
4	10-Jun-1996	KM 10,11 Jalan Baling-Pengkalan Hulu	Kedah	Baling				
5	3-Sep-1996	Grik	Kedah	Grik			X	
6	11-Feb-1996	Teluk Ewa	Kedah	Langkawi	X			
7	9-Dec-1998	Jalan dari Baling ke Pengkalan Hulu	Kedah	Baling				
8	10-Nov-1998	Kem Biro Tatanegara	Kedah	Kulim			X	
9	16-Nov-1998	Taman Kenari	Kedah	Kulim			X	
10	10-Jan-2003	Gunung Raya Langkawi (10-1-2003)	Kedah	Langkawi				
11	11-Dec-2003	Gunung Raya Langkawi (11-12-2003)	Kedah	Langkawi				
12	14-Oct-2003	KM 5.95, Gunung Raya (14/10-2003	Kedah	Langkawi				
13	6-Oct-2004	Bukit Besar (06/10/2004)	Kedah	Langkawi				
14	6-Oct-2003	Bukit Besar (06/10/2003)	Kedah	Langkawi				
15	10-Oct-2003	Gunung Raya Road , Langkawi	Kedah	Langkawi			X	
16	7-Nov-2006	Kuari , Gunung Jerai	Kedah	Gurun				2

Negeri Sembilan

No	Date	Location	State	District:	Rain fall			Fatalities
					Rare	Seldom	Heavy	
1	9-Aug-1994	Kg. Baharu Pantai	Negeri Sembilan	Seremban				
2	22-Dec-1993	Jln. Tok Ungku	Negeri Sembilan	Seremban			X	
3	22-Dec-1993	Jln.Lobak	Negeri Sembilan	Seremban			X	
4	6-May-1993	Dusun Setia	Negeri Sembilan	Seremban				
5	16-May-1993	Pancor	Negeri Sembilan	Seremban			X	
6	30-Jul-1995	Tunke Jaafar Industrial Area	Negeri Sembilan	Senawang				
7	13-May-1995	Sekolah Rendah Puteri, Jalan Labu	Negeri Sembilan	Seremban				
8	15-Nov-1995	Senawang	Negeri Sembilan	Seremban			X	
9	7-Sep-1995	Jln. Tuanku Antah	Negeri Sembilan	Seremban			X	
10	17-Nov-1995	Senawamng Paroi	Negeri Sembilan	Senawang			X	
11	21-Nov-1995	Jln Bahau	Negeri Sembilan	Bahau			X	
12	9-Mar-1996	Kg. Gentam	Negeri Sembilan	Kuala Pilah				
13	1-Jan-1996	Tmn Rasah Jaya	Negeri Sembilan	Seremban		X		
14	27-Feb-1996	Seremban-Kuala Sawah	Negeri Sembilan	Seremban				
15	10-Mar-1996	Sekolah Rendah Tunku Munawir	Negeri Sembilan	Kuala Pilah				
16	30-Aug-1996	Senawang	Negeri Sembilan	Senawang			X	
17	30-Oct-1997	Jln Rasah, off Jln Loop	Negeri Sembilan	Seremban			X	
18	14-Oct-1997	Lengkungan Negeri Sembilan	Negeri Sembilan					
19	15-May-1999	Rakyat Pancur	Negeri Sembilan	Seremban				
20	18-May-1999	Taman Lily, Senawang	Negeri Sembilan	Seremban			X	
21	11-May-1999	Bukit Tangga, KM19 Seremban-Jelebu	Negeri Sembilan	Seremban				
22	3-Dec-1999	Batu 12 Jln Jelebu-Seremban	Negeri Sembilan	Jelebu	X			
23	30-Nov-1999	Jln Kurau 71 Taman Permai	Negeri Sembilan	Seremban			X	
24	25-Oct-2000	Rumah Rakyat Mambau	Negeri Sembilan	Seremban			X	
25	23-Jan-2000	Lorong 3 Taman Irama	Negeri Sembilan	Jelebu		X		
26	6-Sep-2001	Kem Bina Negara, Ulu Sepri	Negeri Sembilan	Rembau				
27	17-Jan-2001	Taman Rasah Jaya	Negeri Sembilan	Seremban				
28	14-Oct-2002	Taman Permai 2	Negeri Sembilan	Seremban			X	
29	4-Mar-2003	Site IKBN, Pedas	Negeri Sembilan	Seremban	X			
30	7-Apr-2005	Jalan Kampung Tohor	Negeri Sembilan	Jelebu			X	

Pulau Pinang

No	Date	Location	State	District:	Rain fall			Fatalities
					Rare	Seldom	Heavy	
1	30-Jan-1984	Tmn. Sardon	P.Pinang			X		
2	13-Oct-1984	Kampung Gajah	P.Pinang				X	
3	20-Jan-1984	Taman Sardon	P.Pinang	Penang			X	
4	4-Mar-1985	Bukit Gambir, Gelugur	P.Pinang	Gelugur				
5	21-Oct-1996	Hye Keat Estate, Air Itam	P.Pinang	Air Itam			X	
6	22-Nov-1993	Hong Seng Estate	P.Pinang				X	
7	19-Jul-1995	Chee Seng Garden	P.Pinang					
8	19-Sep-1995	Jalan Sardon	P.Pinang				X	
9	19-Sep-1995	Teluk Bahang	P.Pinang	Penang			X	
10	19-Sep-1995	Teluk Kumbar	P.Pinang	Penang			X	
11	21-Sep-1995	Bukit Bendera	P.Pinang	Penang			X	
12	9-Nov-1995	Teluk Bahang	P.Pinang	Penang			X	
13	17-Nov-1995	Teluk Bahang	P.Pinang	Penang			X	
14	15-Oct-1996	Jalan Batu Ferringhi	P.Pinang	Penang				
15	28-Nov-1998	Sun Moon City	P.Pinang	Paya Terubong			X	
16	15-Nov-1998	Jln Tun Sardon	P.Pinang				X	
17	25-Aug-1998	Tmn Cemerlang	P.Pinang	Paya Terubong			X	
18	3-Dec-1998	Bukit Awana	P.Pinang					
19	5-Sep-1999	Telok Tempoyak	P.Pinang				X	
20	27-Aug-1999	Jalan Bukit Kukus	P.Pinang	Paya Terubong			X	
21	7-Sep-1999	Persiaran Mayang Pasir Lima, Jln Tengah	P.Pinang	Bkt Gedung				
22	28-Nov-1999	Bukit Awana	P.Pinang	Penang			X	
23	19-Oct-2001	Jln. Pokok Cherri	P.Pinang					
24	30-Aug-2003	Jalan Bukit Baru	P.Pinang	Balik Pulau			X	

Sarawak

No	Date	Location	State	District:	Rain fall			Fatalities
					Rare	Seldom	Heavy	
1	13-Jan-1981	Bukit Canada	Sarawak	Miri		X		
2	12-Jan-1981	Jalan Miri-Pujut	Sarawak	Miri			X	
3	27-Dec-1992	Pulau Salak Batu	Sarawak	Santubong				
4	28-Dec-1993	Canada Hill	Sarawak	Miri			X	
5	24-Jan-1994	Jln. Kuching/ Bau to kampung Puso	Sarawak				X	
6	21-Mar-1995	Kg. Bukit Cina	Sarawak	Kapit				
7	12-Jan-1996	Jln. Tamparuli-Ranau	Sarawak	Tamparuli		X		
8	9-Feb-1966	Jln. Miri-Bintulu	Sarawak	Miri			X	
9	24-Feb-1997	Kampung Haji Baki	Sarawak	Kuching			X	
10	16-Feb-2002	Kampung Tanggak Pelaman	Sarawak	Serian			X	
11	28-Jan-2002	Kampung Ruan Changkul,Simunjan	Sarawak	Simunjan			X	16
12	4-Feb-2002	Kampung Lanchang Sijo	Sarawak	Serian			X	
13	5-Feb-2003	Kampung Lanchang Sijo	Sarawak	Serian			X	1
14	4-Feb-2003	Borneo	Sarawak	Borneo		X		
15	24-Jan-2004	Kampung Podam	Sarawak	Bau			X	1
16	31-Dec-2006	Rumah Panjang Likong Balleh	Sarawak	Kapit			X	
17	26-Dec-2007	Kg Cina , Kapit	Sarawak	Kapit			X	4

Sabah

No	Date	Location	State	District:	Rain fall			Fatalities
					Rare	Seldom	Heavy	
1	8-Oct-1979	Jln. Tuaran	Sabah	Kota Kinabalu			X	
2	8-Jul-1993	Kota Kinabalu - Ranau Highway	Sabah	Kota Kinabalu		X		
3	10-Jun-1994	Kg. Pontudun Kundasang Baru	Sabah	Papar			X	
4	10-Jun-1994	Papar	Sabah	Papar			X	
5	21-Aug-1995	Kg. Bukit Melinsung	Sabah	Kota Kinabalu			X	
6	7-Aug-1995	Penampung-Tambunan	Sabah	Kota Kinabalu			X	
7	7-Jan-1996	Sandakan	Sabah	Sandakan			X	
8	6-Jan-1996	Tmn. Foh	Sabah	Sandakan			X	
9	6-Jan-1996	Jln. Penampang	Sabah	Sandakan			X	
10	13-Nov-1996	Pekan Tambunan	Sabah	Kota Kinabalu			X	
11	2-Feb-1996	Tmn. Nam Tung	Sabah	Sandakan			X	
12	2-Jun-1996	Kg. Murok, Ranau	Sabah	Kota Kinabalu			X	
13	6-Jan-1996	Sandakan	Sabah	Sandakan			X	
14	26-Dec-1996	Kampung pampang,Limbawan,Kandang ayam , Gunung Emas	Sabah	Keningau			X	302
15	13-Feb-1997	Jln. Tuaran	Sabah					
16	29-Aug-1998	Penampang	Sabah	Kota Kinabalu			X	
17	5-Jan-1999	Jalan Kota Kinabalu-Ranau	Sabah	Kota Kinabalu	X			
18	5-Jan-1999	KM25, KM40, KM52 Jalan Kota Kinabalu-Keningau	Sabah	Kota Kinabalu	X			
19	5-Jan-1999	Kampung Baru Luyang	Sabah	Kota Kinabalu			X	
20	8-Feb-1999	Jalan Leila, Kg. Gelam	Sabah	Sandakan			X	17
21	10-Feb-1999	Kota Kinabalu - Ranau Highway	Sabah	Tamparuli				
22	8-Jan-2001	Kota Kinabalu	Sabah					
23	7-Jan-2001	Kg. Lok Banau	Sabah	Sepanggar Bay				
24	5-Jul-2003	Jalab Raya -Berhampiran Muzium Negeri	Sabah	Kota Kinabalu			X	
25	9-Nov-2004	KM 44 Tambunan Moyog Road (09-11-2004)	Sabah	Tambunan			X	
26	8-Feb-2006	Kampung Sundang Darat, Batu Sapi , Sandakan	Sabah	Sandakan			X	3
27	26-Jun-2006	KM 8.5, Jalan Sepanggar	Sabah	Kota Kinabalu				
28	10-Dec-2006	Kampung Lok Benu (10-12-2006)	Sabah	Kota Kinabalu				
29	12-Oct-2006	Kampung Bonu, Jalan Sepanggar	Sabah	Sepanggar			X	
30	10-Apr-2007	KM 85.4 Jalan Tamparuli-Ranau	Sabah	Ranau			X	

Terengganu

No	Date	Location	State	District:	Rain fall			Fatalities
					Rare	Seldom	Heavy	
1	4-Dec-1986	Empangan Kenyir	Terengganu	Hulu Terengganu				
2	14-Dec-1995	Kg. Seberang Baroh	Terengganu	Kula Terenggnu				
3	8-Feb-1995	Kampung Jongok	Terengganu	Dungun			X	
4	28-May-1996	Tasik Kenyir	Terengganu	Terengganu			X	
5	17-Jan-1998	KM26 Jalan Kuala Berang-Tasik Kenyir	Terengganu	Hulu Terengganu		X		
6	13-Feb-1999	Pantai Batu Buruk	Terengganu	Kuala Terengganu			X	
7	24-Apr-2000	Terengganu	Terengganu	Terengganu				
8	28-Nov-2000	Hulu Besat	Terengganu	Jertih				

Perlis

No	Date	Location	State	District:	Rain fall			Fatalities
					Rare	Seldom	Heavy	
1	16-Apr-1976	Kaki Bukit	Perlis	Kangar				
2	22-Dec-1999	Bkt Kukus, Sg Batu Pahat	Perlis	Kangar		X		

Melaka

No	Date	Location	State	District:	Rain fall			Fatalities
					Rare	Seldom	Heavy	
1	9-Oct-1995	Masjid Tanah	Melaka				X	
2	15-Jun-1998	Taman Emas, Teluk Mas	Melaka				X	
3	1-Jan-2003	Kampung Kesang Pajak	Melaka	Jasin			X	
4	1-May-2002	Kg. Padand Sebang,	Melaka	Alor Gajah				

Wilayah Persekutuan Labuan

No	Date	Location	State	District:	Rain fall			Fatalities
					Rare	Seldom	Heavy	
1	11-Nov-1999	Empangan Bukit Kuda	WP Labuan			X		
2	3-Nov-1999	Entrance of Kiamsam Water Tank	WP Labuan			X		
3	3-Nov-1999	The West of Kiamsam Water Tank	WP Labuan			X		

Wilayah Persekutuan Putrajaya

No	Date	Location	State	District:	Rain fall			Fatalities
					Rare	Seldom	Heavy	
1	22-Mar-07	Presint 9 , Putrajaya	WP Putrajaya	Putrajaya			X	

Wilayah Persekutuan Kuala Lumpur

No	Date	Location	State	District:	Rain fall			Fatalities
					Rare	Seldom	Heavy	
1	6-Apr-1975	Jln Syed Putra	WP Kuala Lumpur				X	
2	5-Oct-1976	Jln. Kelang Lama, Kg Penaga	WP Kuala Lumpur	Kuala Lumpur			X	
3	13-Apr-1978	Jln Terasik	WP Kuala Lumpur	Bangsar			X	
4	19-Dec-1984	Tmn. Dri Watan Ampang	WP Kuala Lumpur	Ampang		X		
5	18-Jan-1984	Tmn. Cheras	WP Kuala Lumpur	Cheras			X	
6	21-Sep-1984	Sungai Tua	WP Kuala Lumpur	Selayang				
7	24-Apr-1984	Jalan Pucung KM 14.4	WP Kuala Lumpur		X			
8	23-Dec-1984	Lebuhraya Karak	WP Kuala Lumpur				X	
9	20-Feb-1984	Lebuh Raya KL-Karak	WP Kuala Lumpur				X	
10	10-Dec-1985	Taman Melawati	WP Kuala Lumpur				X	
11	1-Nov-1985	Taman Shamelin Perkasa, KM 5.6	WP Kuala Lumpur	Ceras	X			
12	17-Dec-1985	Taman Tun Abdul Razak	WP Kuala Lumpur	Ampang			X	
13	2-Oct-1986	Jln. Klang Lama	WP Kuala Lumpur	Kuala Lumpur			X	
14	3-Oct-1986	Kg. Dato Harun	WP Kuala Lumpur	Klang Lama				
15	29-Jan-1987	Batu 8, Jln Klang Lama	WP Kuala Lumpur				X	
16	24-Oct-1991	Jln. Bukit Nanas	WP Kuala Lumpur	Kuala Lumpur			X	
17	15-Nov-1991	Tmn Seraya	WP Kuala Lumpur	Cheras			X	
18	2-Nov-1991	Sungai buloh	WP Kuala Lumpur					
19	8-Apr-1992	Bukit Nenas	WP Kuala Lumpur	Kuala Lumpur				
20	16-Nov-1993	Tmn. Mudun	WP Kuala Lumpur	Cheras				
21	8-Sep-1993	Sungai Buloh	WP Kuala Lumpur				X	
22	26-Nov-1993	Kg. Setia Jaya, off Jln Tumbuhan	WP Kuala Lumpur	Setapak				
23	1-Nov-1994	Tmn. Bukit Cheras	WP Kuala Lumpur	Cheras			X	
24	6-May-1994	Kg. Tasik Permai	WP Kuala Lumpur	Ampang				
25	3-Jun-1995	200km dari Terowong Genting Sempah	WP Kuala Lumpur	Kuala Lumpur				
26	26-Oct-1995	Tmn. Mulia Jaya	WP Kuala Lumpur	Ampang				
27	15-Apr-1995	Tmn. Cuepacs	WP Kuala Lumpur	Kuala Lumpur			X	
28	22-Sep-1995	Jln. Ampang	WP Kuala Lumpur	Kuala Lumpur				
29	28-Dec-1995	Jln Permai	WP Kuala Lumpur	Kuala Lumpur			X	
30	26-Apr-1995	Tmn. Len Seng	WP Kuala Lumpur	Cheras			X	
31	17-Oct-1995	Changkat Tunku	WP Kuala Lumpur	Kuala Lumpur			X	
32	18-Oct-1995	Jln. Sultan Salahuddin	WP Kuala Lumpur	Kuala Lumpur			X	
33	12-Sep-1996	Jalan Ampang	WP Kuala Lumpur	Kuala Lumpur			X	
34	4-Sep-1995	Jalan Lidcol, off Jalan Yap Kwan Seng	WP Kuala Lumpur	Kuala Lumpur		X		
35	3-May-1995	Taman Keramat Permai	WP Kuala Lumpur	Ampang Jaya			X	
36	29-Sep-1995	Taman Bukit Teratai	WP Kuala Lumpur	Ampang			X	
37	30-May-1995	Kampung Kerdas	WP Kuala Lumpur	Gombak			X	
38	27-Apr-1995	Tmn. Tasik	WP Kuala Lumpur	Ampang		X		
39	22-Aug-1995	Tmn. Damai Jaya	WP Kuala Lumpur	Cheras			X	
40	20-Aug-1995	Ampang Jaya	WP Kuala Lumpur	Ampang			X	
41	12-May-1995	Jln Cheras	WP Kuala Lumpur	Cheras			X	
42	26-Dec-1995	Jln Tenggiri	WP Kuala Lumpur	Bangsar			X	
43	19-May-1995	Jln Tun Ismail	WP Kuala Lumpur	Kuala Lumpur				
44	1-Jan-1996	Tmn. Dahlia	WP Kuala Lumpur	Selayang			X	
45	2-Jun-1996	Kg. Baru	WP Kuala Lumpur	Kuala Lumpur				

46	28-Jan-1996	Bandar Ampang	WP Kuala Lumpur	Ampang			X	
47	9-Jun-1996	Taman Bukit Permai	WP Kuala Lumpur	Ampang Jaya			X	
48	15-Oct-1996	Bangunan RISDA	WP Kuala Lumpur		X			
49	9-Jun-1996	Jalan Setiabistari	WP Kuala Lumpur	Medan Damansara			X	
50	9-Jan-1996	Jln. 2/112E	WP Kuala Lumpur	Pantai Dalam			X	
51	10-Jun-1996	Ampang Jaya	WP Kuala Lumpur	Ampang Jaya			X	
52	9-Jul-1996	Taman Muda -Cheras	WP Kuala Lumpur	Cheras			X	
53	12-Jun-1996	Mutiara Court Apartment	WP Kuala Lumpur	Cheras				
54	13-Mar-1997	Pantai Dalam	WP Kuala Lumpur					
55	11-May-1997	Pantai Dalam	WP Kuala Lumpur	Bangsar			X	
56	1-Dec-1997	Jln Semantan 2, Jln Lembah Ledang Off Jln Semantan	WP Kuala Lumpur	Damansara			X	
57	12-Mar-1997	Kg. Kerinchi	WP Kuala Lumpur				X	
58	12-Jan-1997	Tebing Sungai Gombak	WP Kuala Lumpur	Batu Caves			X	
59	11-May-1997	Jalan Pantai	WP Kuala Lumpur	Kuala Lumpur			X	1
60	3-Sep-1998	Kuala Lumpur-Rawang Trunk Road	WP Kuala Lumpur				X	
61	10-Jul-1999	Kodominium Mutiara, Bukit Indah	WP Kuala Lumpur	Ampang			X	
62	19-May-1999	Kg. Cheras Baru	WP Kuala Lumpur	Cheras			X	
63	16-Mar-1999	OG Heights Condominium, Jln Awan Cina	WP Kuala Lumpur	Overseas Union Garden			X	
64	30-Mar-1999	Tmn Fern Grove	WP Kuala Lumpur	Cheras			X	
65	17-Nov-2000	Tmn. Kobena	WP Kuala Lumpur	Cheras				
66	5-Oct-2000	Jitter	WP Kuala Lumpur	Jitter				
67	1-Apr-2000	Jalan Gempita 7,Taman Salak Selatan	WP Kuala Lumpur	Salak Selatan			X	
68	26-Feb-2000	Kampung Seri Damai, Taman Kencana	WP Kuala Lumpur	Ampang			X	
69	22-Dec-2000	Jln Jiran 2, Happy Garden	WP Kuala Lumpur	OUG			X	
70	26-Apr-2001	Seksyen 5, Wangsa Maju	WP Kuala Lumpur	Wangsa Maju			X	
71	9-Nov-2001	Tmn Zoo View	WP Kuala Lumpur	Hulu Kelang			X	
72	6-Jun-2001	Jln 14/27A, Section 5	WP Kuala Lumpur	Wangsa Maju			X	
73	22-Sep-2001	Sungai Cincin	WP Kuala Lumpur	Gombak		X		
74	23-Nov-2002	Salak South	WP Kuala Lumpur	Salak South		X		
75	20-Nov-2002	Taman Hillview	WP Kuala Lumpur	Ulu Klang			X	8
76	3-Mar-2003	Bukit Indah Ampang	WP Kuala Lumpur	Ampang			X	
77	11-May-2004	Bukit Aman (11-05-2004)	WP Kuala Lumpur	Kuala Lumpur				
78	2-Apr-2005	Rumah Panjang Jalan Air Madu	WP Kuala Lumpur	Setapak			X	
79	23-Mar-2005	Kampung Air Panas Setapak (23-03-2005)	WP Kuala Lumpur					
80	29-Sep-2005	Jalan CU9, Taman Cheras Utama	WP Kuala Lumpur	Cheras			X	
81	14-Jan-2006	Taman Bukit Pandan, Cheras	WP Kuala Lumpur	Cheras			X	
82	15-Apr-2006	Sekolah Rendah Agama(SRA) Hidayatul Mustaqimah, Taman Berringin , Jinjang Utara	WP Kuala Lumpur	Jinjang		X		
83	29-Apr-2006	Jalan Mutiara Barat 4 dan 6 , Taman Mutiara Barat	WP Kuala Lumpur	Cheras			X	
84	31-May-2006	Kampung Pasir (31-05-2006)	WP Kuala Lumpur	Ampang				4
85	22-Aug-2006	Kampung Kerinchi B, Jalan Pantai Baru	WP Kuala Lumpur	Kuala Lumpur			X	
86	23-Dec-2006	Taman Tasik Tambahan	WP Kuala Lumpur	Ampang			X	
87	4-May-2007	Jln Sultan Salahuddin, Kuala Lumpur	WP Kuala Lumpur	Kuala Lumpur				
88	9-Jun-2007	Kampung Air Panas (09-06-2007)	WP Kuala Lumpur					
89	3-Jun-2007	Jalan Duta , Kuala Lumpur	WP Kuala Lumpur					

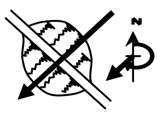
Pahang

No	Date	Location	State	District:	Rain fall			Fatalities
					Rare	Seldom	Heavy	
1	11-May-1961	Ringlet (11-05-1961)	Pahang	Cameron Highlandss				
2	25-Apr-1974	Camerron Highlandss	Pahang	Camerron Highlandss			X	
3	12-Oct-1977	Tanah Rata	Pahang	Cameron Highlandss			X	
4	29-Oct-1984	Kampung Seberang Cek Lek Beserah	Pahang	Kuantan			X	
5	17-Sep-1985	Jln Raya Temeluh- Teriang	Pahang	Temeluh				
6	23-Nov-1985	Lebuhraya KL-Karak	Pahang	Karak				
7	12-Dec-1991	Lebuh raya Karak- KL	Pahang	Karak			X	
8	30-May-1991	Tanah Rata	Pahang	Tanah Rata				
9	14-Nov-1993	Lebuh Raya Karak-Kuala Lumpur	Pahang	Bentung	X			
10	15-Dec-1993	Jln. Persekutuan	Pahang	Kuala Lipis				
11	23-Nov-1993	Lebuhraya Karak-Kuala Lumpur	Pahang	Karak				
12	24-Oct-1993	Jln. Kuala Lipis-Gua Musang	Pahang	Kuala Lipis				
13	29-Nov-1993	KM63 Kuala Lumpur-Karak Highway	Pahang	Bentong		X		
14	19-Nov-1993	Kuala Lipis---Gua Musang	Pahang	Kuala Lipis			X	
15	27-Nov-1993	Batu 6, Bentong	Pahang	Bentong			X	
16	22-Dec-1993	Jalan Kuatuan Sungai Lembing	Pahang	Kuantan			X	
17	15-Dec-1993	Jalan persekutuan Kuala Lipis	Pahang	Kuala Lipis			X	
18	15-Nov-1993	Taman Lipis	Pahang	Kuantan			X	
19	23-Nov-1993	KM 25.5, KL-Karak Highway	Pahang	Karak			X	2
20	25-Nov-1993	Kilometer 20, 24, 27 (25-11-1993)	Pahang	Cameron Highlands				
21	28-Nov-1993	KM63 Kuala Lumpur-Karak Highway	Pahang	Karak			X	2
22	7-Jun-1994	Taman Bukit Bendera	Pahang	Mentakab			X	
23	9-Dec-1994	Kampung Raja	Pahang	cameron Highlands				
24	31-Mar-1995	KM 15 Jln Kuala Lipis-Kuala Lumpur	Pahang	Kuantan		X		
25	29-Dec-1995	Sri Jaya, Maran, Pahang	Pahang	Maran		X		
26	29-Nov-1995	Kuala Lipis -Gua Musang	Pahang	Kuantuan		X		
27	30-Jun-1995	Lebuh Raya Kuala Lumpur-Karak Km 39, (Susur Masuk Genting Highlands)	Pahang	Genting Highlandss			X	20
28	3-Dec-1995	Jalan Kuala Lipis -Gua Musang	Pahang	Kuantan			X	
29	18-Aug-1995	Kuala Lipis	Pahang	Kuala Lipis			X	
30	30-Jun-1995	Camerron Highlandss	Pahang					
31	1-Jul-1995	KM 63.8 KL Karak	Pahang					
32	24-Oct-1995	Tringkap Cameron Highlandss	Pahang	Camerron Highlandss				1
33	1-Dec-1995	Cammeron Highlandss	Pahang	Camerron Highlandss				7
34	25-Mar-1996	Lebuhraya Tun Razak	Pahang	Kuantan				
35	15-Jul-1996	Lebuh Raya Kuala Lumpur-Karak Km 1.5, (Genting Highlands)	Pahang	Genting Highlandss				15
36	12-Oct-1996	KL-Raub	Pahang	Kuantan		X		
37	10-Oct-1996	Cameron Highlands- Kuala Terla	Pahang	Kuala Terla			X	3
38	18-Oct-1996	Cameron Highlands	Pahang	Cameron Highlands				
39	9-Feb-1996	Lebuh Raya Tun Razak Kuantuan-Segamat	Pahang	Kuantuan			X	
40	30-Jun-1996	Genting Highlandss	Pahang					
41	5-Apr-1997	KM 6 Taman Desa Damai	Pahang	Bentong			X	

42	14-Nov-1998	Jln Cheneras, Tempoyang	Pahang	Kuala Lipis			X
43	1-Apr-1999	KM99 Jalan Teranum Kuala Kubu	Pahang		X		
44	9-Jan-2000	Tanah Rata	Pahang	Tanah Rata			X
45	9-Oct-2002	KM31, Laluan FT/498, Jln Utama Mempagacinta Manis	Pahang	Bentong			
46	1-Dec-2002	CH 14450 Jln Kampung Terapai ke Kampung Peijing	Pahang	Maran	X		
47	1-Dec-2002	CH 14650 Jln Kampung Terapai ke Kampung Peijing	Pahang	Maran	X		
48	1-Dec-2002	CH 19715 Jln Kampung Terapai ke Kampung Peijing	Pahang	Maran	X		
49	2-May-2002	Jalan Lama Bukit Fraser	Pahang				X
50	29-Aug-2003	KM 41.7 Lebuh Raya Karak	Pahang	Bentong	X		
51	14-Dec-2003	Jalan Kuantan- Sg Lembing	Pahang	Kuantan			X
52	24-Feb-2004	KM 52 Tapah Tanah Rata (24/02/2004)	Pahang	Camerron Highlandss			
53	11-Feb-2004	Passage 55 Gap Raub (11-02-2004)	Pahang				
54	2-Nov-2004	KM 54.4 Lebuh Raya Karak	Pahang	Bentong			X
55	19-Dec-2005	KM 42, Jalan Tapah- Cameron Highlands	Pahang	Camerron Highlandss			X
56	13-Apr-2006	KM 3.8 Jalan Genting Highlands- Kuala Lumpur	Pahang	Genting Highlandss		X	
57	12-Apr-2006	Km 33 Jalan Simpang Pulai - Cameron Highlands	Pahang	Cameron Highlandss			

Appendix B

FORM A-1

Location	**State**	**District**	**Slope ID**
General Information			
Geomorphologic Hilly Coastal River Mine	**Landuse** Residence Commercial Industries Agriculture Infra	**Position** Upslope On slope Down slope Between slope	**Atmospheric** Rain Strom Flood
Slope Morphology			
Slope form Simple Planar Asymmetrical Compound	**Slope geometry** Height : ______m Length : ______m Width : _______m Angle : _______°	**Plan view** Concave Straight Convex	**Cross section view** Concave Straight Convex
Berm No : ______ Width : _______m Height : _______m	**Slope location** Top Middle Base Basin Sidelong	**Feature aspect**  : ______°	
Landslide Attributes			
Mechanism Intense rainfall Water level changes	**Landslide causes** Geological Morphology Physical Human activities	**Geological hazard** Erosion Fault Rainfall Flooding Earthquake	**Landslide geometry** Size: _______m Volume : ______m^3 Angle : _______°
Destructive Consequences			
-Road closure **YES/NO** -Fatality **YES/NO** No : _______ -Injury **YES/NO** No : _______	Structural damage **YES/NO** Type ; internal External Condition Intact Slightly damage Partly damage Severe damage	Damage cost RM__________	Landslide displacement Advancing Retrogressive Enlarging Diminishing Confined
Geology			
Lithology Colluviums Filled Residual soil Rock Bedrock contact	**Formation** Metamorphic Sediment Igneous Colluviums	**Structural** Interbeded Folded Discontinuity	**Weathering grade** 1 2 3 4 5

FORM A-2

Location	State	District	Slope ID

Feature type
Embankment ☐
Cut ☐
Natural slope ☐
Grade (flat) ☐

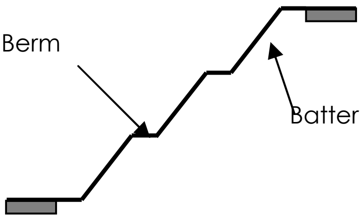
Site condition
Natural ☐
Under construction ☐
Development ☐

Slope geometry
Original geometry ☐
Failed geometry ☐

Slope length : ________________ m

Slope height : ________________ m

Slope angle : ________________ °



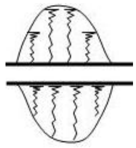
Number berm : ________________

Average berm width : ___________ m

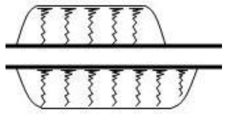
Average batter height : _________ m

Slope shape

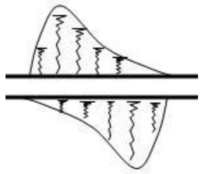
Simple ☐



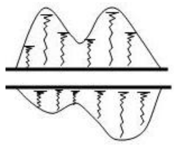
Planar ☐



Asymmetrical ☐

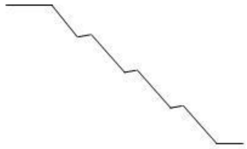


Co
mpound

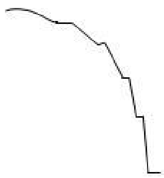


Cross section

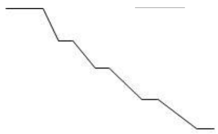
Straight ☐



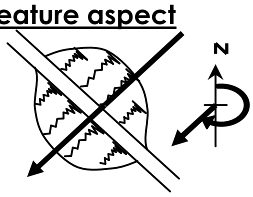
Convex ☐



Concave ☐



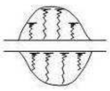
Feature aspect



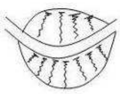
________ °

Slope plan profile

concave ☐



straight ☐



convex ☐

Any structure(s) present
- Piled retaining wall ☐
- Gabion retaining wall ☐
- Concrete retaining wall ☐
- Surface netting ☐
- Rock bolts/Stitching ☐
- Masonry retaining wall ☐
- Soil nailing ☐
- Other ☐
- None ☐