SUSTAINABILITY IN GEOTECHNICAL ENGINEERING IN PUBLIC WORKDS DEPARTMENT MALAYSIA

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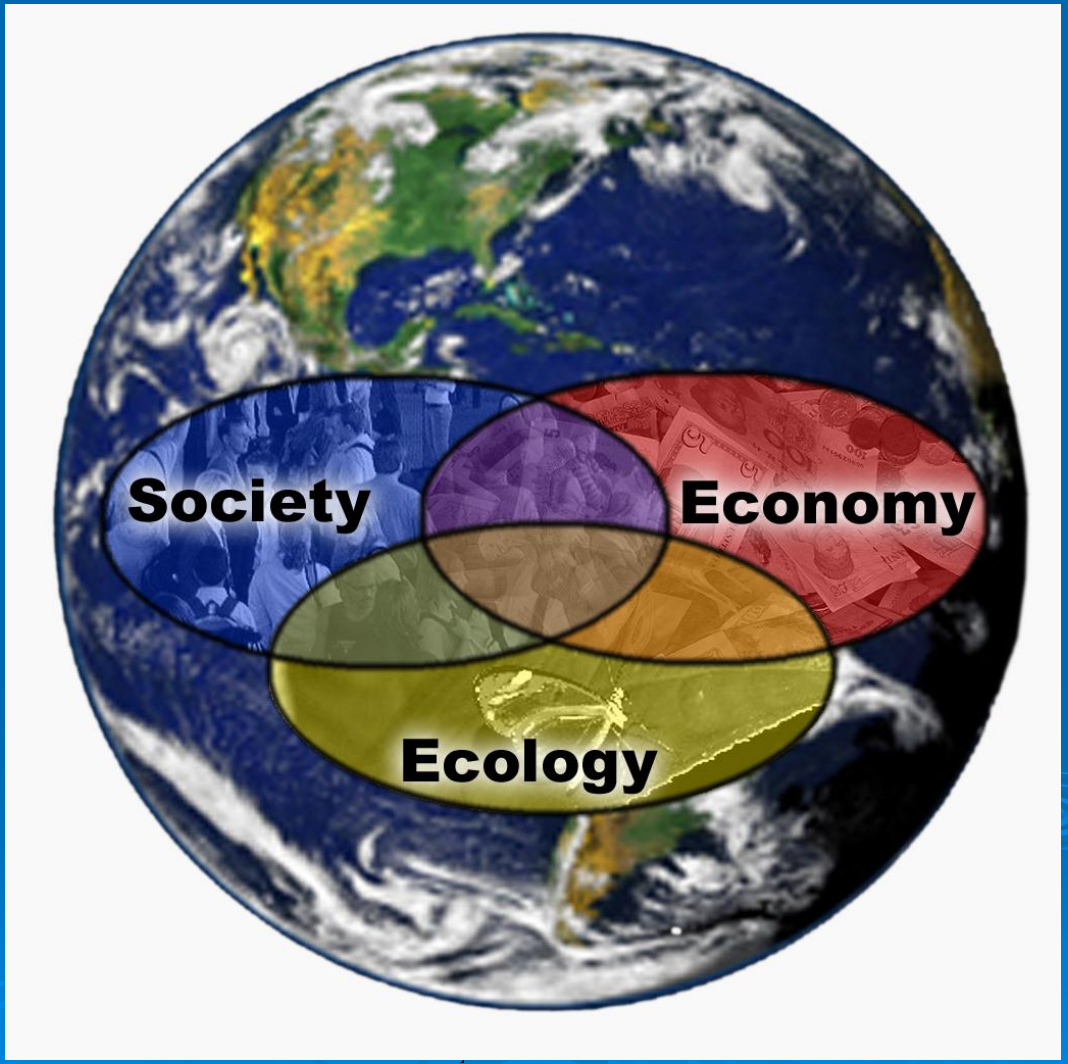
Cawangan Kejuruteraan Cerun

World Centre of Excellence on Landslide Risk Reduction

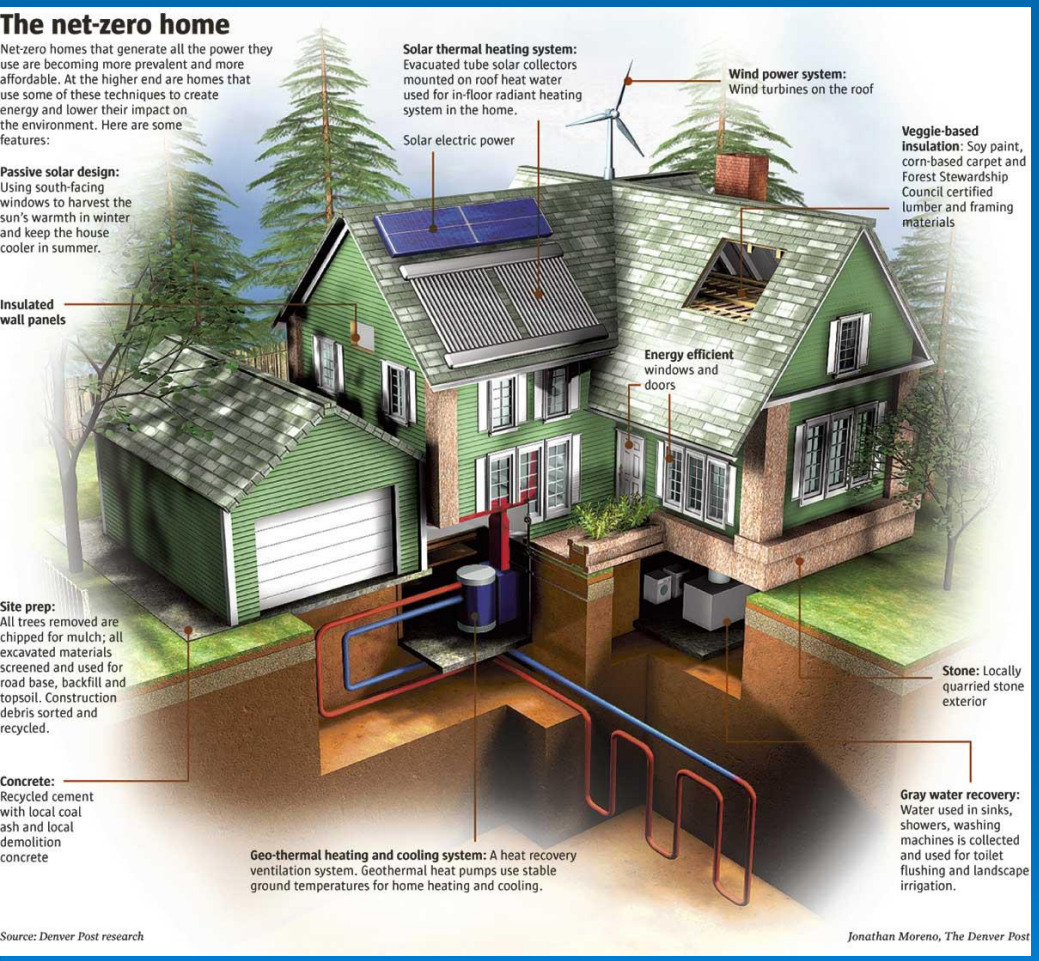
JKR

What is Sustainability?

Optimizing the resources used minimizing damages to the environment & causing social disruption



INTRODUCTION



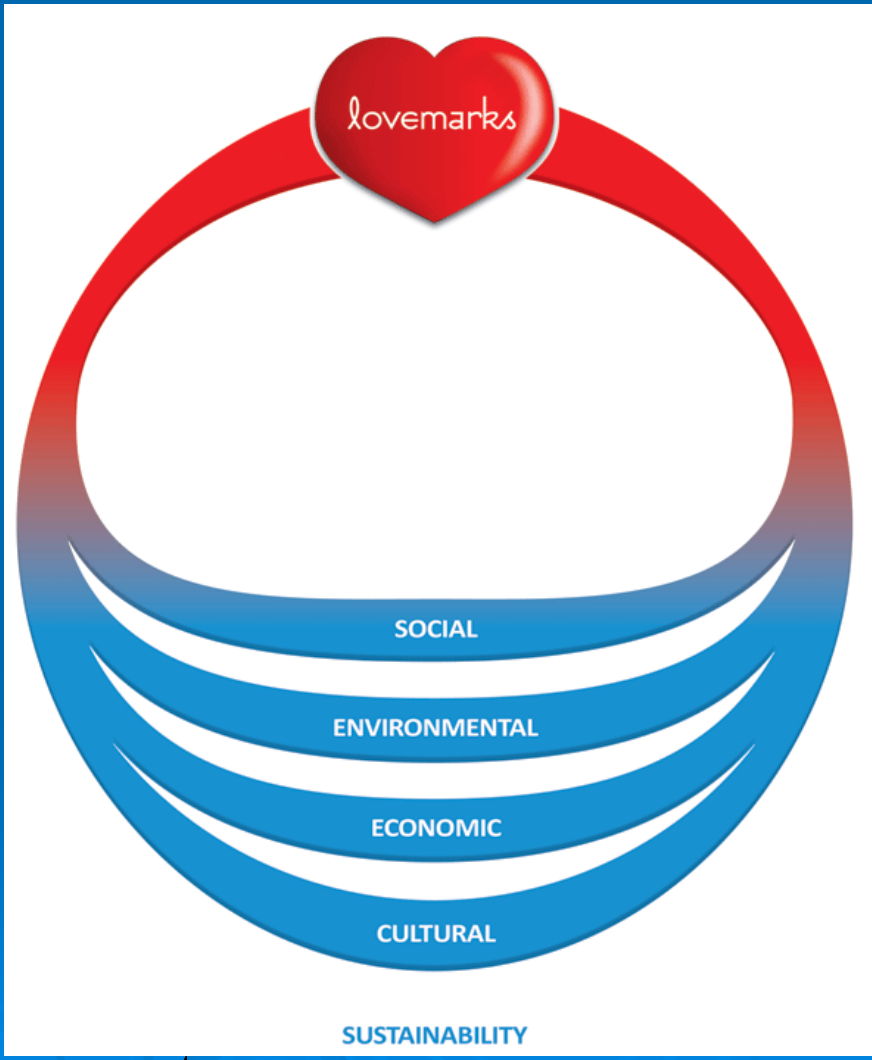
- Malaysia plan to reduce carbon emission by 40% by the year 2020 (PM, 2009 in Copenhagen)
- All government agencies are asked to reduce energy consumption and apply value engineering

Elements of Sustainability in Geotechnical Engineering

1. Proper planning and management
2. Recycling of materials
3. Reduce environmental damage
4. Innovation in design and material use
5. Reduce earthwork
6. Waste recycling
7. Avoid public disruption

Sustainability Status in PWD Malaysia

- PWD is not involved in geoenvironmental engineering
- Environmental Div. was established 10 years ago, Maintenance Div. 5 years ago, Slope Engineering Div. 6 years ago
- Concentrate on green building and reduction of energy usage
- Sustainability in geotechnical engineering is at its initial phase



Sustainability in PWD Malaysia

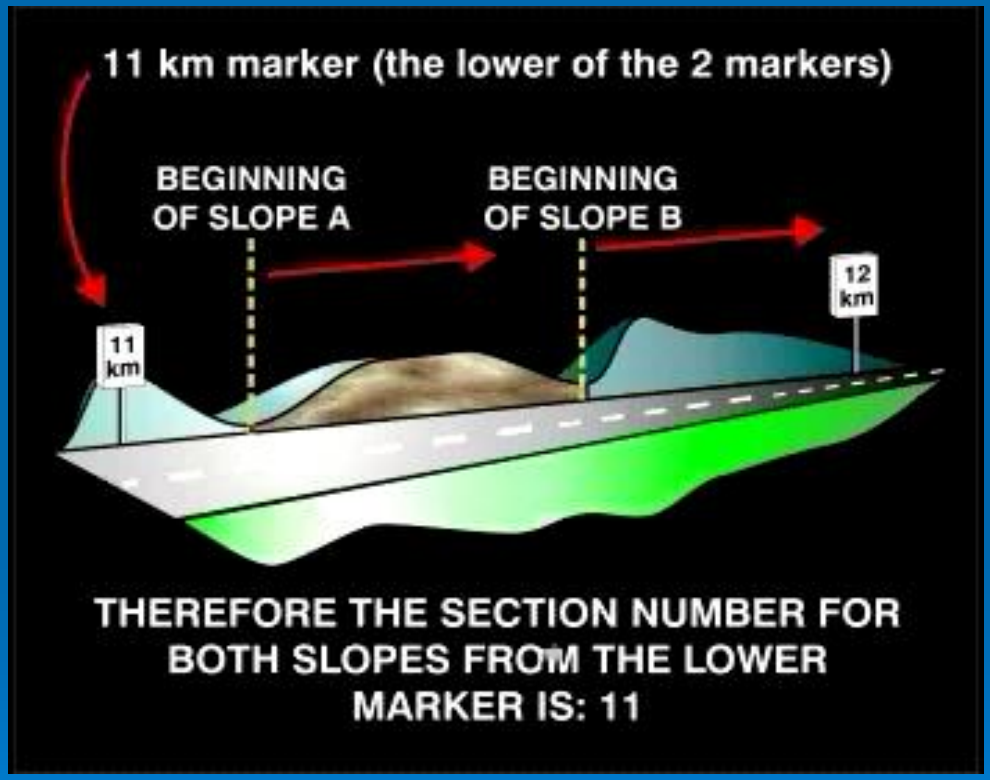
1. Gathering information, archiving, interpretation and dissemination
2. Hazard and risk maps for landslides
3. Guidelines
4. Bio-engineering
5. New technology
6. Public awareness and education

1) Collection, Archiving, Interpretation & Dissemination

- Slope information
  - Malaysia has 16,946km of Federal roads with estimated 16,000 slopes
  - Inventorized more than 6,000 slopes
  - Record the characteristics of landslides

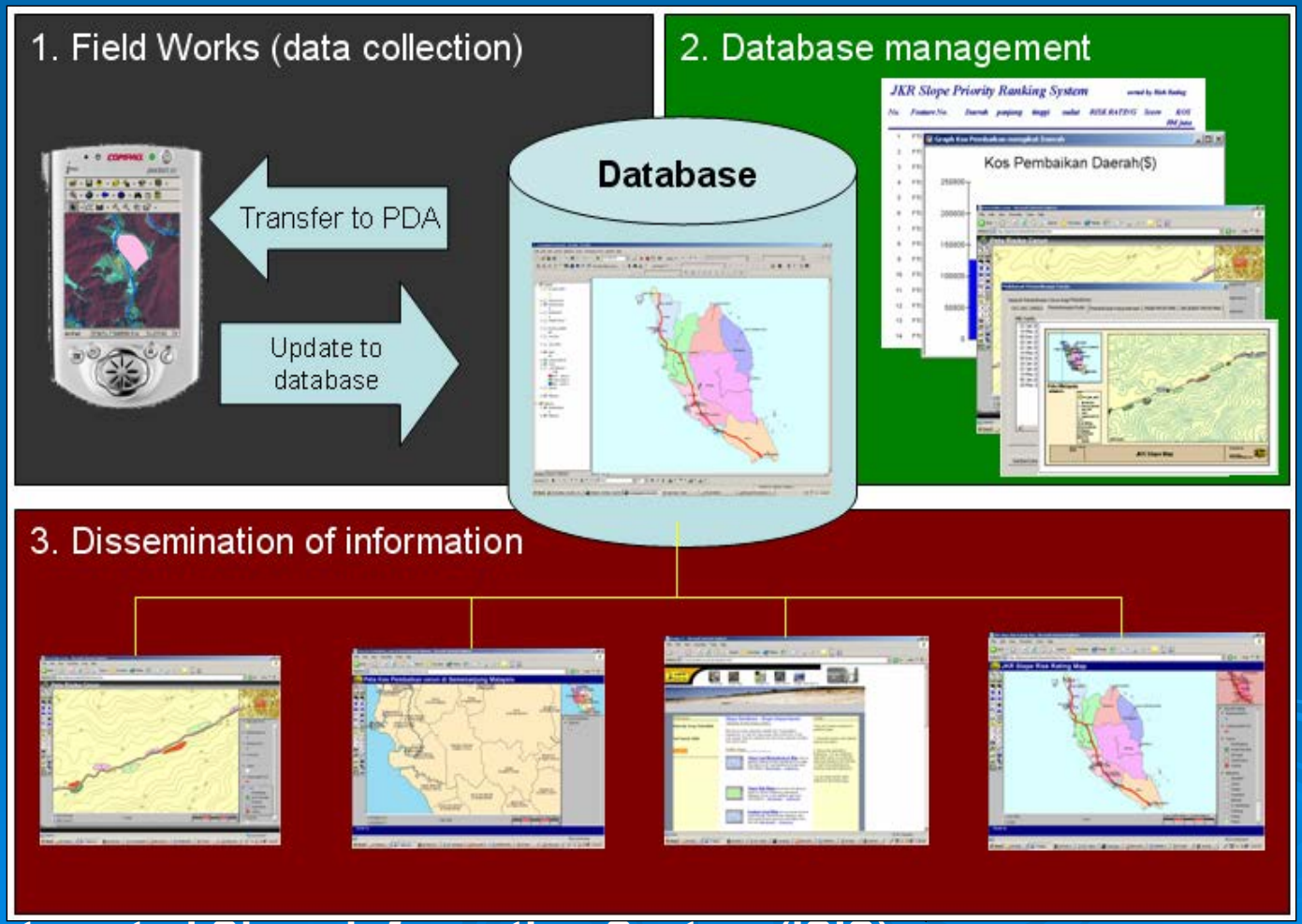
1) Collection, Archiving, Interpretation & Dissemination

- Slope information



1) Collection, Archiving, Interpretation & Dissemination

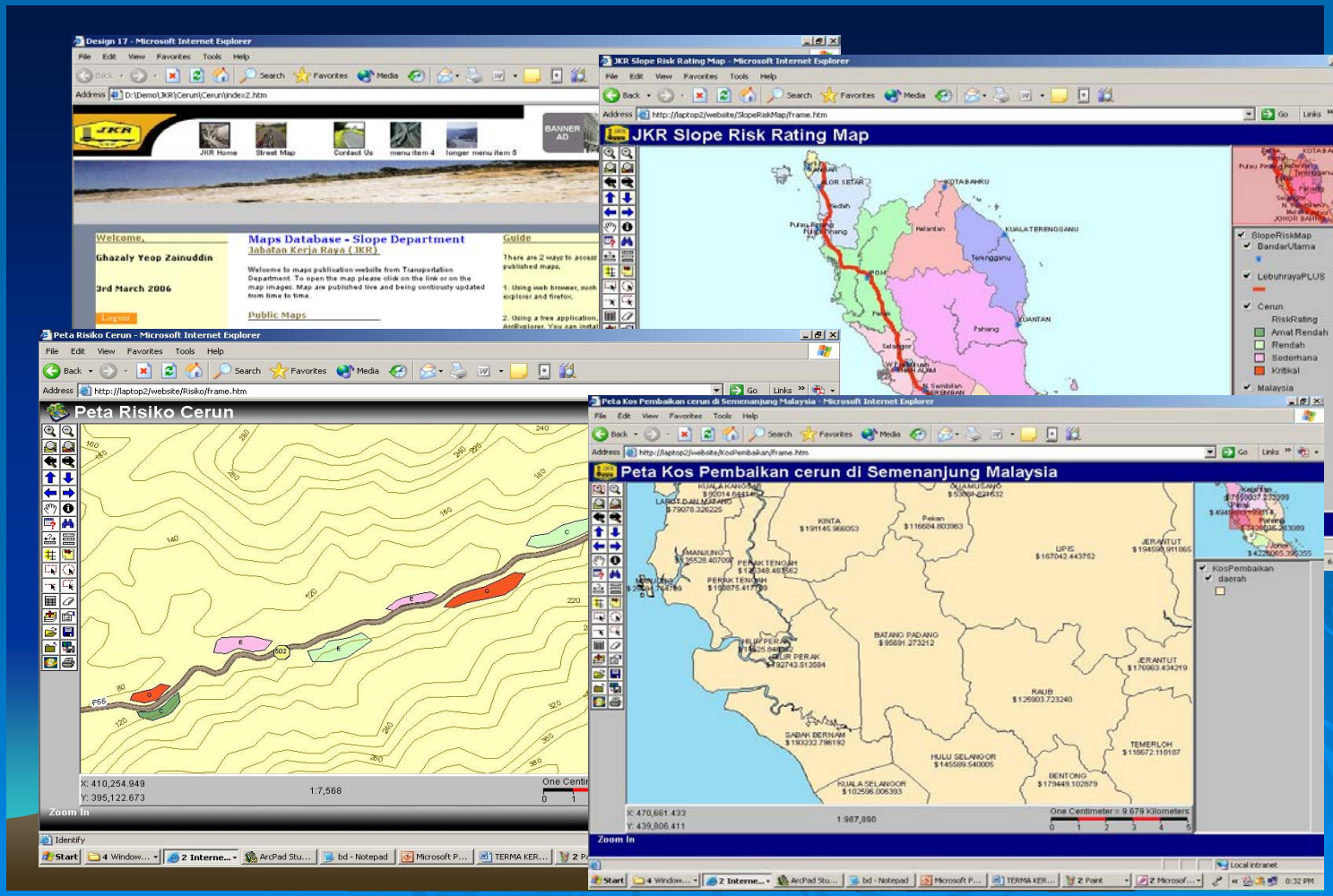
- Slope information



Integrated Slope information System (ISIS)

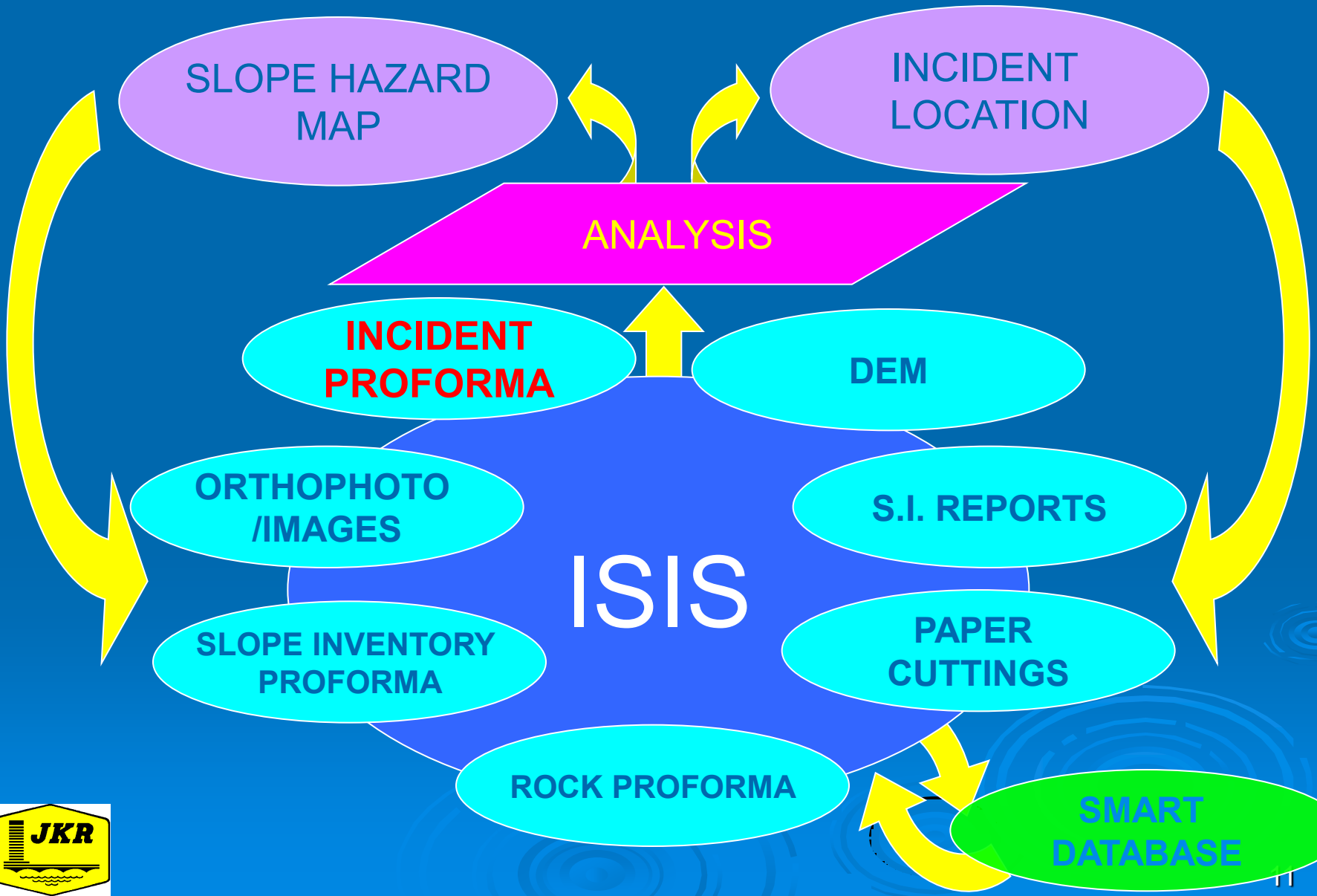
1) Collection, Archiving, Interpretation & Dissemination

- Slope information



Data browsing through intranet

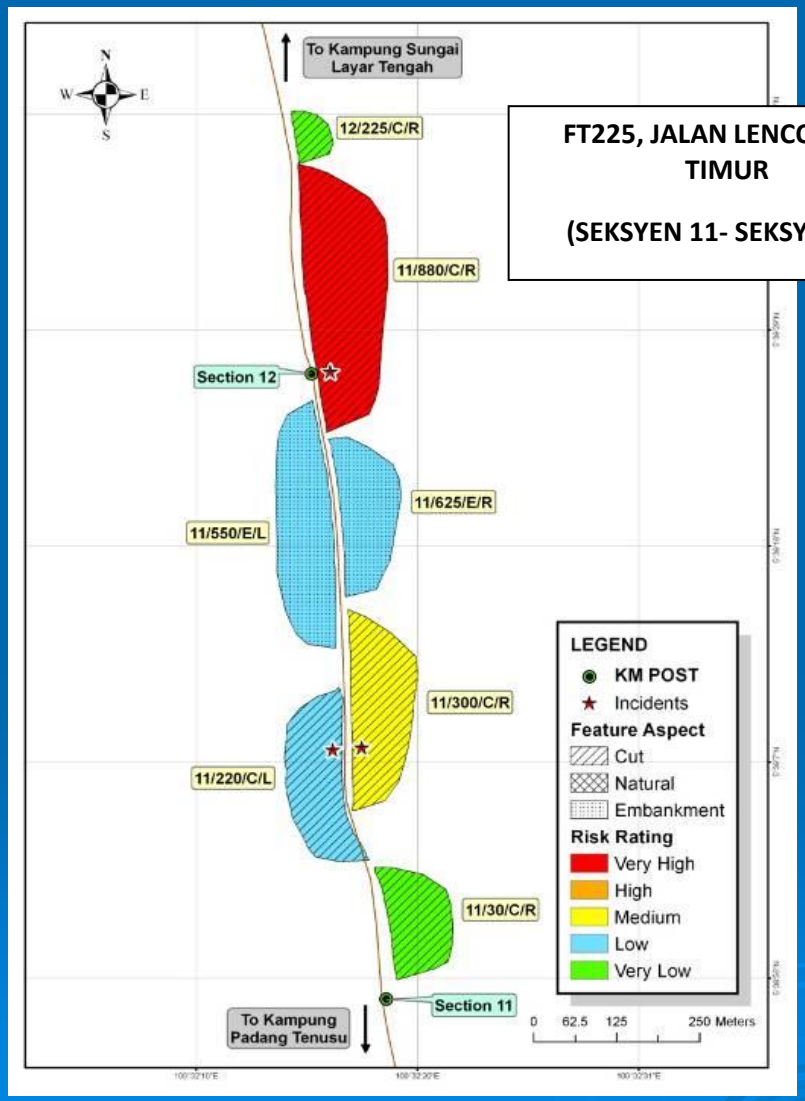
Integrated Slope Information System



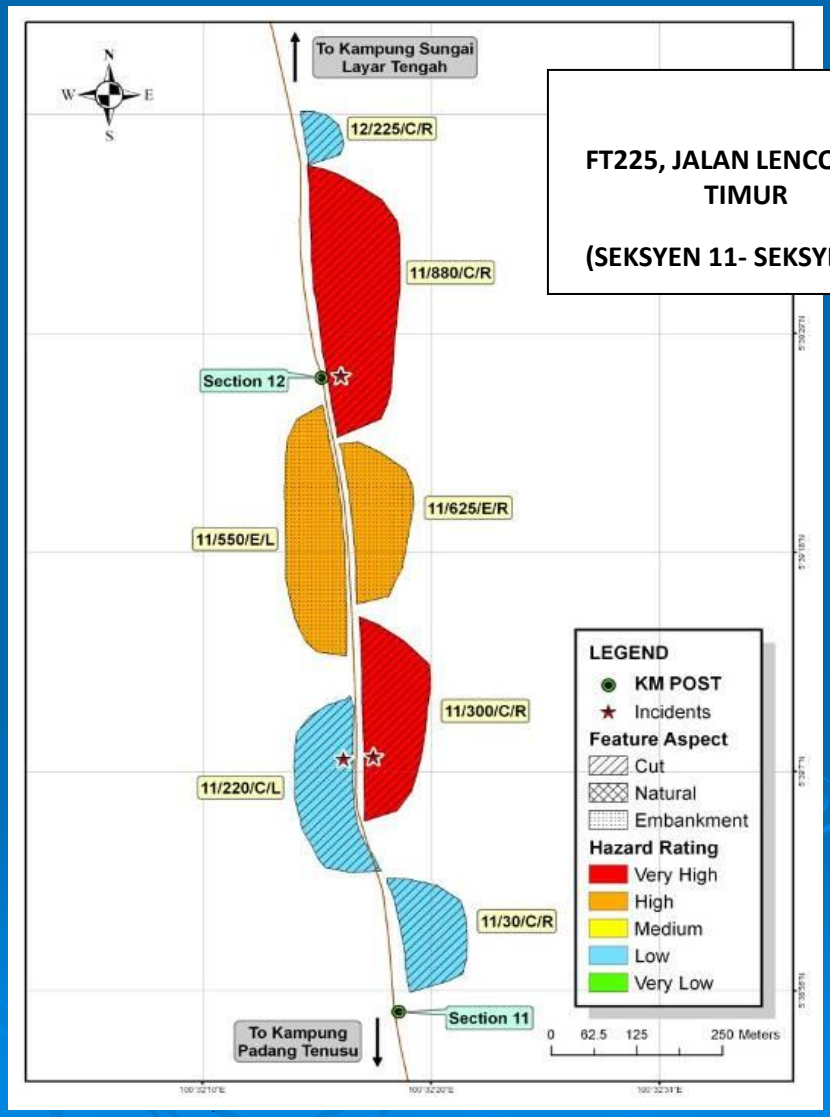
Input Data on Slope (Linear-based)

- Twenty (20) attributes :-
  - Height (H)
  - Slope Angle (SA)
  - Slope Shape (SS)
  - Slope Cross-Section (CS)
  - Plan Profile (P)
  - Cutting Topography Relationship (CT)
  - Upslope/downslope geometry (UDG)
  - Structure Present (ST)
  - Main Vegetation Cover Type (MCT)
  - Vegetation Cover Type condition
  - Rock Exposed Percentage (EP)
  - Corestone Boulder (CB)
  - Rock Condition Profile (RCP)
  - Rock Type
  - Rock Description
  - Feature Aspect (FA)
  - Seepage present
  - Evidence of saturation ground
  - Evidence of Ponding
  - Condition of surface runoff

Hazard and Risk Maps for Roads (linear base)

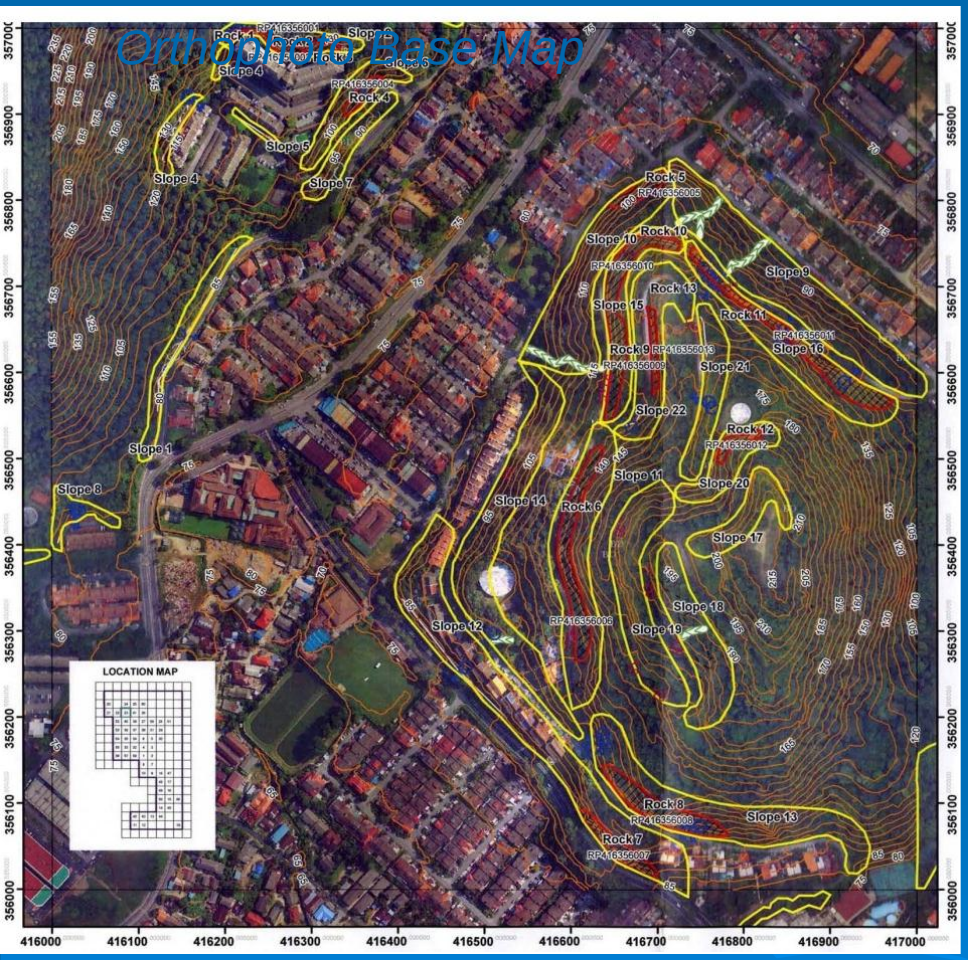


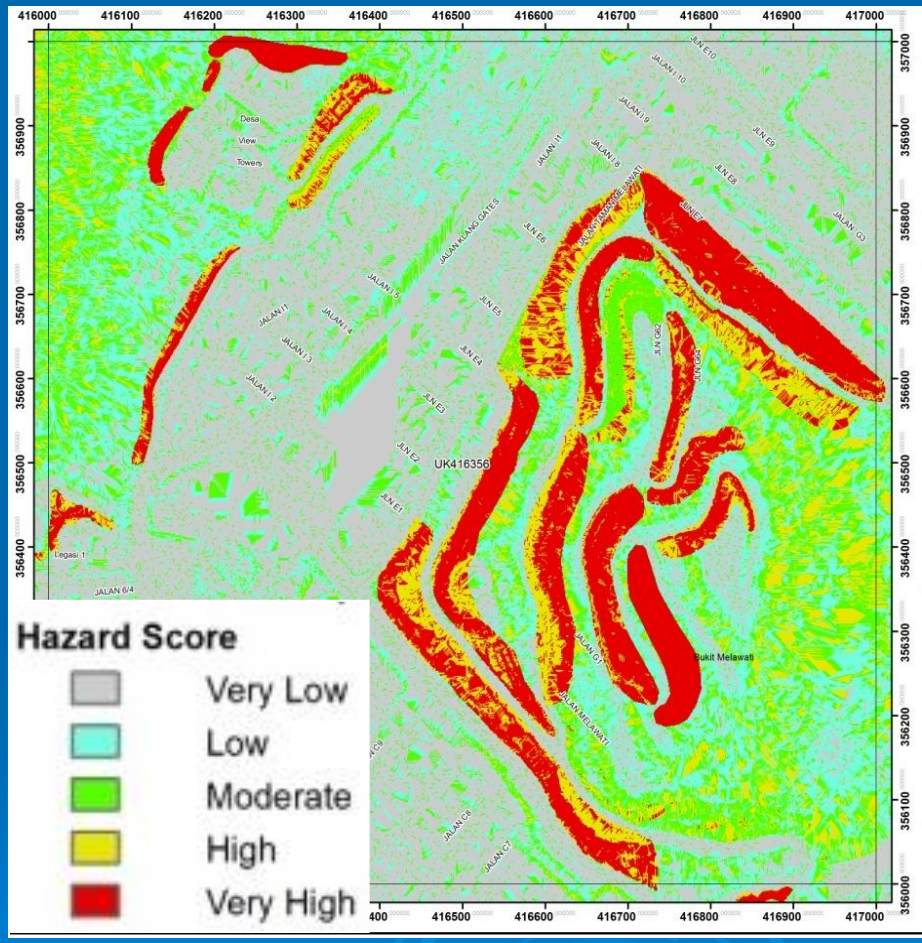
Risk map



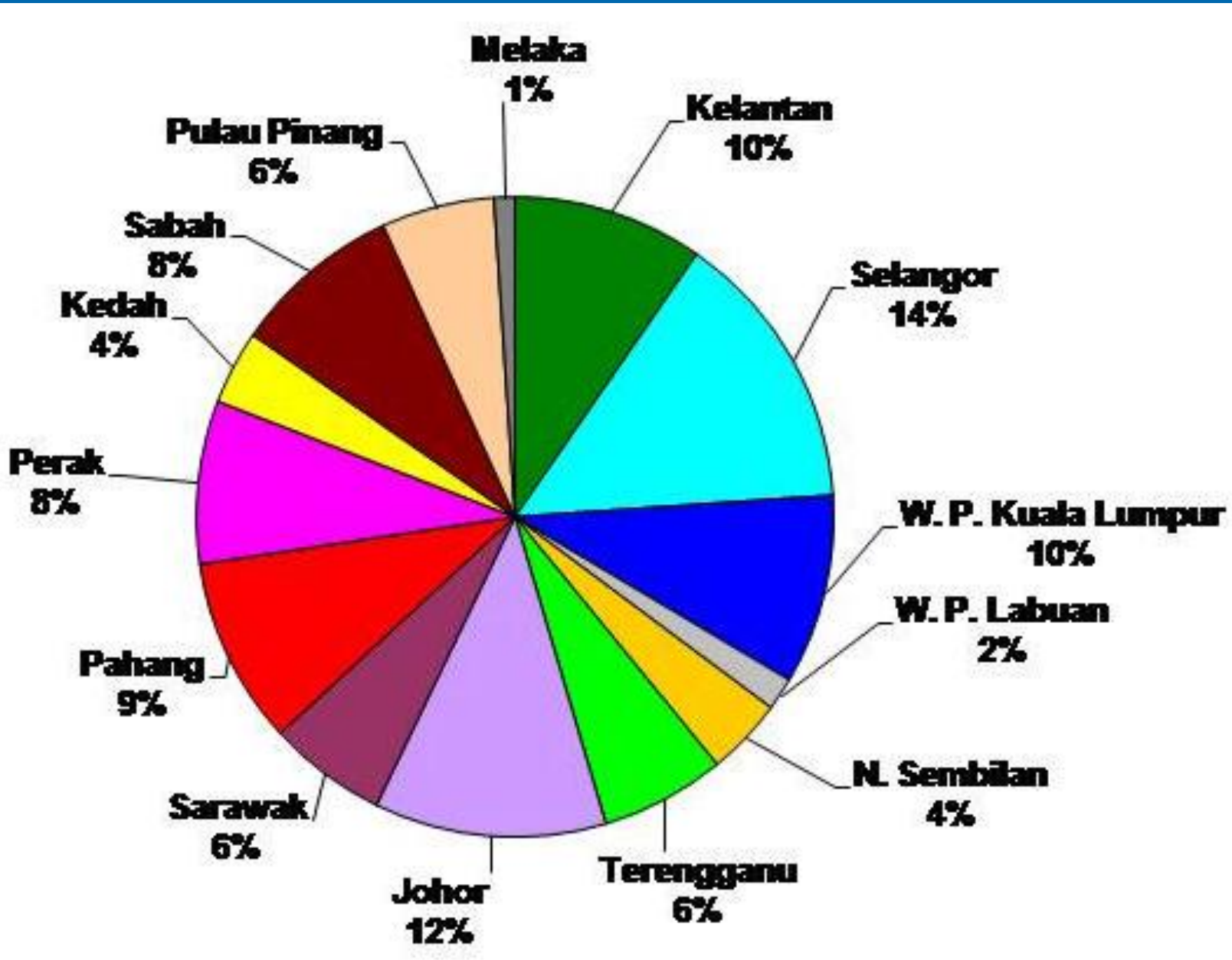
Hazard map

HAZARD MAP
(*Area Based*)

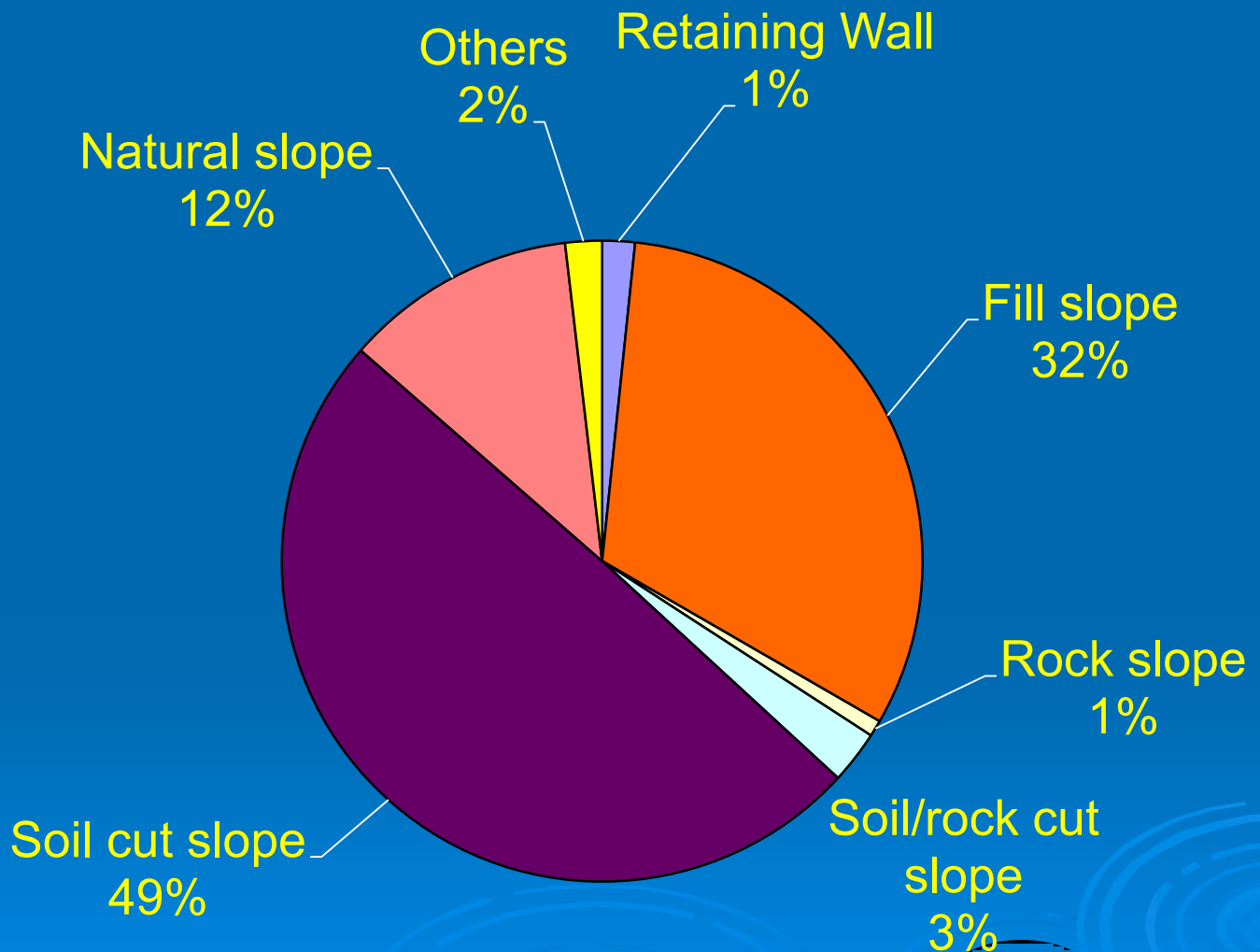




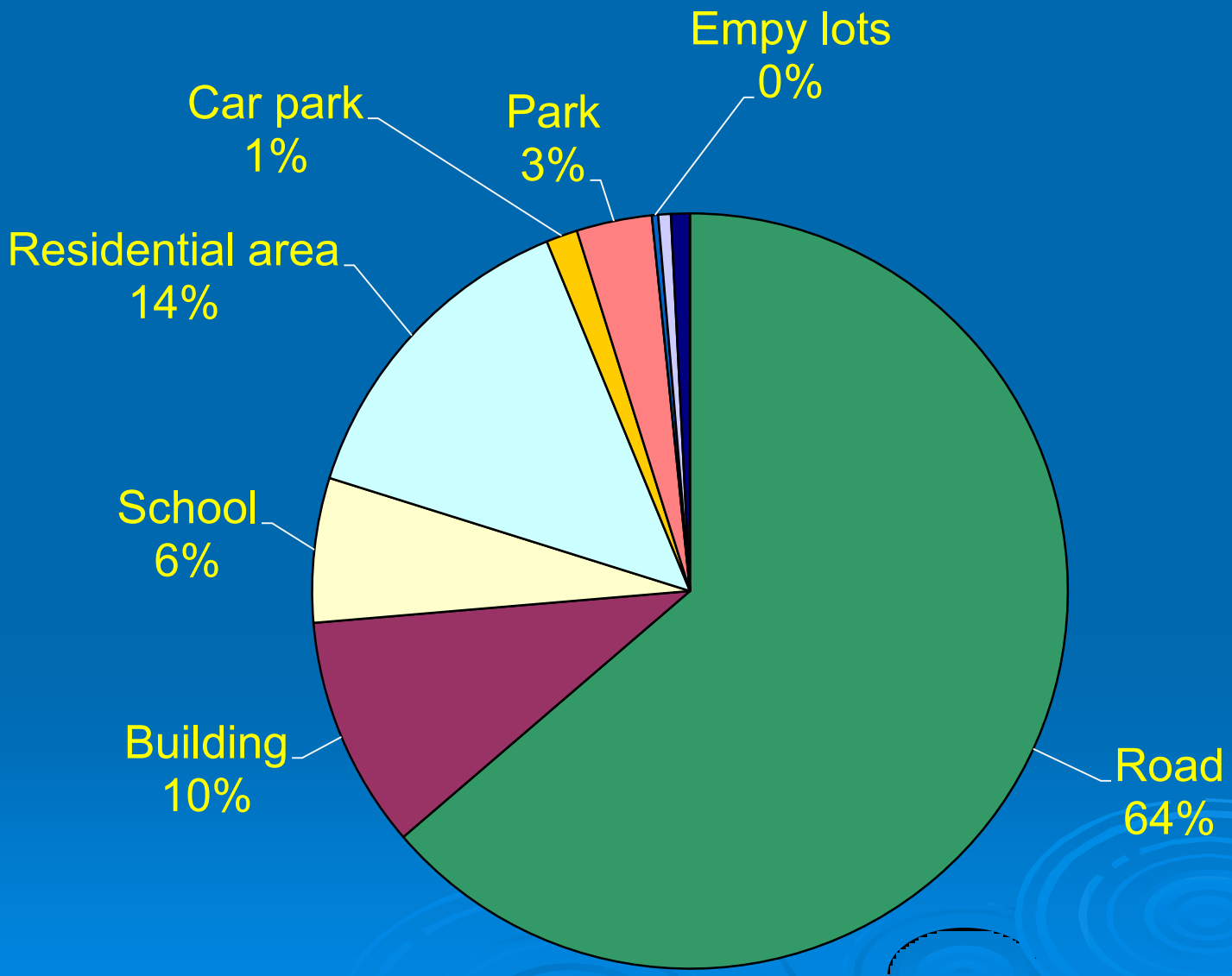
Landslides by States (2005-2009)



Material/Structure where Landslides Occurred (2005-2009)

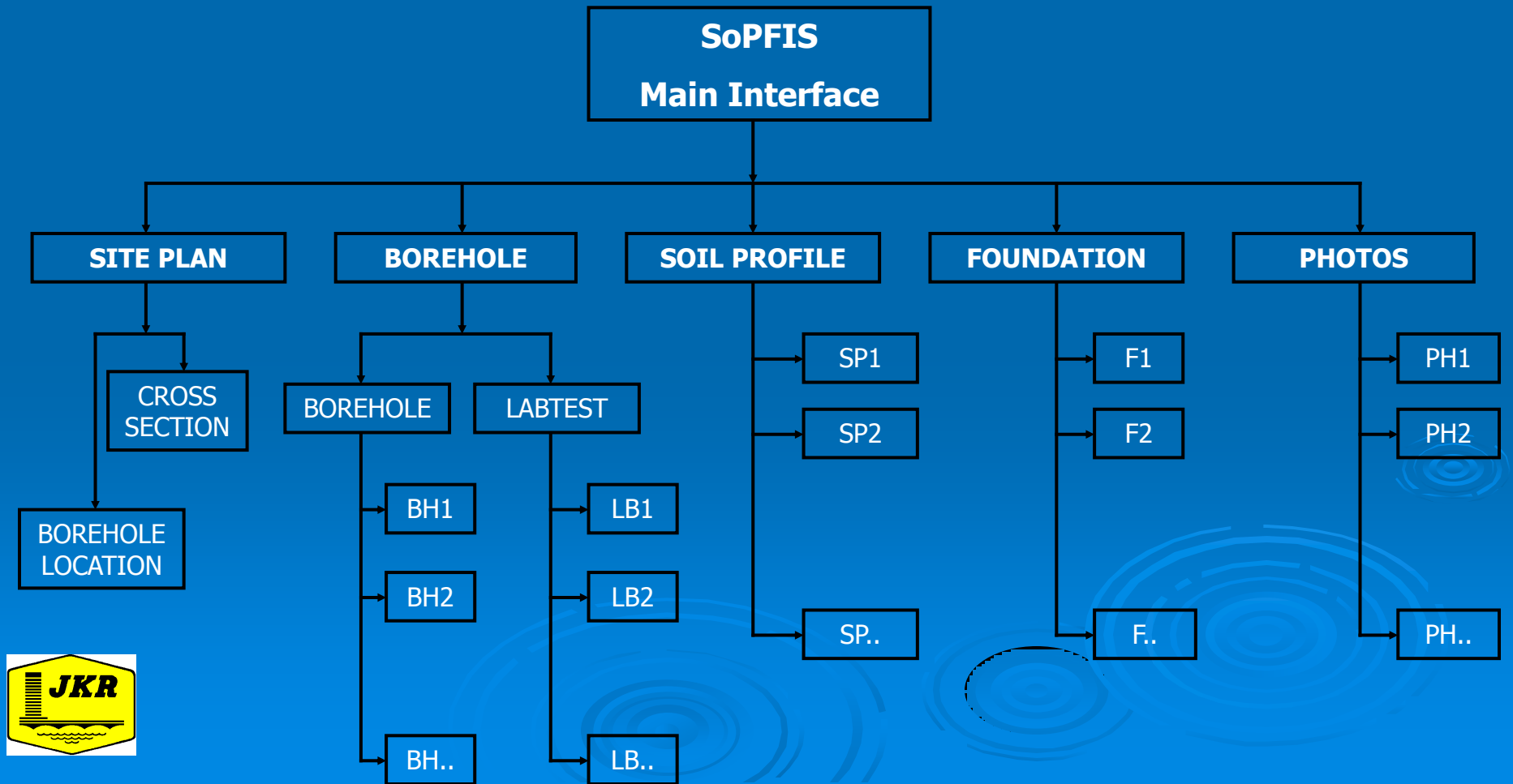


Facilities Affected (2005-2009)



1) Collection, Archiving, Interpretation & Dissemination

- Soil Profile and Foundation Information System (SoPFIS)



SOIL PROFILE

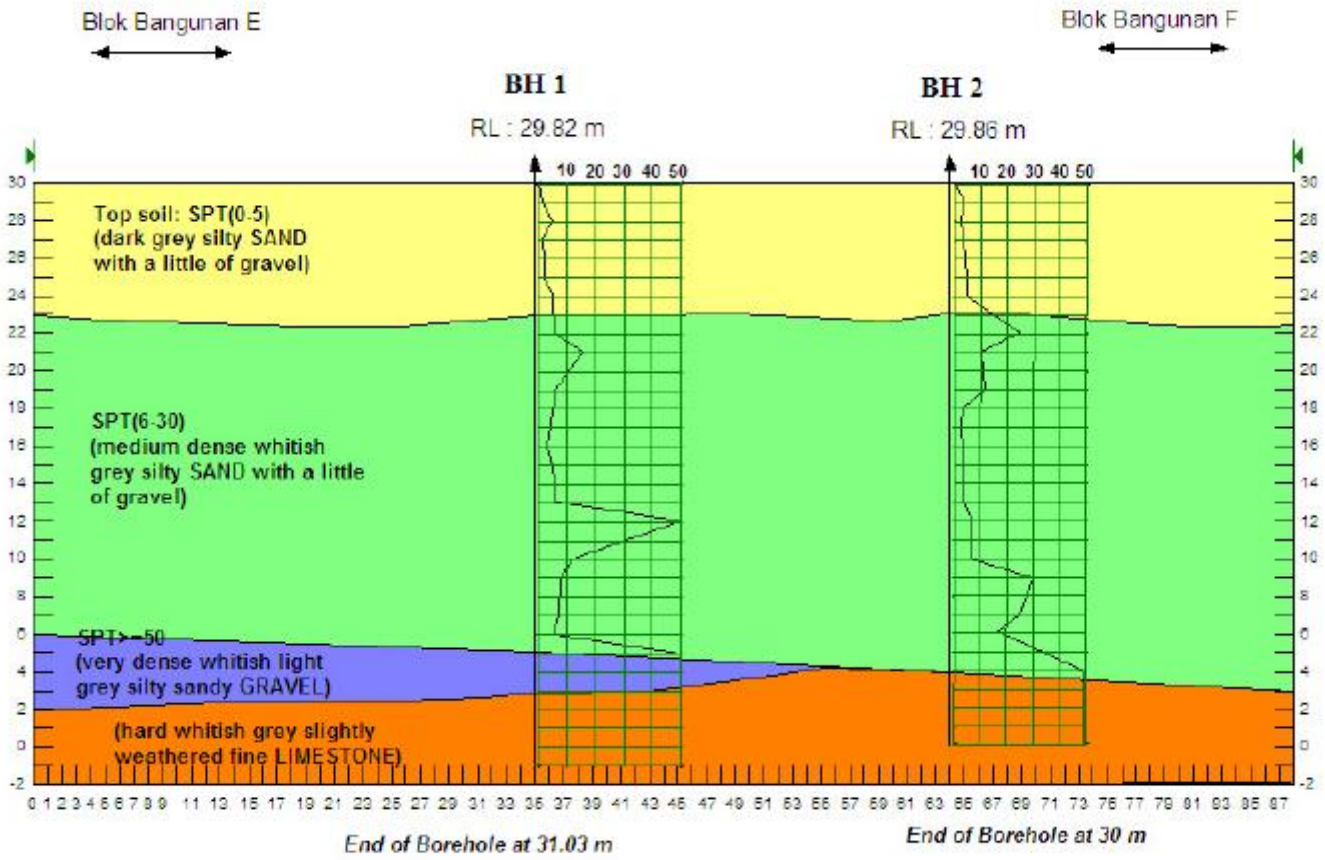


PHOTO MENU INTERFACE

Jabatan Kerja Raya Malaysia
Cawangan Pakar dan Kejuruteraan Awam

Soil Profile and Foundation Information System

PHOTO


Block A


Block B


Block C


Block D


Kantin


Pondok Basikal


Pondok Pengawal

HOME

PWD GUIDELINES

JKR 21504-0001-09

SLOPE DESIGN GUIDELINE

SLOPE ENGINEERING BRANCH, PUBLIC WORKS DEPARTMENT MALAYSIA

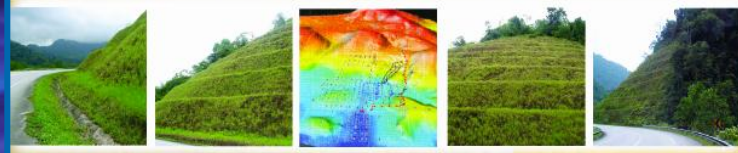
JKR 21504-0001-06

PEMERIKSAAN CERUN
JABATAN KERJA RAYA
MALAYSIA

Nota Dan
Garis Panduan

CERUN 1

Public Works Department Malaysia



GUIDELINES ON
SLOPE MAINTENANCE
IN MALAYSIA

JKR 21503-0001-06

MAINTENANCE GUIDELINES
Inspection Frequency

Maintenance Type	Personnel	Risk Category	Frequency (minimum)
Routine Maintenance Inspections	TA or Technician (any trained person)	1 & 2	Once/yr
		3	Once/2 yrs
Engineers Maintenance Inspection	Qualified Engineer	1 & 2	Once/5 yrs
		3	Once/10 yrs
Regular checks on water/sewage pipes	Qualified water personnel	1, 2 & 3	Recommended by the qualified engineer

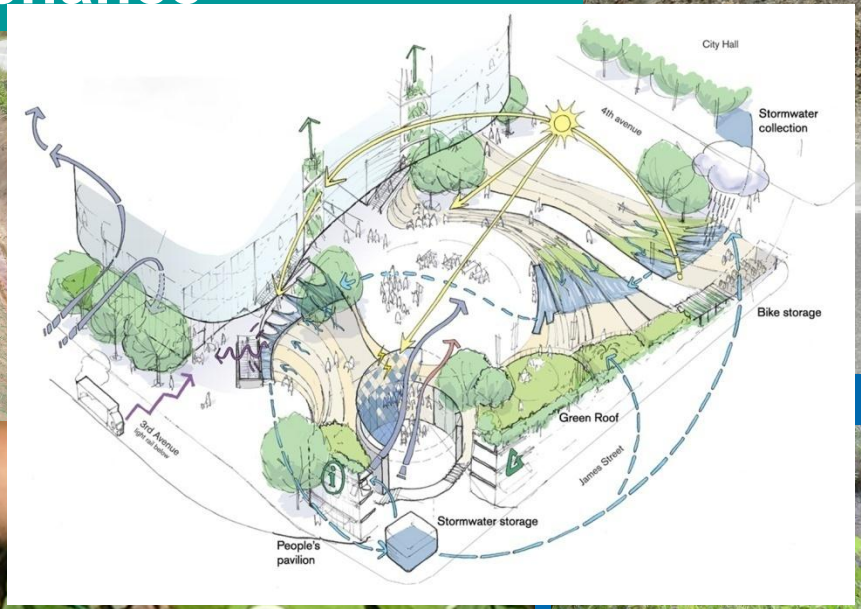
DESIGN GUIDELINES

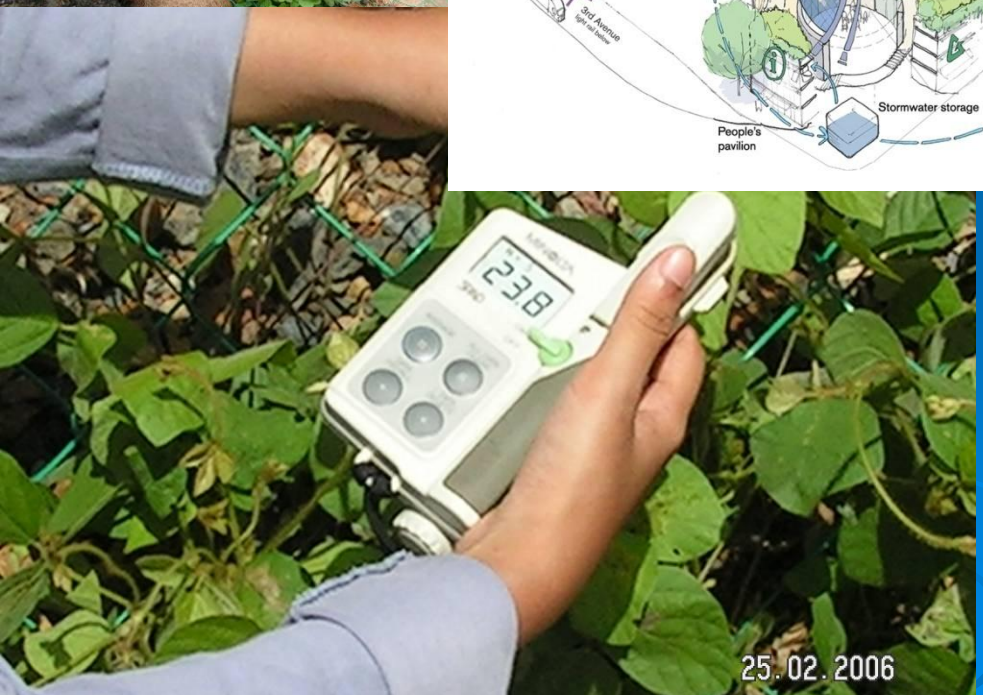
- Limiting the height of slopes to not more than 30m
- Use other alternatives
- Geological mapping
- Independent checker

BIO-ENGINEERING

- Reduce erosion & sediments yield
- Decrease of liability exposure
- Improve aesthetics
- Enhance existing environment
- Improve stability

mellastoma and legumes grown in weathered carbonaceous rock without regular maintenance





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SOIL-ROOT MATRIX REINFORCEMENT EFFECT WITH UNIVERSITY MALAYA

Jalan Kuala Kubu Baru – Gap Slope at km 15

One Year Later

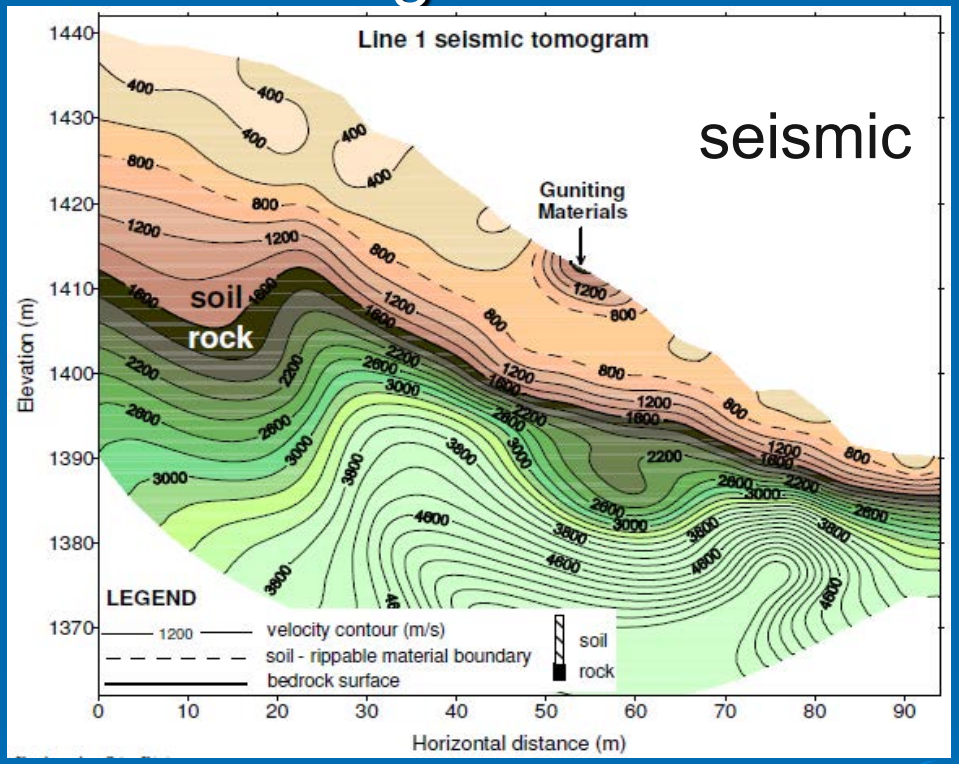
NEW TECHNOLOGY

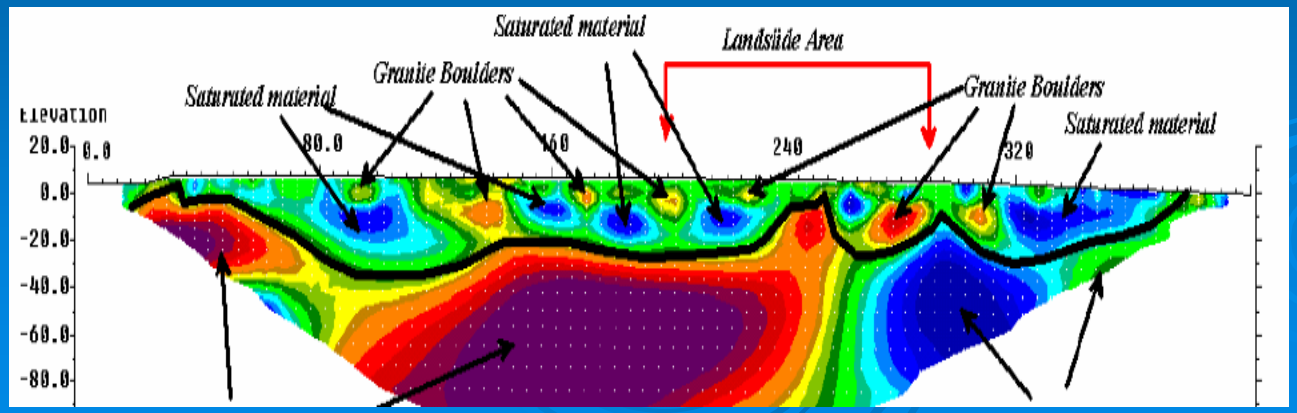
- Malaysian geotechnical engineering fraternity is opened to new technologies
  - Flexible polyester-based woven geogrids were developed starting in 1984 and the first application was in mid-1985 in a highway in Malaysia (Pegg, 2008)
- Not many geotechnical technologies are presented as sustainable
- PVD has been used since 1986

NEW TECHNOLOGY

Geophysical methods for Site Investigation

- Seismic
- Resistivity





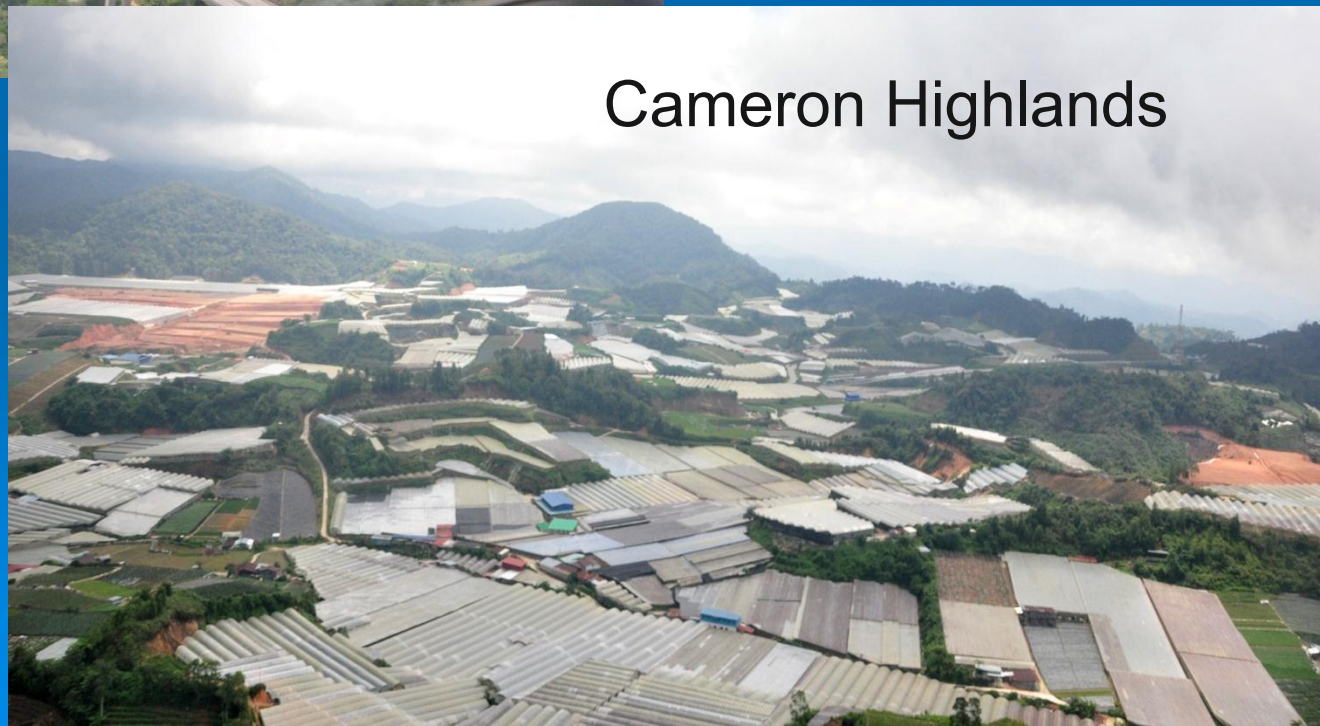
SLOPE PUBLIC AWARENESS EXHIBITION

For NGOs

SLOPEWATCH
BukitAntarabangsa CoBARA

mercy MALAYSIA

Do We Want This???

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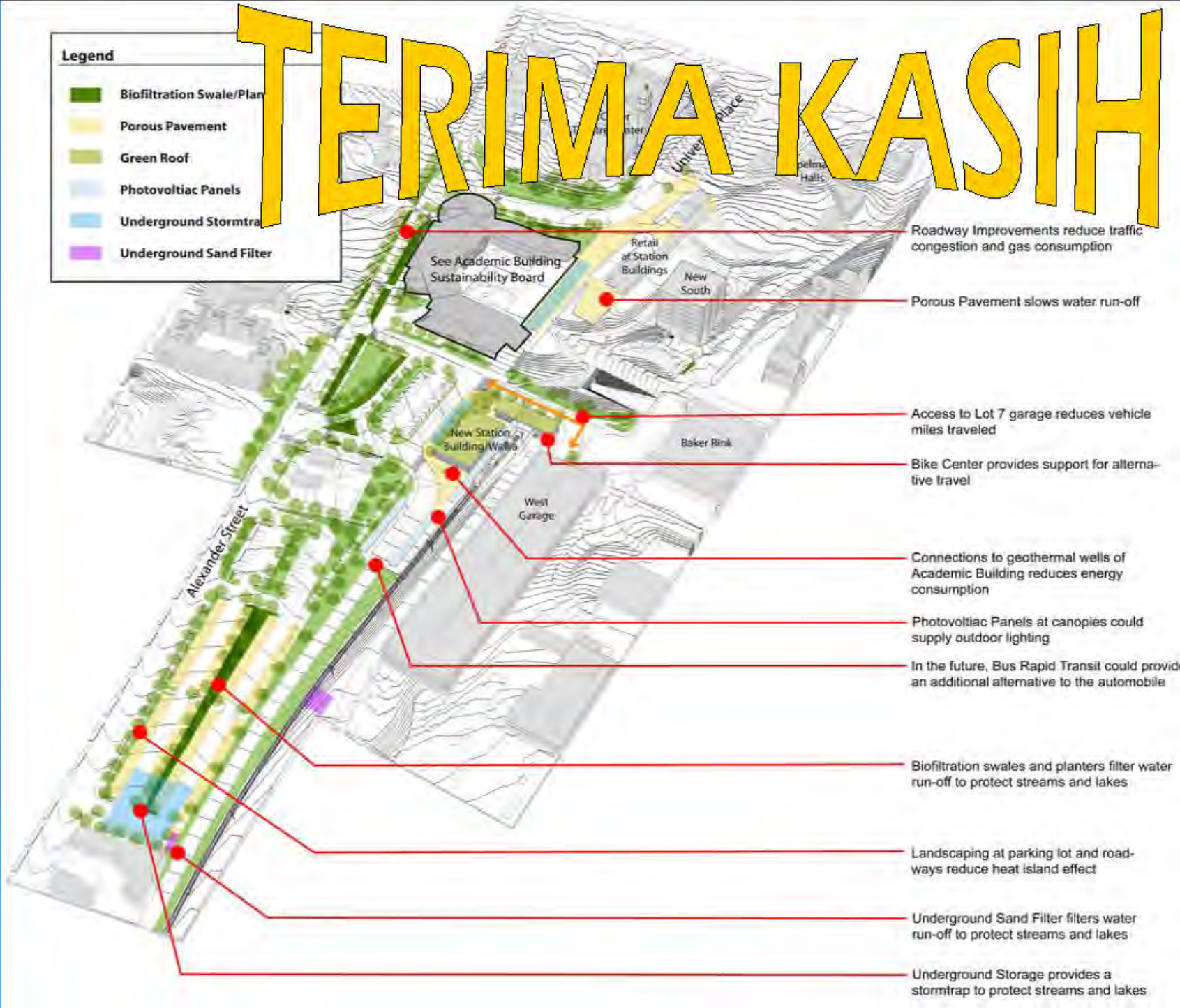
Or This???

The River That We Pollute

SUMMARY

- PWD has initiated some sustainability elements in geotechnical engineering
- Sustainability is currently in the initial phase
- Data collection, archiving, interpretation and dissemination especially for better slope and SI management are ongoing
- hazard and risk maps are used for planning, treatment and maintenance
- Research on bio-engineering has produced results
- Guidelines on design and maintenance of slopes will hopefully reduce landslides
- PWD have embraced new technology and innovation
- Public awareness programs have created awareness in some landslide prone areas

TERIMA KASIH



STUDY AREA 2

Cut Slope km 36.2 Gerik – Jeli Road, studies by UKM Pakarunding (science environment faculty), during October '06 – December '07,

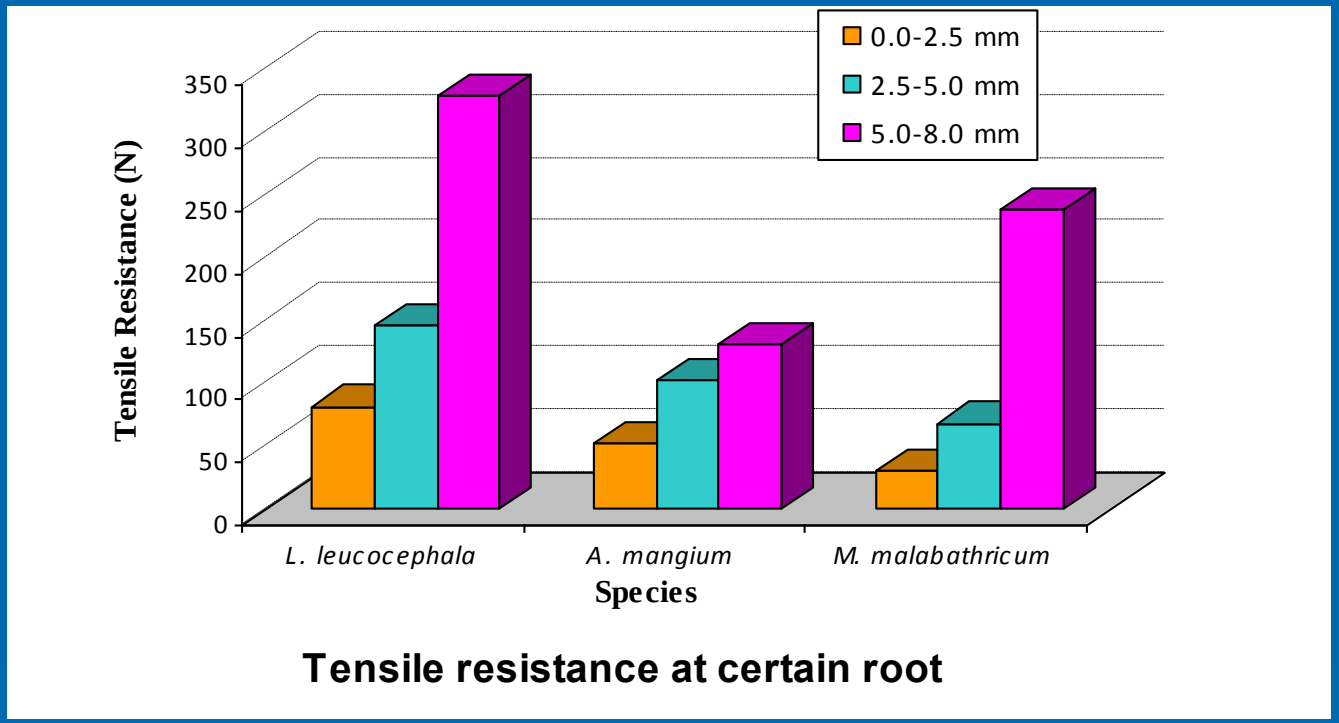
Field shear box test : 300mm x 300 mm steel box

Soil & root was compacted in the shear box

Normal load was applied

Displacement measured after the end of experiment

Results & Findings : Soil-Root Matrix Studies



Tensile resistance at certain root

- ***L.leucocephala* - highest** tensile resistance in all diameters
- Root **diameter influences** the total max force
- Tensile resistance increases with increasing root diameter
- **Significant** tensile resistance at **higher diameters**

STUDY AREA 4 (on going project)

Km 20, Jln. Simp. Pulai – Cameron


Selected species were
planted for in situ testing
on the locality of cut slope
Km 20, Jln. Simp. Pulai – Cameron
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Jalan Kuala Kubu Baru – Gap

Jln. K. Kubu Baru – Gap Slope Failed at km 15

- Using Coil Rolls & Fiber Mat
- Done by MTS Sdn Bhd
- Planted with Vetiver grass on granitic soil in area 15 X 10 m^2
- Study on Okt. – Nov., 2007

Jln. K. Kubu Baru – Gap

Slope Failed at km 23

- Using Fiber Mat only
- Done by Wintima Sdn Bhd
- Planted with Vetiver grass on granitic soil in area 30 X 10 m^2
- Study on Okt. – Nov., 2007

Jalan Kuala Kubu Baru – Gap Slope Failed at km 23

After One Year

Times


VIEW of STUDY area 2
22.06.2006 14:19
22.06.2006
22.06.2006 14:27
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SLOPE CHARACTERISTIC

- The formation of crack at the slope is an obvious sign of instability; they formed and developed through the position of tension and shear zones.
- Failure in form of **wedging** of slope was observed.
- Some erosion mark such as rill and gully erosion was observed widespread.

Installation of Geo-Materials

Installation of Geo-Materials

Installation of Bio-Materials

- Total of 1030 plant materials which representing of 39 species were used

- 10 species of herbaceous plant species, 14 species of climbers and 15 species of woody plants species were installed

Procedure of root pullout test

Site clearing

↓

Apparatus assembly

↓

Measurement of the plant was taken

↓

Stem was cut and gripped with wedge

↓

Dial gauge and load ring was set to nil (zero)

↓

Pull-out resistance force value was taken

↓

Until root is pull-out

↓

Root was carefully excavated from the soil

Pull-out test machine

Diameter measured

Wedge and barrel

Dial gauge

Load ring

Plant was pull-out from the soil