SEACAP 21/004

Mainstreaming Slope Stability Management – Hazard and Risk Assessment – to Laos Practitioners

Terminal Report

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Prepared for:
Crown Agents on behalf of
Department for International Development

Version/ Revision	Dated	Prepared By	Reviewed By	Review Date
1	13 May 2009	G Hearn	T Hunt	17 May 2009

SEACAP 21/004
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Terminal Report

1. Introduction

This Terminal Report for SEACAP 21/004 summarises the outcome of activities undertaken during the period March to May 2009. The overall programme of work undertaken is given in Appendix 1.

2. Aims and Objectives of the Project

The objectives of the training were to increase capacity in slope stability hazard and risk assessment within the National University of Laos (NUoL), the Ministry of Public Works and Transport (MPWT), and local consultant companies. The Slope Maintenance Manual and the Slope Maintenance Site Handbook produced under SEACAP 21/001 were to form the basis of the training. This was to be achieved by:

- First, training six selected Trainers, each of whom possessed existing skills, knowledge and experience relevant to the training aims and objectives, and
- Second, for these Trainers to then train 20 or so selected Practitioners from the road (and possibly the University) sector.

Details of the selection procedure and design of training curricula can be found in the Inception Report (March 2009).

The approach adopted in the design of the Mainstreaming training programme was to combine the hazard and risk assessment within an overall training structure that covers slope stability hazard identification and description, inspection, mapping and investigation, and the design and construction of remedial and stabilisation measures, including both civil and bio-engineering works.

The following detailed aims and objectives therefore underlie this course.

The **aims** of the course were to introduce Practitioners to:

- the causes and mechanisms of slope failure within the geological and geomorphological context of Lao PDR;
- roadside and slope inspection methods
- slope stability hazard and risk assessment for works prioritisation
- landslide mapping and landslide investigation
- design of remedial measures
- construction of remedial measures
- use of bio-engineering methods of slope protection and erosion control

The **objectives** were that, at the end of the course, the Practitioners' ability to undertake the following will be strengthened:

- carry out roadside and slope inspections in order to identify hazard situations
- examine an unstable slope and identify the causes and components of instability
- define landslide areas and be aware of when and how to schedule a ground investigation

- assess hazard and risk, and prioritisation of works
- schedule slope improvement and stabilisation/road reinstatement schemes
- develop a knowledge of where, how and when to apply bio-engineering works
- manage construction and maintenance issues concerning slope stability

3. Course Outline

The course covered the following main topics:

- geology, geomorphology and hydrology of landslides affecting roads in Laos
- recognition, definition and investigation of slope stability hazards
- approaches to slope stabilisation and protection
- implementation of remedial/reinstatement works and best construction and maintenance practice

The following disciplines are embodied in the above:

- Geology
- Geotechnical Engineering
- Civil and Structural Engineering
- Forestry/Bio-engineering
- Construction Implementation/Maintenance

4. Training Themes

The training material was subdivided into a number of Training Themes which were based essentially around the Slope Maintenance Manual prepared and issued in English and Lao under SEACAP 21/001. This was adapted to provide a rounded programme of training, and included elements not covered by the Slope Maintenance Manual. The Training Themes are listed below and summarised in Section 5:

1. Types of slope instability affecting the Laos Road Network
2. Factors influencing slope stability in Laos
3. Introduction to Slope Stability Management
4. Slope and roadside inspections and assessments
5. Slope Instability hazard and risk assessment
6. Engineering geological assessments
7. Remedial Measures: Selection of Options
8. Remedial Measures: Design
9. Remedial Measures: Construction
10. Bio-engineering techniques of slope protection
11. Integrated Stability Slope Management

The Trainer Training materials were prepared by the Scott Wilson Trainer Training team (see Section 6) in English for the Trainer Training programme (see Section 9). All slide projector material was then translated into Lao for the Practitioner Training programme and adapted by the Trainers as necessary.

5. Training Themes Content

1. Types of slope instability affecting the Laos Road Network

This draws on Sections 2.1-2.3 of the Slope Maintenance Manual, but includes additional photographs and some material taken from the SEACAP 21/002 Feasibility

Study Report. It discusses failure mechanisms, depths, and position/configuration relative to the road. It also illustrates typical outcomes and reference to the landslide inventory contained in the Background Paper to the Feasibility Study Report. It was supported principally by power point projector slide material.

2. Factors influencing slope stability in Laos

This is not covered in detail in the Slope Maintenance Manual and so illustrative material was drawn from the Feasibility Study Report. It covers both natural and engineering/land use factors. It was supported principally by power point projector slide material with some textual material from the Feasibility Study Report.

3. Introduction to slope stability management

This Theme introduces the basic principles and techniques of slope stability management, covered in later Themes in more detail. It highlights the importance of establishing records and data sets of landslide locations and slope stability events, and the need to assess these in some way according to hazard and risk for prioritisation of mitigation works. It discusses overall approaches to slope stability management, including the need to accept some risk outcomes due to lack of resources and geotechnical uncertainty, and emphasises the importance of adequate site assessment and monitoring. It was supported principally by power point projector slide material.

4. Slope and roadside inspections and assessments

Section 3 of the Slope Maintenance Manual is the principal source of illustrative information for this Theme. This Theme emphasises the importance of making adequate site assessment, and describes the methods for doing so. Many slope problems can be averted, or otherwise mitigated, if action is taken at the right time. Each site needs to be assessed and a decision made as to the appropriate action to take. Figures 3.1 and 3.2 from the Slope Maintenance Manual form important elements of this Theme. The training was supported by power point projector slides plus some text to describe how Figures 3.1 and 3.2 are used.

5. Slope instability hazard and risk assessment

This Theme focuses on the requirement and method to assess the risk posed by identified slope hazards in order to prioritised slope mitigation. It draws upon Figs 3.3-3.5 in the Slope Maintenance Manual, and provides additional explanatory text, regarding definitions and approaches.

6. Engineering geological assessments

Sections 3.4 and 3.5 of the Slope Maintenance Manual form the basis of this Theme. Descriptions and illustrations are given of the need to establish landslide outlines and topographic details sufficient to develop cross-sections for geological interpretation, and ultimately stability analysis. It provides a general description of the major rock and soil types present in Laos, and describes and illustrates how these materials behave in an engineering sense. Rock and soil samples were demonstrated in the classroom. On-site description methods through logging and ground investigation are reviewed and discussions are held on laboratory testing, particularly for soils. The level of detail provided for this Theme is sufficient to enable the main concepts to be addressed. Power point projector slides, handouts and written text formed the basis of the training.

7. Remedial measures: selection of options

Sections 4.1 and 4.2 of the Slope Maintenance Manual apply. This section examines the range of options available to mitigate slope instability hazards, depending on the depth, extent and configuration with respect to the road. It overviews both

engineering and bio-engineering options and emphasises the need to gain a correct interpretation of slope conditions from the previous Themes in order to select the preferred option. The training was supported primarily by power point projector slides.

8. Remedial Measures: Design

This Theme introduces methods of slope analysis and the design of cross-section and earthworks in relation to slope stability. The intention is not be to enable the Practitioners to become proficient in the use of the analysis, but to demonstrate how the analysis is undertaken, and the data required to run the analysis. This process helps to identify the key factors in controlling stability and shows, for example, what happens to factors of safety if groundwater levels are increased/decreased or spoil is placed in critical locations with respect to failure circles. These basic criteria and illustrations help to explain the importance of earthwork design and cut and fill slope angles and configuration with respect to slope stability, both in terms of pre-existing failures and hitherto unfailed slopes. Power point projector slides, handouts and text were utilised.

The second phase of this training examines the use of retaining walls; both as slope and road retaining structures. Basic wall types and shapes are discussed. Considerations are given as to how different wall types might be selected to suit different ground conditions. The basic principles of wall design are covered, and spreadsheet methods of design are illustrated. Again the purpose was to enable the Practitioners to carry out design, but to make them aware of the factors and considerations, and the options at their disposal. Sections 4.3 and 5.2 and 5.3 of the Slope Maintenance Manual apply. The importance of foundation stability is stressed, and simple relationships between bearing capacity and bearing pressure are illustrated. Methods of determining bearing capacities are discussed, following on from Theme 6.

Engineering methods of drainage management and surface water/groundwater reduction are covered. This includes a review of surface and subsurface drainage types and their contribution to design.

9. Remedial measures: construction

This theme examines practical aspects of road and slope management to avoid or reduce slope instability problems. It calls upon the previous Themes as a means of illustrating the importance of controlling drainage, managing spoil effectively and ensuring adequate foundations for retaining walls. This training was supported by projector slides and textual contributions where appropriate.

10. Bio-engineering techniques of slope protection

This Theme describes the role of bio-engineering, both as a means of conservation and of engineering protection. It examines the role of planting as a means of reducing erosion and increasing the strength of surface soils, and describes and illustrates the interface between bio-engineering and conventional slope engineering. The discussion demonstrated how bio-engineering is best applied to suit different slope conditions. A combination of projector slides, handouts and text were used.

11. Integrated slope stability management

This final Theme brings together all of the key points and issues raised in the previous Themes, and demonstrates the importance of an integrated approach to slope stability management. Projector slides supported this training.

MODULE 1: TRAINING OF TRAINERS

6. The Scott Wilson Trainer Training Team

This comprised the existing SEACAP 21 team, augmented by two additional expatriate staff and one additional Lao staff member. The team members are listed below:

Dr Gareth Hearn	Team Leader and trainer in remedial options, construction issues and integrated slope management. Also responsible for training materials preparation for other themes
Ms Arouny Sakulku	Deputy Team Leader
Mr Tim Hunt	Trainer in landslide types, causes, field assessments, inventories and hazard/risk assessment for prioritisation
Dr Bill Murphy	Trainer in engineering geology and review of course content and structure
Ms Sarah Dagostino	Trainer in geotechnical issues concerning earthworks and retaining walls
Mr John Howell	Trainer in bio-engineering
Mr Neil Carruthers	Assistance with training materials preparation
Mr Xayphone Chonephetsarath	Training/Examination Facilitator

7. Selected Trainers

The Practitioners were originally to be trained by six Trainers drawn from the Roads Administration Division of MPWT and NUoL sources. These were invited to nominate candidates, and the list below is the outcome of this nomination and selection. As it happened, one of the NUoL candidates had to withdraw from the training programme at the last minute due to teaching commitments. Other sources were sought, including the Public Works Training Centre, the Planning and Environmental Division of the Department of Roads (MPWT), the Department of Communication and Transport of NUoL and Lao Transport Engineering Consult (LTEC) and Lao Consulting Group (LCG). Regrettably, due to work load, none had any staff available to commit to the training programme.

The Trainers indicated in the table below were trained in the same training Themes as those that formed the basis of the Practitioner training. The table below indicates which Trainers were selected for each of the training roles.

No	Trainer Role	Themes for which Trainer is Designated Champion	Trainer Name	Trainer Affiliation
1	Geology and geomorphology_1	1, 2 , 3 and 6	Associate Professor Nhinxay Visane	Faculty of Engineering, NUoL
2	Geology and Geomorphology_2	Support to Geology Champion in all Themes	Mr. Vongsavanh/ Ms Phetnakhone Xaysongdeth	Faculty of Engineering, NUoL
3	Geotechnical, Structural and Civil Engineering	5 joint, 7, 8a joint, 8b	Mr Phonepheth Mounnarath	Faculty of Engineering, NUoL
4	Forestry/Bio-engineering	10	Mr Chanthaphone Phon - asa	Faculty of Forestry, NUoL
5	Road Construction/Maintenance	4, 5 joint, 9 11	Mr Sengmany Sysouvanthong	MPWT

8. Method of Trainer Training

Scott Wilson staff trained the Trainers in the weeks running up to the Practitioner Training. Because the selected NUoL trainers had teaching commitments during the period in the run-up to May, they had to be trained on a part time basis. All of the six trainers were trained in each Theme.

One trainer was nominated as the Champion for each Theme to take responsibility for ensuring that the training materials were delivered effectively to the Practitioners. This occasionally meant that additional one-to-one training had to be given by the respective Scott Wilson staff member to the relevant Champion where it was considered that his or her knowledge and application skills needed to be strengthened further. Powerpoint slides and handouts formed the principal means of trainer training.

9. Trainer Training

The Trainer Training programme is given in the table below.

Trainer Training Week No	Date (W/C)	Approx Trainer Training Time (dys)	Training Theme to be Covered	SW Staff	Trainer Champion
1	23 March	2 2	1-5 Site visit	Tim Hunt	Geologist 1 & 2 Construction/ Maintenance Engineer Civil Engineer
2	30 March	2	6	Bill Murphy	Geologist 1 &2
3	06 April	2 3 for Civil Engineer	8	Sarah Dagostino	Civil Engineer Structural Engineer
	13 April		Lao New Year		
	20 April		Trainers consolidate training materials thus far		
4	27 April	2.5 3.5 for Forester	7, 9 -11	G Hearn/J Howell	Civil Engineer Structural Engineer Forester Construction/ Maintenance Engineer

Training was mainly carried out in the Hydrology and Environmental Laboratory at the NUoL Sokpalouang Campus. This was fully equipped with tables and chairs, air-conditioning and an LCD projector and screen. This location was also used for the Practitioner Training.

The Trainers were examined before and after the training programme. The Pre-Training Examination was devised in order to establish the current knowledge of the Trainers in the Theme subjects. The End of Training Examination was intended to ascertain the extent to which they absorbed the training and improved their knowledge and awareness as a result of the training. The results of the examinations are given in Appendix 4.

MODULE 2: TRAINING OF PRACTITIONERS

10. Practitioner selection

The training course was developed with the following Practitioners in mind:

- Appropriate professional project staff of the MPWT
- Engineering site staff of the DPWTs
- Senior technical staff of the DPWTs
- Consultancy companies; design and supervision engineering staff
- Others, including selected staff from NUoL

MPWT selected Practitioners from each of seventeen Provincial DPWT offices, together with a representative from the Roads Administration Division, the Local Roads Division, the Technical and Environmental Division and the Training Centre, all from the MPWT offices in Vientiane. In addition, two consultancy groups, LTEC and LCG, each nominated a candidate. The list of Practitioners is given in Appendix 2.

12. Practitioner Training

This took place between 2 and 15 May 2009 and comprised the following activities:

- Site visit to SEACAP 21/001 trial sites on Road 13N on 2-4 May
- Registration, Opening Ceremony, SEACAP 21/003 Terminal Workshop, Pre-Training Examination and commencement of classroom training on 5 May
- Continued classroom training between 6 and 8 May with an End of First Week Examination on 8 May
- Continued classroom training between 11 and 15 May, with an open-air bio-engineering demonstration at the University campus on 14 May
- End of Training Examination, SEACAP 21/004 Terminal Workshop and Closing Ceremony on 15 May.

The detailed programme is shown in Appendix 3.

The Practitioner training aimed to raise the awareness and familiarity of the Practitioners in the various training Themes. The intention was not to try to create a group of specialists, but to provide information and demonstration sufficient to enable them to grasp the main concepts and be aware of the techniques that are available, their strengths and weaknesses and the manner in which they are applied.

The Practitioners were examined before, during and after the training programme. The Pre-Training Examination was devised in order to establish the current knowledge of the Practitioners in the Theme subjects. The End of Training Examination was intended to ascertain the extent to which they absorbed the training and improved their knowledge and awareness as a result of the training. The results of the examinations are given in Appendix 4.

Towards the end of the training programme the Practitioners were requested to complete a questionnaire on their opinions of the programme and any perceived deficiencies. The results of this questionnaire are given in Appendix 5.

13. Terminal Workshop

The Terminal Workshop was held at the end of the Practitioner Training course on 15th May. It was decided to make this informal and interactive. The results of the examinations and the questionnaire were given in a Powerpoint presentation in the same format as Appendices 4 and 5 and the Practitioners encouraged to express their thoughts and opinions. This was then followed with the presentation of certificates by the Dean of the Faculty of Engineering.

Each Practitioner had been given a bound copy of the Slope Maintenance Manual and the Slope Maintenance Site Handbook (in English and Lao) at the beginning of the course. At the Terminal Workshop they were also presented with a copy of a CD containing all the lecturers' presentations (in Lao), the Slope Maintenance Manual, Slope Maintenance Site Handbook and Slope Maintenance Specifications (in Lao and English) and some additional reference material (in English). It is hoped that this will assist in the rapid dissemination of slope maintenance material to other interested parties.

14. Findings

Broad conclusion

The broad conclusion to be drawn from the results given in Appendicies 4 and 5 is that the training course was an undoubted success. All the provinces were represented and almost all the Practitioners had been closely involved with slope stability management. This resulted in many lively discussions during the site visit and the formal lecturing. Practical problems were freely aired and attendance was always close to 100%. It was particularly gratifying that MPWT gave the opportunity for Sengmany Sysouvanthong to be one of the Trainers, since he had been the Ministry's Project Manager for SEACAP 21 and therefore had the same background as the Practitioners. The additional presence of Bounthavy Silipon of LCG (SEACAP 21 Construction Supervisor) as a Practitioner, and Xayphone Chonephetsarath of SD and XP consultants (SEACAP 21 Deputy Team Leader) as the training facilitator, greatly strengthened the SEACAP 21 presence during the course of the training programme.

Practical training

The learning experience was further strengthened by the two-day site visit at the beginning of the course to some of the SEACAP 21/001 and 003 slope remedial works locations, and the bio-engineering demonstration at the end of the course. The latter demonstration was conducted outside the lecture room on a small slope in the University campus by Bounhome Malaythong, who was the local Bioengineer on SEACAP 21/001, with the active participation of the Practitioners.

Examination results

The results of the examinations (Appendix 4) are very interesting but quite logical. The conclusions are:

- The Practitioners generally had more hands-on experience of slope instability problems than most of the Trainers, as evidenced by the higher percentages they scored in the first two examinations.
- Both the Trainers and Practitioners nonetheless gained significantly in their understanding of problems and solutions related to slope instability, as evidenced by the higher percentages both groups scored in the second examination.
- It was decided to make the final examination for the Practitioners an open-book exam since, if they did not know a particular answer, it was important that they knew where to find it. The questions were set by the Trainers themselves, but not all the answers could be found in the Manual or Handbook. Perhaps unsurprisingly, nearly all the Practitioners scored extremely well.

Questionnaire results

The results of the questionnaire (Appendix 5) led to the following main conclusions:

- The length of the course was of the right order but many thought it could be shortened. The course was judged to be very interesting by two-thirds of the Practitioners and interesting by the rest.
- They were divided in their views about the venue
- Most of the Practitioners felt that the presentation material varied from being easy to being difficult to understand, and that the quality of the lecturing was generally good to satisfactory.
- Roughly two-thirds thought the site visit was very interesting and well organised, the remainder being more moderate in their views
- More than two-thirds thought they had learned a lot, and just under two-thirds thought that the Slope Maintenance Manual and Handbook would be very useful.
- Almost all felt that the course should be repeated for other Practitioners
- In their suggestions as to how the course could be improved, the most frequently expressed views were that some of the presentational methods should be improved and the trainers better prepared; handouts should have been given, and more opportunities allowed for the discussion of some of the actual problems they have been facing.
- In respect of their views on which topics they would have liked covered in greater detail and how this could be done, the Practitioners made a number of suggestions. There was clearly a desire with several of them for more instruction and information

Trainers

The Trainers generally performed well, given that they were often lecturing to Practitioners who were more familiar with some of the more practical aspects of the subject matter than the Trainers were. It was, of course, partly for this reason that MPWT were originally requested to provide more than one trainer. However, the Trainers were particularly able to provide the theoretical background to many of the practical problems, and the ensuing, often lively, lecture room discussions meant that all those present benefited. In the occasional need for clarification, the Scott Wilson training team member present would be called upon to present his views.

Practitioners
The Practitioners came with a variety of backgrounds and experiences, but nearly all had experienced direct problems of slope instability. They were unafraid to ask questions or challenge each other and this interaction created an excellent learning atmosphere. Between them they had a good team spirit and as an example of this, the grass planting practical in the bio-engineering demonstration became a competition between the provincial DPWTs.

Informal functions
There were also a number of informal functions, including two evening meals and a football match, which gave the opportunity for further networking. It seemed clear that this will lead to continuing contacts and support on landslide problems between the various province DPWTs, the MPWT, the local consultants and the University.

Additional highlights
Two additional highlights were the televised opening speeches of the course on the national TV network and the unexpected presence of the Minister of Public Works and Transport at one of the sites on the site visit. The Minister was passing by and stopped to speak with the Practitioners. He expressed his approval of the training course and wished them success. He asked for a copy of the training materials, and this has been arranged through the Ministry.

15. Closing Comments

The Department of Civil Engineering, NUoL, now has sufficient presentation material to include a module on slope engineering in their post-graduate Master of Engineering programme and to supplement their existing material for their graduate programme. In particular, the lecturers have been exposed to the practical aspects of slope stabilisation in Laos, which will give them and their students a better understanding of the issues involved, and a number of the sites on road 13N have already been used for graduate studies and theses. The Department will be pleased to undertake a similar training course in the future. However, the Department needs to take cognisance of the comments given in the questionnaire to improve the conduct of any such course.

Although the two-week training programme has undoubtedly been of considerable value to all the Practitioners, it can only touch on many of the topics covered – some of which are usually individually the subject of a one-year full time post-graduate course. There is a definite lack of expertise in engineering geology and geotechnical engineering in Laos, and this can only be properly filled by post-graduate training outside the country, at least at the present. It is to be hoped that some future donor or internal funding might be made available for this purpose.

Appendix 1

Overall Programme

Task No	Task	Mar-09					Apr-09				May-09	
		W/C 2nd	W/C 9th	W/C 16th	W/C 23rd	W/C 30th	W/C 6th	W/C 13th	W/C 20th	W/C 27th	W/C 4th	W/C 11th
1	Project Planning and Inception											
2	Project Inception Workshop											
3	SEACAP 21/003 Terminal Workshop											
	Module 1 Training of Trainers											
4	Selection of Candidates											
5	Preparation of Training Materials by SW Team											
6	Training											
	Training Week 1											
	Training Week 2											
	Training Week 3											
	Training Week 4											
	Trainers Site Visit to R13N											
	Trainers Examination											
	Module 2 Training of Practitioners											
7	Selection of Candidates											
8	Preparation of Training Materials by Trainers											
9	Training											
	Practitioners Site Visit to R13N											
10	**Project Reports**											
	Inception											
	Module 1 Progress											
	Terminal											
11	**Publications (after the end of May)**											

Staffing

Position	Name
Team Leader	Gareth Hearn
Dep Team Leader	Arouny Sakulku
Geotechnical Engineer	Tim Hunt
Training Expert	Bill Murphy
Soil Mechanics Specialist	Sarah Dagostino
Bio-Engineer	John Howell
Engng Geologist & GI Specialist	Neil Carruthers
Training Facilitator	Xaphone Chonephetsarath

UK

Laos

NB Only International staff in Laos are continuous inputs, the remainder were spread over the periods approximately indicated

Appendix 2 Practitioners Training Programme

Theme No	Content	Delivered by	Time	Date
	Field Visit to Road 13N Site training to include: 1. Landslides types, causes and impacts 2. Inspection and observational methods 3. Slope stabilisation: civil works 4. Slope protection: bio-engineering works 5. Drainage management and erosion control 6. Retaining walls and road reinstatement Site Inspections at: SEACAP 21/001 and 003 sites	All Trainers (GH in attendance)	All day	2-4 May
	Training Registration and Opening Ceremony SEACAP 21/003 Terminal Workshop Discussion Session	 GH	09:00 10:00 10:00 12:00 12:00 12:30	
	Pre-Training Examination	XP	14:00 15:00	
1	**Types of slope instability affecting the Laos Road Network** 1.1 Landslide mechanisms 1.2 Shallow versus deep-seated slope failures 1.3 Failures above, below and beneath the road 1.4 Typical outcomes Discussion Session	All Trainers Geology Champion to lead (GH in attendance)	 15:00 16:30 16:00 17:00	5 May
2	**Factors influencing slope stability in Laos** 2.1 Topography and geology Slope steepness and aspect; rock type;structure; weathering grade 2.2 Climate and rainfall Warm, humid climate yields high weathering; seasonal rainfall yields seasonal increases in GW and short term, high intensity rain yields failures in surface soils due to transient pwps 2.3 River and stream erosion Toe erosion 2.4 Engineering effects Steep cuts; steep fills; poor wall foundations; spoil disposal; road runoff Discussion Session	All Trainers led by Geology Champion (GH in attendance)	 09:00 12:00 12:00 12:30	6 May
3	**Introduction to Slope Stability Management** 3.1 Slope hazard inventory for route selection 3.2 Slope hazard inventory for roadside slope management 3.3 Engineering practice to minimise roadside slope stability hazards 3.4 Engineering mitigation of specific roadside slope stability hazards 3.5 Monitoring	All Trainers Led by Geology Champion (GH in attendance)	 14:00 14:30	
4	**Slope and roadside inspections and assessments**	All Trainers led by Construction/ Maintenance Champion (GH in attendance)	14:30 15:30	6 May

Theme No	Content	Delivered by	Time	Date
5	**Slope Instability hazard and risk assessment** 5.1 Definition 5.2 Hazard and risk matrix 5.3 Prioritisation and decision making Discussion Session	All Trainers led by Construction/ Maintenance Champion with assistance from Civil Engineering Champion (GH in attendance)	 15:30 16:45 16:45 17:00	
6	**Engineering geological assessments** 6.1 Topographic survey and topo-sections 6.2 Engineering geological mapping 6.3 Field descriptions of soils and rocks 6.3 Ground investigations and lab testing 6.4 Geological/landslide sections 6.4 Ground movement monitoring 6.5 Use of the data Discussion Session	All Trainers led by Geology Champion (GH/TH in attendance)	 09:00 09:30 09:30 11:00 11:00 12:30 14:00 16:00 16:00 17:00	 7 May
7	**Remedial Measures: Selection of Options** 7.1 Selection of remedial options Discussion Session Overview of Week's Training End of Week 1 Examination	All Trainers Civil Engineer Champion to lead with Construction/ Maintenance Champion as support (TH in attendance)	 09:00 11:30 11:30 12:30 14:00 15:00 15:00 16:00	 8 May
8	**Remedial Measures: Design** 8.1 Soil slope stability analysis 8.2 Rock slope stability assessment Discussion Session 8.3 Cross-section design 8.4 Earthworks design Discussion Session	All Trainers Led by Civil Engineering Champion (TH in attendance) All Trainers Civil Engineering Champion to lead assisted by Geology Champion (TH in attendance)	 09:00 11:30 11:30 12:30 14:00 15:00 15:00 16:30 16:30 17:00	 11 May
8 cont	**Remedial Measures Design cont/** 8.5 Retaining wall types 8.6 Retaining wall design Discussion Session Break out group assignments on investigation and design	All Trainers Led by Structural Engineering Champion (TH in attendance) All Trainers	 09:00 12:00 12:00 12:30 14:00 17:00	 12 May

Theme No	Content	Delivered by	Time	Date
9	**Remedial Measures: Construction** 8.1 Spoil management 8.2 Cut and fill slopes 8.3 Drainage 8.4 Wall construction 8.5 Site safety Discussion Session	All Trainers led by Construction/ Maintenance Champion with assistance from Civil Engineering Champion (TH in attendance)	All day	13 May
10	**Bio-engineering techniques of slope protection** 10.1 Functions of bio-engineering 10.2 Plants and their engineering capabilities 10.3 Nurseries and growing/planting seasons Discussion Session 10.4 Bio-engineering application 10.5 Slope maintenance strategies 10.6 Field demonstrations	All trainers led by Forester Champion (TH in attendance) XP	09:00 12:00 12:00 12:30 14:00 15:30 15:30 17:00	14 May
11	**Integrated Slope Stability Management** 11.1 Pro-active measures reduced cutting angles, wall foundation controlled spoil disposal, slope drainage, scour protection, bio-engineering	All Trainers led by Civil Engineering Champion (TH in attendance)	09:00 10:00	15 May
	Post-Training Examination	XP	10:00 11:00	15 May
	SEACAP 21/004 Terminal Workshop	TH	14:00 15:00	15 May
	Closing Ceremony and Votes of Thanks		15:00 15:30	15 May

NB coffee breaks not included in the above

GH: Gareth Hearn
TH: Tim Hunt
XP: Xayphone Chonephetsarath

Appendix 3 List of Practitioners

Name	Affiliation
Phonexay Panyavouvong	Borlikhamxai DPWT
Souvanh Sengchamphone	Savannakhet DPWT
Kongphet Dalavone	Vientiane DPWT
Veunchay Banthongsay	Houa Phanh DPWT
Vansana Vongphouvanh	Champosak DPWT
Somchith Kounmysay	Phongsaly DPWT
Thongsouk Aphaiyalath	Attapeu DPWT
Saybandith Singsakda	Bokeo DPWT
Xaisack Sisoulath	Khammoun DPWT
Thongphet Chandyphit	Luang Prabang DPWT
Karakanh Phetsomphou	Sekong DPWT
Vannalath Mahaxay	Nakorn Luang DPWT
Mixaysack Sukhaseum	Xieng Khoung DPWT
Sonephet Sopha	Sayaboury DPWT
Sai Xaybounheuang	Oudomxay DPWT
Sithon Vongchankham	Luang Namtha DPWT
Phounone Kayyallath	Salavane DPWT
Bouakeo Chanthepha	TED/DOR/MPWT
Khamphet Savangsengouthai	LRD/DOR/MPWT
Somephachanh Syvongdao	RAD/DOR/MPWT
Kittisack Phommavongsy	PTTC/MPWT
Phosaysy Kongsaysy	LTEC
Bounthavy Silipon	LCG

Appendix 4 Results of Examinations

Results are graded A (80-100%), B (60-80%), C (40-60%) and D (20-40%).

Trainer examinations

Examination	Grade			
	A	B	C	D
Pre-training				7
Post-training		1	4	2

Participant examinations

Examination	Grade			
	A	B	C	D
Pre-training		4	19	
Mid-training		*12*	*10*	
Post-training		10	12	1

Notes

1. The pre-training exam questions for the trainers were identical to the pre-training examination for the Practitioners.
2. The post-training exam questions for the trainers were identical to the mid-training examination for the Practitioners.
3. The post-training examination for the Practitioners was set mainly by the trainers towards the end of the Practitioners training programme.
4. The mid-term training exam was set as a group, and therefore there was a degree of discussion between Practitioners. The key comparison is therefore the results of the pre and post exams.

The Trainers also set their own questions at the end of the Practitioner training and the results to these are given below.

Examination	Grade			
	A	B	C	D
Post-training Trainer Qs	13	5	3	2

Appendix 5 Results of Practitioner Questionnaire (14th May 2009)

1. What do you think about the length of the course?

Too long?	Satisfactory?	Too short?
35%	52%	13%

2. Was the course:

Very interesting?	Interesting?	Boring?
63%	37%	

3. Were the lecture room and its facilities:

Good?	Satisfactory?	Needing improvement?
29%	42%	29%

4. Did you feel that the presentation material was:

Easy to understand?	Partly easy and partly difficult to understand?	Needing Improvement?
8%	88%	4%

5. Did you think the quality of the lectures were:

Generally good?	Generally satisfactory?	Needing improvement?
38%	58%	4%

6. Was the site visit:

Very interesting?	Interesting?	Not very interesting?
71%	29%	

7. Was the site visit:

Well organised?	OK?	Needing improvement?
65%	35%	

8. Do you think you have:

Learned a lot?	Learned a little?	Not learned anything new?
71%	29%	

9. Do you think that the Slope Maintenance Manual and Site Handbook are going to be:

Very useful?	Useful?	Not very useful?
58%	42%	

10. Do you think the course should be repeated for other Practitioners?

Yes?	Maybe?	No?
92%	8%	

11. How do you think the course could be improved?	No. of comments
Transfer of knowledge on some topics could be improved, trainers should be better prepared	8
Training room could be improved as toilet facilities are too far away/microphone could be provided	4
Trainers should have more practical experience as well as theory in construction who can explain things more clearly.	2
There should be exercises set after each session for practice and review	2
Should be more opportunities for discussion of real problems encountered	6
There should be new ideas to improve safety and reduce budget requirements	1
Handouts should be provided with the training sessions	6
Hours of training should be 8:30 – 11:30 and 13:30 – 16:30	1
Should be more site visits to look at real problems	1
Training should have follow-up	1
Detailed training timetable should be available	2
Time allocation could be better for each topic	1

12. a) Which subjects would you have liked covered in greater detail? b) How do you think this could be done?	No. of comments
a)	
Design of reinforced concrete structures	4
Foundation design	1
Slope stability inspections/assessments	3
Soil stability/lateral pressures/erosion	3
More details on retaining walls/structures	7
More actual site related topics/examples	4
b)	
More exercises	1
Training could have more examples and practical implementation	1
More time for design in training sessions	1
Continued training/time extension	4

Appendix 6 Selected Photographs

DIFD project manager addressing Practitioners

Training session in progress

Site visit instruction from Sengmany Sysouvanthong

Site visit at km 254, Road 13N to inspect slope remedial works

Practitioners with Minister of Public Works and Transport (green in green)

Bio-engineering demonstration