

## **PROJECT ANNEX #2**

**Title:** **Experimental Studies of Landslides at Selected Sites in China** (hereinafter referred to as the "Project")

### **1. AUTHORITY**

This is a Project Annex (hereinafter referred to as "Annex") pursuant to and subject to the Memorandum of Understanding ("MOU") signed at Beijing on the 20<sup>th</sup> of January, 2005, between the Ministry of Land and Resources of the People's Republic of China (hereinafter referred to as "MLR"), and the Department of Natural Resources of Canada (hereinafter referred to as "NRCan"), hereinafter jointly referred to as the "Parties". This Annex is developed in accordance with section 2 of the MOU.

### **2. SCOPE**

To collaborate on a study of the application of remote sensing technology to further the understanding of landslide hazards for loss reduction purposes.

### **3. BACKGROUND**

MLR, through the China Geological Survey (CGS) has started a two-year experimental program at three landslide sites in central China for landslide monitoring and testing of various technologies. CGS has installed instruments at the sites for slope movement monitoring. The experiments, if successful, are expected to be implemented to about 200,000 km<sup>2</sup> of active landslide areas in China. NRCan, through the Earth Sciences Sector (ESS), has been using remote sensing technology for experimental landslide studies and including in remote permafrost regions. It is expected that the results of this Project will ultimately benefit both Parties understanding of landslide processes and contribute to natural hazard loss reduction in both countries.

### **4. OBJECTIVE**

The Parties will develop a prototype model for landslide monitoring and analysis based on data received from selected landslide sites in China (see detailed Work Plan attached as "Appendix A"). Specific objectives of the Project are as follows:

- i. to mutually undertake field visits to the experimental sites to evaluate site conditions;
- ii. to mutually prepare a scientific proposal that incorporates current knowledge on the selected landslides sites and state-of-the-art technologies that address research needs; and
- iii. to mutually identify further potential collaboration with funding organizations, working organizations, community based organizations for implementing prototype model to other landslide areas.

The proposal (4. ii above) will outline Phase 2 (technical feasibility and implementation) and will be based on the results of the Project. The goal is to develop this proposal for implementation of

the prototype model developed for use in attracting potential funding from international development agencies with the support of the Governments of China and Canada.

## **5. PROJECT COORDINATION**

### **a) NRCan participation:**

The responsible unit shall be the Natural Hazards and Emergency Response Program of the Earth Sciences Sector (ESS) of NRCan and the ESS Project Coordinator shall be:

Peter Bobrowsky  
Head, Canada Landslide Loss Reduction Project  
Earth Sciences Sector  
Natural Resources Canada  
601 Booth Street  
Ottawa, ON  
Canada K1A 0E8

Tel. : (613) 947-0333  
Fax : (613) 992-0190  
E-mail: Peter.Bobrowsky@nrcan-rncan.gc.ca

### **b) MLR participation:**

The responsible unit shall be the Department of Hydrogeology and Environmental Geology of the China Geological Survey (CGS) of MLR and the CGS Project Coordinator shall be:

Yin Yueping  
Director of the Department of Hydrogeology and Environmental Geology  
China Geological Survey (CGS)  
Ministry of Land and Resources of China  
24 Huangsi Dajie, Xicheng District  
Beijing, 100011  
People's Republic of China

Tel.: (86-10) 5163 2809  
Fax: (86-10) 5163 2863  
E-mail: yyueping@cgs.gov.cn

## **6. ADMINISTRATIVE ARRANGEMENTS GOVERNING ESS AND CGS PERSONNEL**

The Parties shall assign personnel to activities under the Project in accordance with applicable laws, regulations, and policies of their respective countries.

## **7. FINANCIAL ARRANGEMENTS**

- a) Unless otherwise indicated in this Annex or agreed to in writing by the Parties, both Parties will be responsible for their own expenses and costs incurred as a result of this Project.

- b) CGS will pay all costs relating to local activities in China (including accommodation and local transportation expenses for ESS personnel), excluding per-diem.
- c) Each sending Party shall continue to pay the salary of each visiting scientist for the duration of the visit.
- d) Medical expenses will be the responsibility of each Party or their personnel.
- e) Where appropriate, each Party shall provide research facilities and assistance for visiting scientists. Before proceeding with an exchange of scientists, the Parties will be required to sign a specific agreement to this effect.

## **8. INTELLECTUAL PROPERTY**

- a) The Parties shall retain ownership of their existing Intellectual Property that they bring to the Project. Intellectual Property arising out of the Project or resulting from activities conducted under this Annex shall be jointly owned by the Parties.
- b) For the purposes of this Project, Intellectual Property refers to all rights in any information including, without limitation, data, techniques, methods, processes, know-how, inventions, designs, formulae, photographs, drawings, plans, specifications, reports, studies, technical and procedural manuals and computer programs, and all patents, copyrights, trademarks, and industrial designs arising there from.

## **9. PUBLICATION/COMMUNICATIONS**

Publications and public communications related to the Project shall be made in a spirit of collaboration, with consultation and participation by both Parties. All publications and public communications relating to the Project shall acknowledge the contribution of NRCan and MLR.

## **10. TITLE TO PROPERTY**

Any property or equipment of whatever nature or kind furnished by any Party in connection with work under this Project is and will remain the property of the Party furnishing such property or equipment.

## **11. INDEMNIFICATION AND LIABILITY**

- a) Each Party shall indemnify and save harmless each other and their Ministers, officers, employees and agents from and against all claims, demands, losses, costs including lawyers fees, damages, actions, suits or proceedings, that are in any manner based upon, arising out of, or attributable to any wilful misconduct or negligent acts or omissions of their employees and agents relating to activities conducted under this Annex.
- b) The products/services provided by the Parties are provided on an "as is" basis and neither Party makes any guarantees, representations or warranties respecting these products/services, either expressed or implied, arising by law or otherwise, including but not limited to, effectiveness, completeness, accuracy, or fitness for a particular purpose.
- c) Neither Party shall be liable in any way for loss of profits or contracts, or any other consequential loss of any kind relating to the Project.

## **12. DISPUTE RESOLUTION**

Any disputes regarding the interpretation or implementation of this Annex will be resolved only by consultation among the Parties and will not be referred to a national tribunal or other third party for settlement.

## **13. DURATION AND TERMINATION**

- a) This Annex will remain in effect until June 30, 2008. It may be amended at any time with the mutual written consent of the Parties and may be terminated immediately upon the written consent of both Parties or by either Party upon ninety (90) days written notice to the other Party.
- b) Each Party shall immediately upon early termination, return the other Party's papers, materials, or other property held for the purpose of carrying out the Project.

## **14. RESPONSIBLE AUTHORITIES AND EFFECTIVE DATE**

This Annex becomes effective upon the signing below by the Parties designated responsible authorities.

Signed in Beijing this 17 day of November, 2005.

Accepted on behalf of ESS by:

Accepted on behalf of CGS by:

Murray Duke  
Director General  
Geological Survey of Canada  
Earth Sciences Sector  
Department of Natural Resources

\_\_\_\_\_  
Peng Qiming  
Director  
Department of Science and Technology &  
International Cooperation  
China Geological Survey  
Ministry of Land and Resources

## Appendix A:

### PROPOSED WORK PLAN FOR THE EXPERIMENTAL STUDIES OF LANDSLIDES AT SELECTED SITES

#### **1. Technical Background**

##### **A. Geoscience Issues**

- i. Monitoring landslide movement. Timely monitoring is critical for landslide loss reduction. It is often difficult due to location, spatial, time and economic constraints.
- ii. Developing warning systems. A warning system is an important component of any landslide loss reduction effort. The reliability of a warning system depends on the level of understanding of landslides. In order to develop a reliable warning system, various investigation and monitoring systems are needed.

##### **B. Risk Management Issues**

- i. Land use planning. Understanding landslides helps to improve land use planning. Understanding landslides has direct implication to understanding risks associated with landslides. It helps to facilitate environmental impact review of major infrastructure projects and contribute to loss reduction. Many infrastructures and buildings are being constructed in adjacent to or within landslide zones in China. Some major infrastructures are being developed across landslide prone regions in Canada, e.g., northern pipelines. Improvement on landslide monitoring is expected to enhance our capability of understanding landslides and hence improve land use planning in both countries.
- ii. Risk management strategies. Methodologies adopted to address the geosciences issues at selected sites, if successful, are expected to be implemented to other landslide prone regions in both countries. It will help to improve risk management strategies.

#### **2. Project Activities (conducted jointly by the Parties):**

##### **A. Preliminary Test Case (Phase 1)**

Objective: To develop a prototype model for landslide monitoring and analysis. To evaluate conditions of the selected landslide sites. To monitor landslide activities using field information, conventional and advanced technologies.

Method: Field visit will be conducted to landslide sites in China. CGS has installed instruments at selected landslide sites to monitor landslide activities. Instruments installed will be reviewed during site visit. Ground conditions will be examined for assessment of suitability of remote sensing technologies. Satellite data of the sites will be acquired and analyzed. Remote sensing results will be compared with in-situ measurements.

Specific tasks to be accomplished through the field test case will include:

- i. Visit study area to appreciate geotechnical, geological and other related issues.  
(CGS will arrange for transportation to field)
- ii. Undertake field works to install ground monuments if necessary for monitoring of slope movement from satellite.

*(Materials, equipment and installation will be provided by CGS whereas remote sensing data will be responsibility of ESS)*

- iii. CGS send and financially support a visiting scientist to work at ESS on geo-hazards for six months. *(This will require the parties to sign a visiting scientist agreement.)*
- iv. Initiate remote sensing data acquisition and analysis to detect slope movement. *(Data acquisition and analysis will be ESS's responsibility. CGS visiting scientist to ESS will work on remote sensing data analysis in collaboration with ESS staff on the test cases in China and some remote sites in Canada.*
- v. Collect and analyze in-situ monitoring data of slope movements. *(CGS is responsible for in-situ data acquisition and analysis)*
- vi. Compare results from remote sensing data analysis and those from in-situ measurements. *(CGS to provide in-situ monitoring data, ESS to provide remote sensing results)*
- vii. Discuss successes/limitations of proposed work.
- viii. Discuss the important scientific issues.
- ix. Discuss warning and remediation possibilities.
- x. Discuss other areas of potential collaboration.
- xi. Draft report of test results.

#### **B: Proposal Development**

Objective: To develop a proposal on implementation of the prototype model evaluated at the test sites to other landslide prone areas in China (Phase 2). Canada will also learn from the prototype application and benefit from the implementation, e.g., satellite sharing for increased frequency of data acquisition and data resolution.

Method: Discussions will be conducted during the field-trip and during execution of the Project with the aim of developing a proposal for Phase 2 (technical feasibility and implementation phase) for use in attracting potential funding from international development agencies with the support of the Governments of China and Canada.

The specific task to be accomplished is a draft proposal for the technical feasibility and implementation (Phase 2). Approval by both Parties to proceed to Phase 2 will be contingent upon the mutual agreement of the:

- a) results from Phase 1;
- b) proposal for Phase 2; and
- c) availability of funds/resources.

#### **C: Development of Further Collaboration**

Objective: To develop further collaboration with funding organizations, service providers, etc.

Methods: Both Parties will carry out preliminary consultations with stakeholders and potential funding organizations for the proposed Phase 2 (technical feasibility and implementation).

Develop contacts with other scientific organizations that will enhance our capacity to prepare a successful proposal and conclude the objectives of the research.

Solicit input from service providers in Canada and in China who could develop business opportunities through this Project.

### 3. Project Schedule/Activities or Deliverables:

The Project commences on signing of the Annex and is scheduled to end on June 30, 2008. The following Table shows specific deliverables from this Project together with the expected date of delivery.

<b>Deliverable or Activity</b>	<b>Schedule or date of delivery</b>
Formal announcement (in Beijing, China) of the project initiation	November, 2005
CGS provides coordinates selection of sites for satellite data acquisition	February 2006
Collection of remote sensing data for selected sites in China	February 2006 - August 2006
Field visit to selected landslide sites in China	June 2006
CGS provides in-situ measurements of slope movement of selected landslide sites	July -August 2006
Install field bench marks if necessary for satellite monitoring of slope movements	July-September 2006
ESS acquires remote sensing data and conducts data analysis with a certain interval of time and comparison of results with in-situ measurements.	September 2006- September 2007
Visiting scientist from CGS to ESS. Participates in acquirement and analysis of data from selected sites from China and Canada	September 2006 – November 2006
Report of results from studies	December 2007
Progress report on technical feasibility and proposal for further broader implementations	January – February 2008
Final report	May 2008

### 4. Project Team

A team composed of personnel from Canada and China will undertake the Project. The following Table shows the names of the members together with an estimate of allocated days to the Project.

<b>Canada's Estimated Personnel Expenses</b>		<b>China's Estimated Personnel Expenses</b>	
<b>Name of Participant</b>	<b>Days</b>	<b>Name of Participant</b>	<b>Days</b>
P. Bobrowsky, NRCan/ESS	40	Y. Yin, MLR/CGS	20
B. Wang, NRCan/ESS	40	Z. Zhang, MLR/CGS	20
V. Singhroy, NRCan/ESS	40	X. Li, MLR/CGS (to visit NRCan)	90
R. Couture, NRCan/ESS	20	D. Wu, MLR/CGS	20
K. Molch, NRCan/ESS	60	W. Zheng, MLR/CGS	20
G. Robichaud, NRCan/ESS	20	M. Zhang, MLR/CGS	20
		H. Chen, MLR/CGS	20
<b>Total personnel days</b>	<b>220</b>		<b>210</b>