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Estimating Landslide Losses—Preliminary Results of a Seven-State Pilot Project

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Estimating Landslide Losses—Preliminary Results of a Seven-State Pilot Project

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Introduction

In 2001, the U.S. Geological Survey Landslide Hazards Program provided funding for seven State geological surveys to report on the status of landslide investigation strategies in each of their States, and to suggest improved ways to approach the tracking of landslides, their effects, losses associated with the landslides, and hazard mitigation strategies. Each State was to provide a draft report suggesting innovative ways to track landslides, and to participate in subsequent workshops. A workshop was convened in June 2003 in Lincoln, Neb., to discuss the results and future strategies on how best to incorporate the seven pilot projects into one methodology that all of the 50 States could adopt. The seven individual reports produced by the State surveys are published here to put forth a forum for discussion of the varying methods of tracking landslides. The goal is to eventually adopt a single, universally applied methodology to track landslides that will provide a consistent framework for collecting data on landslide damage and economic impact. Participating States include: California (James Davis, Jack McMillan); Kentucky (Jim Cobb, John Kiefer, John Rockaway); Nebraska (Mark Kuzila, Duane Eversoll); Ohio (Thomas Berg, Jon Rockaway), Oregon (John Beaulieu, Yumei Wang, Renee Summers, Jon Hofmeister); Pennsylvania (Jay Parrish, Helen Delano); Utah (Richard Allis, Francis Ashland). The USGS personnel involved in the planning and meeting facilitation are Paula Gori, Peter Lyttle, and John Pallister.

The general USGS strategy to address landslide loss reduction was developed with input from State geological surveys, the engineering-geology consulting community, and academic investigators. The strategy was reviewed by the National Research Council, 2004), is summarized in USGS Circular 1244 (Spiker and Gori, 2003) and is endorsed by the AASG.

This pilot study, conducted by seven State geological surveys, examines the feasibility of collecting accurate and reliable information on economic losses associated with landslides. Each State survey examined the availability, distribution, and inherent uncertainties of economic loss data in their study areas. Their results provide the basis for identifying the most fruitful methods of collecting landslide loss data nationally, using methods that are consistent and provide common goals. These results can enhance and establish the future directions of scientific investigation priorities by convincingly documenting landslide risks and consequences that are universal throughout the 50 States.

This report is organized as follows**:** A general summary of the pilot project history, goals, and preliminary conclusions from the Lincoln, Neb. workshop are presented first. Internet links are then provided for each State report, which appear on the internet in PDF format and which have been placed at the end of this open-file report. A reference section follows the reports, and, lastly, an Appendix of categories of landslide loss and sources of loss information is included for the reader's information.

Please note: The Oregon Geological Survey has also submitted a preliminary report on indirect loss estimation methodology, which is also linked with the others. Each State report is unique and presented in the form in which it was submitted, having been independently peer reviewed by each respective State survey. As such, no universal "style" or format has been adopted as there have been no decisions on which inventory methods will be recommended to the 50 states, as of this writing. The reports are presented here as information for decision makers, and for the record; although several reports provide recommendations on inventory methods that could be adopted nationwide, currently no decisions have been made on adopting a uniform methodology for the States.

Background and Rationale for Development of the Seven State Geological Survey Pilot Projects

The State geological surveys employed insights from an AASG-sponsored survey in 1999 and 2000, which asked the 50 States to submit reports of their landslide losses from the El Nino winter of 1997 – 1998. Twenty-nine States reported that landslides were among the top three geologic hazards in their jurisdictions. Of the 47 States that responded to the question on collection of landslide damage data for their States, 39 reported that no systematic collection was being done, six States were unsure, and two States had some form of landslide damage information reporting system in place. The common obstacles to loss estimation include: nonstandard collection methodology, lack of a centralized data repository; lack of standard loss and landslide terminology, reluctance of property owners and others to reveal loss information; and absence of insurance claim adjustment information because landslide damage is generally not covered in private insurance policies. The AASG surveys also indicated that landslide hazard information is not available for many landslide-prone areas within their jurisdictions and that landslide hazards are poorly understood in many areas. Where landslide hazard information is available, apparently it is often not used in land-use policies and (or) development. A final summary of the results of the 50-State survey/questionnaire has not been officially published as of this writing, but the findings suggest that many State geological surveys are interested in coming up with a universal inventory methodology. Improving the estimation of landslide damage loss costs is an important objective for the Landslide Hazards Mitigation Strategy (Spiker and Gori, 2003). Improved documentation would increase public awareness of the risk associated with landslides, and aid in the adoption of mitigation strategies. State geological surveys in California, Kentucky, Nebraska, Ohio, Oregon, Pennsylvania, and Utah volunteered to participate, by submitting inventory methodologies.

The Importance of Accurate Landslide-Loss Estimation

In addition to accurate landslide inventories, the importance of tracking accompanying monetary losses more accurately frames the economic impact of landslide hazards. The annual expected economic cost of landslide damage in the United States has been estimated in a number of nationwide studies of landslide hazards (National Research Council, 1975; Schuster, 1978; Wiggins and others, 1978; Fleming and Taylor, 1980; Schuster and Fleming, 1986). A discussion of the history and application of landslide loss estimation can be found in Schuster (1996). The past estimates have been, in general, very qualitative and not well-documented. Landslide hazards, as defined in this investigation, present problems to property and public safety in all 50 States. Landslide monetary losses are also not generally systematically or comprehensively investigated by most of the State geological surveys. Yet it is well established that

appropriate use of the knowledge of landslide movement processes and awareness of the geographic distribution of landslide hazard potential, including loss estimates, can contribute to efforts to avoid putting unprotected structures in harm's way. As far as collective monetary loss estimates for all landslides in the United States, a 1985 National Research Council report estimated the average annual cost of landslides in the United States to be between $1 and $2 billion dollars. This figure, adjusted for inflation, would be $1.7 – $3.6 billion in 2004 dollars. This estimated figure is a qualitative estimate with significant uncertainty. Assuming a constant dollar value as urban development continues, this figure grows every year.

Content of Individual State Reports

Each State geological survey investigation provides information on five topics:

- Potential sources of landslide loss data;
- Extent of standardization of landslide loss data;
- Availability and accessibility of landslide damage losses by source;
- Distinctions between direct and indirect landslide losses;
- Conclusions.

In addition, several investigations include information that can provide insights towards the development of a national landslide hazards mitigation policy:

- Questions raised for landslide damage loss estimation;
- Next steps to advancing understanding;
- Recommendations for further action.

Preliminary Conclusions by Pilot Study Participants

The following conclusions are based on discussions at the first project meeting, held in June 2003, in Lincoln, Nebraska.

1. Data on highway and public utility repairs are generally available

    - Past data are generally labor intensive to retrieve;
    - Loss data are sometimes absorbed into general maintenance costs, where it becomes cost-of-maintenance data rather than loss data.

2. Data are not generally available for nondisaster event recovery periods;

    - Disaster pay out for direct cost replacement and repair may be available from Federal and State emergency management agencies as well as local governments;
    - The content of loss records kept by emergency management agencies is generally limited to eligibility for disaster assistance;
    - Concerted efforts to conduct studies by devoting personnel, time, and funding can generally be fruitful; however they take long periods of time to compile because loss data usually become available only after periods of several months and, in some cases, many years. A USGS report on landslide losses from the Nisqually, Wash., Earthquake of 2001 (Highland, 2003) is one exception, as resources were allocated to compile an extensive report within a short period of time. The report, USGS Open file Report 03-211, is available as a paper report or online at:

http://pubs.usgs.gov/of/2003/ofr-03-211/.
This publication has extensive appendices on detailed landslide loss compilations, photographs, and loss-estimation methodology.

3. Record keeping of loss data is most extensive by local governments in urban areas where ordinances require permits for reconstruction

- Those records that are kept commonly are only of direct costs;
- The records are associated with issuance of rebuilding, repair, or grading permits associated with landslide damage;
- Record keeping is most complete in communities in which certain staff have developed a personal interest in tracking landslide damage losses.

4. Where record keeping exists it is not standardized

- Categories of direct costs, for example, slope stabilization, structural repair, and so forth, are not systematically separated from each other during recording;
- Secondary direct costs, such as geotechnical investigations for remediation, mortgage-company losses on destroyed structures, and so forth, may be kept by different parties than those who keep the direct costs.
- Indirect costs, (such as, business interruption and other economic consequences of landslide damage), may only be available by post-event economic surveys and analysis by the business community.

5. Summary conclusions about landslide loss data

- It is very labor intensive to retrospectively collect loss data from any of the identified sources. Use of information technology in future record keeping may provide a practical means of retrieving landslide loss data if the information is coded as it is recorded. A considerable amount of time, money, and personnel would have to be devoted to loss data collection, at least until methods are streamlined;
- Media sources of cost data are generally incomplete and not systematic or reliable. However, many media outlets publish special reports from time to time that review data and knowledge about an incident.
- Due to copyright issues and privacy concerns, consulting firms are not a practical source of extensive landslide cost data. However, these sources are not to be ruled out, as permission to use private and copyrighted data is sometimes granted, or in some cases can be purchased for a fee.
- A standardized approach to landslide loss inventory would reduce the cost and improve the usability and availability of landslide loss information.

Pilot Project Questions

This section is a summary of still unanswered questions posed by pilot study participants that will help define the future goals and methods needed to address the challenges of collecting and analyzing landslide loss data. One of the primary questions is to decide which inventory/loss data methodology would

be best for all 50 States. Possibilities include that (a) one of the Pilot Project proposals be adopted, or (b) aspects of several could be consolidated into one, universally adopted methodology. One suggestion was to decide on one or two methodologies or composite methodologies and test them "in the field," and later critiquing the ensuing pros and cons at the end of a designated period of time. After these evaluations, it would likely be up to one unifying entity, such as the AASG to facilitate the adoption of the chosen methodology(s) by all 50 States. It would be best to reach a consensus on the type of adoption of a methodology, for example by a committee making recommendations and (or) by a vote by a representative of each State geological survey. The group discussed the acquisition of secondary direct costs and indirect costs, and whether these second-tier investigations would be cost-effective and/or useful. Other concerns were whether State geological surveys could work with local governments in landslide-prone areas to establish cost-effective means of retrieving loss data associated with future events, especially by employing new technology such as advanced Geographic Information Systems (GIS) for construction permit approvals, and so forth. There was discussion as to what would be the most effective means be to collect secondary and indirect loss data from private sector entities such as financial institutions, consulting firms, etc. A final question posed is whether there is a practical means to standardize and collect damage cost data from Federal and State land-management institutions using new information technology, and what entity would be the keeper of state data bases. Participants suggested that the U.S. Geological Survey might be a logical repository for all the State geological survey landslide inventory and loss data, and the question would remain as to how this effort would be funded and managed.

Next Steps and Recommendations Suggested by Pilot Study Participants

1. Conduct a national workshop including AASG pilot State participants and their studies, representatives of some of the other State geological surveys with landslide-prone areas in their jurisdictions, representatives of State departments of transportation, USGS landslide program managers, and investigators and specialists from the consulting geological engineering, academic research, financial, and land-use planning communities to address the open questions from the pilot project. Possibly, a test case, or pilot methodology, would be agreed upon and would be put forward as a test of effectiveness. An evaluation would follow the pilot project implementation.

2. Begin implementation of recommendations developed in the workshop that would also serve as part of the design and future goals of The National Landslide Hazards Mitigation Strategy's future vision, for working with State geological surveys..

Internet Addresses for Accessing Each Pilot Study State Report

State Geological Survey Landslide Loss Reports on the Internet/World-wide Web
(In PDF Format)

California: http://pubs.usgs.gov/of/2006/1032/pdf/California.pdf
Kentucky: http://pubs.usgs.gov/of/2006/1032/pdf/Kentucky.pdf
Nebraska: http://pubs.usgs.gov/of/2006/1032/pdf/Nebraska.pdf
Ohio: http://pubs.usgs.gov/of/2006/1032/pdf/Ohio.pdf
Oregon: http://pubs.usgs.gov/of/2006/1032/pdf/Oregon1.pdf
Second Oregon Report on Indirect losses: http://pubs.usgs.gov/of/2006/1032/pdf/Oregon2.pdf
Pennsylvania: http://pubs.usgs.gov/of/2006/1032/pdf/Pennsylvania.pdf
Utah: http://pubs.usgs.gov/of/2006/1032/pdf/Utah.pdf

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Spiker, E. C., and Gori, P. L. 2003, National landslide hazards mitigation strategy -- A framework for loss reduction: U.S. Geological Survey Circular 1244, online version: http://pubs.usgs.gov/circ/c1244/.

Wiggens, J.H., Slosson, J.E. and Krohn, J.R., 1978, National hazards—Earthquake, landslide, expansive soil loss models, Redondo Beach, California Technical Report, J.H. Wiggins Co.

It should be noted here that the State of Utah, in its analysis, identified a category of “secondary” direct costs that are proposed to be distinct from direct and indirect costs. As of this writing, there is no generally accepted “secondary” classification for indirect loss data--this aspect of Utah’s analysis may be controversial, but worth discussing at some future point in time.

Appendix

This section presents an introduction and short summary describing the types and sources of landslide loss data, that are generally available throughout the United States. For a more comprehensive discussion of losses, the reader should consult publications on losses in the reference section of this report. Highland's Nisqually Earthquake Open-File Report (2003) presents a very thorough discussion of landslide loss data collection methodologies in its appendices.

Comparison of direct and indirect landslide losses

Direct costs are the repair, replacement, or maintenance resulting from damage to property or installations within the boundaries of the responsible landslides or from landslide-caused flooding (Schuster, 1996). All other costs of landslides are indirect.

Some examples of indirect landslide losses are:

1. Loss of industrial, agricultural, and forest productivity and tourist revenues as a result of damage to land or facilities or interruption of transportation systems;
2. Reduced real estate values in areas threatened by landslides
3. Loss of tax revenues on properties devalued as the result of landslides;
4. Steps taken to prevent or mitigate additional landslide damage;
5. Adverse effects on water quality in streams and irrigation facilities outside the landslide;
6. Loss of human or animal productivity because of injury, death, or psychological trauma;
7. Secondary physical effects, such as landslide-caused flooding, for which losses are both direct and indirect.

Indirect costs may exceed direct costs; unfortunately, most indirect costs are difficult to evaluate and thus are often ignored or, when estimated, are often overly conservative (Highland, 2003).

Information for landslide damage costs include both public and private sources. General conclusions from the pilot project concerning sources are presented in the following two sections.

Public Sources of Landslide Loss Data

Federal Land Management Agencies: examples include the Bureau of Land Management (BLM), National Park Service (NPS), and United States Department of Agriculture (USDA).

- Loss data are usually only available for severe damage events;
- Landslide damage loss data are difficult to separate from other types of damage data.
- Public agencies are not necessarily required to track natural hazard damage costs, and at times categorize such costs as "general maintenance."

Federal Emergency Management Agency (FEMA)

- Loss data are generally only available for declared disaster events;
- Loss data are incomplete because only a portion of the data from these events are available from FEMA damage payout records. This is because a significant segment of the total losses are not eligible for FEMA reimbursement and (or) are covered by private insurance policies, making such data difficult to retrieve;
- Damage loss data are not recorded in a standardized format;
  Indirect damage losses may not be tracked, or be available. There are generally no uniform FEMA regulations to collect and track these types of data, and Disaster Field Offices, set up in areas of disasters to facilitate rapid FEMA response, do not always have uniform requirements for data collection;
- Landslide damage loss data are often difficult to separate from other types of damage data, such as clean-up and repair of damaged structures.

State Highway Departments

- Some landslide-loss data in many States are retrievable and are used in future-year budget projections;
- Many landslide costs are blended with "general maintenance" costs, and are not easy to extract from the totals.

State Emergency Management Agencies

- States may co-administer FEMA reimbursements for declared disasters, requiring cross-checking of costs. This may be difficult if accounting procedures are different for each entity;
- Damage loss data are not standardized;
- Indirect damage losses may not be available, as indirect costs are not easily tracked and may be expensive to investigate.

Local Governments

- Landslide damage loss data from road and street repairs are the most generally available information;
- Local governments in some landslide-prone urban areas keep landslide damage loss records separate from other data—for example, landslide costs could be merged with storm or flood damage data, and not itemized as damage due to landslides;
- Landslide loss data are most useful and complete for municipalities where certain staff members have personal interest in landslide damage. This interest may not endure through subsequent changes in personnel, and thus tracking may not be consistent over time;
- Building and grading permitting requirements for repair, remodeling, and replacement of damaged structures are the most complete sources of landslide damage loss data;
- Landslide loss data are difficult to separate from other types of storm or flood damage data.

Private Sources of Landslide Damage Loss Cost Data

Media Accounts

- Several States tallied media accounts of significant events in which landslides contributed to the damage losses;

- Utah compared landslide property damage tallies from the print media for specific disasters with other sources, including local government records, and found that media tallies are the least reliable;
- The categories for summarizing landslide loss information, such as size, triggering mechanism, and geologic materials, are not standardized;
- Secondary and indirect losses are often not reported and (or) mentioned in media accounts, which otherwise are fairly reliable to use as sources of information.

Engineering and Geotechnical Firms

Several States explored the availability of damage loss data from consulting firms

- Data are dispersed and difficult to assemble for a community or region; therefore, records are often incomplete;
- Secondary direct loss data and indirect loss data are not generally available;