Landslide Loss Estimation Pilot Project For Pennsylvania

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INTRODUCTION TO PENNSYLVANIA LANDSLIDES

Most of Pennsylvania is at least somewhat susceptible to landsliding. Southwestern Pennsylvania, and especially the area around Pittsburgh is well documented to have the most sever problems and largest numbers of occurrences. The clay-rich sedimentary rocks and deeply incised valleys of the Appalachian Plateau create the geologic setting for landslides, and the effects of approximately 200 years of industrial and residential development provide many of the classic human triggers for slope failures. The dominant types of landslides in this part of Pennsylvania are slump-earthflows in clay-rich bedrock, colluvium and fill; and rockfalls and mudflows on natural and cut slopes. Individual slides are typically small—a few hundred feet in length and width. Rockfalls and rain-induced debris flows move rapidly, but because they are mostly restricted to locally steep slopes, they tend to affect transportation corridors and streams more than residential and commercial areas. Slump-earthfllows move slowly, but can affect gentler slopes and probably cause more property damage. There is a strong correlation between landslide activity and precipitation, but short-term (Individual storm events) and long term (prolonged periods of greater-than average rainfall). Other parts of Pennsylvania are susceptible to different types and intensities of landsliding, but the concentration of social and economic effects in the Pittsburgh area caused us to decide to form efforts for this project in Allegheny County.

All planning and zoning authority in Pennsylvania is at the local municipal level. County Planning agencies have an advisory and support role, but cannot enact ordinances, or force decisions on local governments. Building and Grading regulation is also at the local level, although a new statewide building code will take effect in 2003. Enforcement will still be at the local level.

Allegheny County, which includes the City of Pittsburgh, has a population of 1.28 million people in 130 separate municipalities. Municipalities range in size from Pittsburgh, at about 335,000, to small boroughs of a few hundred people in less than a square mile. Municipal governments have widely varying resources and staff. Small boroughs and townships may have only a part-time secretary and maintenance crew, with Legal and engineering services are typically contracted. Other municipalities have large staffs including planners and engineers. A few townships have Geographic Information Systems vary widely. The Pittsburgh areas include old urban areas where traditional heavy industries have closed, areas of urban redevelopment and migration of commercial, business and residential development to suburban and formerly rural areas.

Many of the old urban neighborhoods are built on steep slopes above former and current industrial areas on the river terraces and floodplains. Aging infrastructure contributes to landslide problems. Suburban sprawl is pressing on the remaining rural areas, driving development of subdivisions and large commercial development on colluvial slopes that were marginally stable when undisturbed.

METHODS AND SCOPE OF SURVEY

Criteria used for selecting jurisdictions. We relied on our own experiences and discussions with a variety of colleagues and other landslide professionals to target municipalities known to have experienced landslide problems. We attempted to select for a variety of geographic sizes, population sizes, urban/suburban status and economic status, but included several because we believed they had reasonable advanced planning and zoning programs, and were therefore more likely to yield information. We also identified a number of state agencies, organizations and the County government to interview for possible other sources. As an additional data source we explored newspaper archives available over the internet.

Which jurisdictions were contacted

Agencies and organizations:

Dept. of Conservation and natural Resources, Bureau of Topographic and Geologic Survey,
Pennsylvania Dept. of community and Economic Development
Pennsylvania Dept. of Transportation
Pennsylvania Emergency Management Agency
Pittsburgh Geological Society
Pennsylvania Association of Township Supervisors

Local Governments.

Allegheny county
City of Pittsburgh
Carnegie Borough
Crafton Borough
Municipality of Penn Hills Borough
O'Hara Township
Findlay Township
Shaler Township
Wilkins Township

Other

Internet archives of the Pittsburgh Post Gazette, and Pittsburgh Tribune Review group of newspapers.
Discussion with S. Murray Rust III of Montgomery and Rust, a large development and construction firm was useful in suggesting municipalities which address landsliding in planning and permitting.
Discussions with James V. Hamel of Hamel Geotechnical Consultants, and Richard E. Gray, GAI Consultants, Inc. confirmed that in most cases, client confidentiality would limit availability of information from the engineering and geotechnical consulting community.

Methods used for interviews.

In most cases, the interview was a telephone inquiry and discussion with borough or township manager, member of planning staff or secretary. If the municipality has an internet site, it was examined first. Some communities have extensive resources available on the web, including copies of ordinances, permit files, and zoning maps. Others have much less information or not site at all. Our original plans included field visits to local offices to collect specific data, but the general absence of any data to collect changed this part of the plan. In a few cases we attempted to reach municipalities, but could not get phone calls returned. These are not included in the above list.

Newspaper archives were searched using the following terms: Landslide. mudslide, rockslide, rockfall, and geologist. After eliminating the political and sports stories, (approx. 2/3 of the "hits") the stories were copied and saved as text files (or .html files when photos were included). Summary data was compiled in spreadsheet format, eliminating duplicate references to the same events.

Other contacts were in person, by telephone or in the course of other business with an organization.

Data Sources Identified

Previous knowledge

Numerous previous studies have attempted to quantify Pittsburgh area landslide occurrences. Landslide inventory maps prepared by the U.S. Geological Survey in the 1970's identified 300 recent and 12,000 older landslides in Allegheny and Washington Counties. A 1986 PhD dissertation identified over 700 recent and active landslides in Allegheny County. A 1991 list from the PA Department of Transportation tabulated 226 current problem landslides in Allegheny County. None of these included significant information on costs of landsliding.

A U.S. Geological Survey study found that total public and private costs of landsliding in Allegheny County averaged at least $4 million per year from 1970 to 1976. No more recent similar accounting is known, but estimates from the Pennsylvania Department of Transportation are that they spend average of $10 million per year in landslide repair contracts across the state and a similar amount in mitigation costs in grading projects.

Cost information is known for some individual cases. Large contracted projects for the Pennsylvania Dept. of Transportation typically range from $300,000 to $2 million, and at least one reached $4.2 million. Costs to business and industry are largely unknown, but one case involving a ruptured petroleum products pipeline, identified costs of repair of the landslide damage, clean-up of the spill, technical investigations, legal and court costs and environmental fines were approximately $12 million. Landslides on residential properties are commonly repaired incompletely or not at all when estimates for engineering analysis exceed the values of the homes.

State Government agencies

The Pennsylvania Department of Transportation

PennDOT does not specifically track costs of landslides, but they have considerable data that could be compiled. Case specific data on minor maintenance and clean-up is nearly impossible to track, but data exists on total costs.

Information from the Highway Expenditure Analysis Report from the Maintenance Section includes cost code breakouts for the following codes:
7332 – Road Section Restore/Gabions/retaining walls;
7333 – Road Section Restore/Slides, Sinkholes
7341 – Major Slides
7342 – Major Structure Damage
For each of these codes, costs are updated monthly in the categories of Personnel; Materials; Equipment Rented; and Equipment Dept. The basic data comes from Maintenance personnel payroll reports. It is not normally communicated back to Engineering staff, but can't be retrieved.

Large construction and repair projects are generally contracted out, and each has its own contract documentation. Details are not broken out with in each contract for man-hours, equipment and sub-locations, but amounts paid and remaining on each contract are updated regularly.

Separating out extra costs for design and investigation in landslide areas for construction projects may be difficult, but specific major repairs can be individually maintained, and practices may vary from district to district.

Dr. William Adams was working on trying to collect some of this data for the District 11 (Allegheny, Beaver and Lawrence Counties), but has been reassigned, and no one else has continued the project. He shared some preliminary data, which is included below.

Dept. Of Conservation and Natural Resources, Bureau of Topographic and Geologic Survey.

The Pennsylvania Geological Survey keeps files of specific cases we have been asked to investigate, but these rarely include any cost data or follow-up beyond an initial site visit. We have plans to develop a database of our landslide information, but it is still administratively from the Emergency Response agencies in the Department of Environmental Protection, so we get fewer calls to investigate small landslides on private property and on municipal roads.

Pennsylvania Dept. of Community and Economic Development

DCED does not track any information on landslides or their damages. They do work with municipalities on a variety of issues including zoning and building codes. Pennsylvania will have a State-wide Construction Code, but not until next year (2003). At present, both construction codes and zoning codes are unique to each municipality, and vary widely. Some have no codes, some rather comprehensive ones.

Pennsylvania Emergency Management Agency

Landslides are one of many types of incidents that PEMA considers, but they do not get involved in small ones. They do maintain a log of all incidents reported to them. Landslides are classified under Geological Emergencies along with sinkholes, earthquakes and mine-related incidents. In 2002, the number of geological emergencies

Reported ranged from 0 to 6 per month statewide. If a case develops beyond initial reporting, PEMA will have some data, but most landslides don't get into the system.

Local Governments

Allegheny County

The Geotechnical unit of the County Engineering Department is involved in all repairs of landslide damage to County roads and facilities. They have some cost information, but it is in the individual project files and has not been compiled or evaluated.

Municipalities

The information available from municipal governments varies greatly. Municipal public works departments typically do small repairs and clean-up of landslides involving public property and streets, but records would be difficult to extract. Larger projects usually are contracted, or for the City of Pittsburgh become a line-item in the budget. These costs could be collected by searching hard copy files, but no one is tracking them. We identified on township (Findlay Twp.) with digital permit files and a GIS system that collects data on estimated costs of private property repairs and grading, and information on purpose of repairs. They do not presently track costs of landslides, but modification of the database would allow it. Three other municipalities have fields on their permit applications that should provide information, but files are hard copy only and managers were not aware of recent examples.

Other municipalities that were contacted either do not collect cost estimates for grading, d not collect reasons for repairs, or do not require a grading permit. Several of the interviewed people observed that southwestern Pennsylvania has a long history of slides—they are a relatively common occurrence, and the local practice is to "just fix them" (not always in ways an engineering geologist would approve). Although in theory building permits are required for all construction and repair, in practice many repairs are done without permits and little energy is spent on enforcement. As a result, may landslide repairs still occur "off the books" with no possible way to track costs. Businesses and municipalities are more likely to have insurance coverage which will cover some landslide repairs—especially, if liability is demonstrated.

Other

Pittsburgh Geological Society

This professional organization has for many years been active in education and outreach efforts in the Greater Pittsburgh area. Most recently, they have considered ways to use the world-wide web as a resource and vehicle. They have a page on their web site: www.pittsburghgeologicalsociety.org that includes a link to an informal group of individuals willing to share experiences and advice about dealing with landslides. The society intends to provide technical support to the group and track cost and occurrence data they obtain. This is a new initiative as of June 2002, and as yet there have been no results reported.

Internet archives of newspapers

This source provided the best cost and occurrence information of any that we explored. It is certainly not complete, but most large landslides that affect major roads are reported, and many private property slides are covered, especially if local government is somehow involved. Only some newspapers have on-line archives and coverage varies for localities. Smaller newspapers that cover township and borough council meetings provided some of the most comprehensive coverage, but road closings and major slides are widely reported.

FINDINGS FROM SURVEY

Private costs

Actual costs in Allegheny County documented from news reports or local government anecdotal information for the last two years: $650,025 for three events. In O'Hara Township, a threatened home was purchased by the neighbor. Landslide repair costs were approximately $250,000. Legal costs are unknown. In Carnegie, the borough installed a catch basin to drain a slide affecting 3 homes—repairs are expected to cost about $250,000. In Richland Township a developer purchased a new home back from the owners for $150,025 after landslide damage. These costs are known to be incomplete. In addition, two other slides for which no cost data are available are reported to have damaged residences. Several others for which public costs are identified below also involve unknown private costs. A partial list of known damages, with unknown dollar amounts includes costs of moving a house; costs of relocating families to temporary living arrangements; loss of swimming pools and outbuildings; costs to repair drainage on rock cut slope above a restaurant parking lot; changes in property values; and legal costs.

Public costs

Costs to local and state government in Allegheny County identified from news reports for the last two years were $1,105,400. These include:

Baldwin Borough: engineering reports and repairs to stabilize Doyle Road and Private property above road: $225,000. The road was partially closed for approximately one year.

Baldwin Borough: initial repair of Cathell Road Landslide $6,000. Repair of subsequent failure: $50,000.

City of McKeesport: purchase and razing of $15,400 home damaged by slide. Soil removal from three yards, $35,000. No information on costs to relocate three families for several months. Paid by city's insurance company. City has revised its policy on dumping by city employees.

Shaler Township: Purchase of damaged home $35,000. Clean up and repairs to township park $417,000. Park closed to public for 4 years. Unknown cost to purchase second house lot. Unknown private costs.

Wilmerding Borough: Road closure requiring 3 to 5 mile detour. County paid $37,000 to contractor, the National Guard provided assistance with labor. Slide was on land which the county, borough and school district had taken title to for non-payment of taxes.

Crafton Borough has budgeted 55,000 for repair and upgrade of roads in FY2002.

City of Pittsburgh and the state shared $30,000 cost to repair Frankstown Road, which had been closed for 3 years.

PennDOT contracted for $200,000 in scaling of the rock cut slope above Rt. 28 in Harmar Township.

In addition, news reports identified 7 other events which closed roads in Allegheny County for extended periods and several which were cleaned up in less than a day.

News reports identified 10 other instances of landslide road closings and r repair in other counties in southwestern Pennsylvania. These ranged from volunteers repairing a damaged hiking trail in a state park to a $1.28 million repair of a state road in Greene County that will close the road for 9 months. Most provided no cost information and involved road closures of a few weeks. One report of a railroad closed by rockfall involved an injured employee and 3 tracks closed for 1 to 3 days.

Highway loss estimates

From PennDOT, District 11 (Allegheny, Beaver and Lawrence Counties): partial totals for FY 2001 (through June) are $394,247 for in-house landslide related maintenance. The maintenance costs break out as: restoration of road section from slides and sinkholes, $104,596, restoration and repair of gabions and retaining walls $132,598, Major slides, $156,086 and Major structure damage, $967. Expenditures in the same time period on three major contracted projects total $1,585,723. The total is just short of $2 million for 3 counties for 11 months.

A news report quoted a representative of District 12 (Washington, Westmoreland, Fayette and Greene Counties) saying that they repair 30 to 50 landslides a year, but no cost information is available.

LIMITS AND OPPORTUNITIES

At present it seems that there is little potential for uniform, systematic collection of information on local landslide occurrences in Pennsylvania. More data is becoming available, and this trend can be expected to continue; but most areas have incomplete data, data is mostly in hard-copy only, and the degree of attention varies greatly. Property values across Allegheny county also vary considerably, making comparisons difficult. This study identified damaged single family homes ranging in value from $15,400 to over $150,000, but each represents someone's home and a significant part of a community.

In this process of conducting this study, we became aware of several local governments using landslide susceptibility and/or slope steepness as a zoning criterion. We had known of only two of these before. Several others are considering doing so or have draft zoning ordinances in the works. We also became aware of several cooperative groups of small communities sharing resources to be more effective at many tasks including Code enforcement and Building inspection. Crafton, Rosslyn Farms and Thornburg Boroughs have a Draft Joint Zoning Ordinance which will address steep slopes and know areas of slide-prone soils. The Steel Valley Council of Governments is another example—although they are not yet addressing landslides specifically, an increased ability to address any code functions will allow hem to consider other topics later. The Pennsylvania DCED has a grants program to encourage small municipalities to

develop programs to share code enforcement activities. This is a positive development since one of the limiting factors has been the inability of small municipal governments to muster the resources needed for effective hazard zonation and code administration. Sharing these tasks represents a change in the traditional independent stance of many communities.

SUMMARY OF FINDINGS

Landslide costs in Allegheny County, Pennsylvania have been at least $3 million in public money and $650,025 in private funds in 2001 and 2002. We believe these figures are very incomplete, especially for private and local government costs. The late 1990's and early 21st Century have been dry to average years for southwestern Pennsylvania, and it is well documented that landslides in the area are most prevalent in times of above average rainfall. High rainfall years such as 1972 and 1990 produced many more landslides and future wet periods are expected to do likewise.

No effort has been made to quantify effects of intangible costs of landslides, such as lost business and productivity due to road closures, effects on property values, and damage to utilities.

Most landslides in southwest Pennsylvania are small and move slowly. Injuries are rare, but property damage is often extensive. Municipal zoning for landslide hazard is increasing, and it is hoped that damages to new development will begin to decrease as a result.