Natural Hazard Research

NOTICES, WATCHES AND WARNINGS: AN APPRAISAL OF THE U.S.G.S.'S WARNING SYSTEM WITH A CASE STUDY FROM KODIAK, ALASKA

by

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In accordance with the Disaster Relief Act of 1974, which directed federal agencies to give technical assistance to state and local governments in providing disaster warnings, the U.S. Geological Survey began to issue hazard notifications in 1977. One such notification was sent to public officials in Kodiak, Alaska, advising them of a potential landslide on Pillar Mountain, one-half mile from the city. The procedures followed by the Survey alienated the community and drew criticism from a variety of sources. Citizens felt that the USGS had threatened Kodiak's economic development and well-being by issuing the notification 1) without providing complete information directly to the public; 2) without estimates of the extent of the risk or the probability of the landslide occurring; and 3) without suggestions as to what actions could be taken to reduce potential damage.

This study presents the results of interviews with USGS personnel, public officials in Alaska, and residents of Kodiak. Findings confirm that the perception of the USGS role by citizens and officials differs greatly from the Survey's interpretation of its responsibilities. Recommendations for the improvement of the warning program include:

- the USGS should determine the proper extent of its involvement in potential hazard situations;
- the USGS needs to become more sensitive to the views and needs of the affected community;
- the social, economic, and political impacts of the notification must be considered; and
- a better method of communicating warning information to the public should be developed.

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PREFACE

This paper is one in a series on research in progress in the field of human adjustments to natural hazards. It is intended that these papers be used as working documents by those directly involved in hazard research, as well as inform a larger circle of interested persons. The series was started with funds from the National Science Foundation to the University of Colorado and Clark University, but it is now on a self-supporting basis. Authorship of the papers is not necessarily confined to those working at these institutions.

Further information about the research program is available from the following:

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Requests for copies of these papers and correspondence relating directly thereto should be addressed to Boulder. In order to defray production costs, there is a charge of $3.00 per publication on a subscription basis, or $4.50 per copy when ordered singly.

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This study had its inception at the Natural Hazards Research and Applications Information Center at the University of Colorado. Robert Alexander and Gilbert White suggested assessing the U.S. Geological Survey's Hazard Notification Process. They continued to provide sound advice and useful information through the project. The background research was carried out while Tom Saarinen was on sabbatical at the Center during the 1978-79 academic year.

After receiving funding for a pilot study from the USGS in the spring of 1979, the research design was further developed with the aid of the Center staff and Bob Alexander, Tom Downing, Rud Platt, Susan Tubbesing and Marv Waterstone. The research design was further refined at the Advisory Committee meeting. The insights, suggestions, and support of this group, consisting of Bill Anderson, Martha Blair, Mike Carter, Alex Cunningham, Jim Davis, Don Nichols, Jim Pendleton, Robert Rigney and Jim Rold, are greatly appreciated.

The field research was carried out in the spring and summer of 1979. Tom Saarinen interviewed the USGS officials in Denver, Menlo Park and Reston in the spring. Their cooperation is gratefully acknowledged and especially that of Don Nichols who at the time headed the Earth Science Application Program. After he left, Clem Shearer served as our contact with the Reston headquarters. Many other knowledgeable California officials were also interviewed and the authors especially appreciate the aid of Joanne Nigg and Denise Paz who provided the most recent interpretations of the closest predecessor to our study, that of Ralph Turner in Los Angeles.

The field work in Alaska was carried out in the summer of 1979 by Harry McPherson and Tom Saarinen. They interviewed federal and state officials in Alaska as well as local officials and citizens of Kodiak, Alaska. All were cooperative and provided us with a lively introduction to their state and community. Caryl Saarinen is to be commended for her bravery in single-handedly babysitting four small children from two separate families at Juneau, Alaska to make it possible for us to interview in Anchorage and Kodiak.

The maps and figures were prepared at the University of Alberta. Several people sent us detailed suggestions for corrections and improvements and we hope that the changes in the final version reflect our gratitude for their efforts. These reviewers included Bob Alexander, Tom Downing, Frank Patton, Don Nichols, Jerry Stephens, Robert Wallace, and Marv Waterstone. The final editing was done by Jacquelyn Monday.

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INTRODUCTION

In the 1974 Disaster Relief Act the President of the United States directed appropriate federal agencies to provide technical assistance to state and local governments to insure that timely and effective disaster warnings were provided. The Director of the U.S. Geological Survey (USGS) was given the responsibility for doing so with respect to geological hazards such as earthquakes, volcanic eruptions, landslides, subsidence, and mudslides. In response to this directive the USGS developed procedures for providing warnings and began to issue hazard notifications in early 1977 (U.S. Department of the Interior, 1977).

The USGS has a long history of scientific studies on topics relating to geologic hazards. In addition, USGS mapping programs have produced baseline information against which better to describe and measure such hazards. Some state geological surveys are performing a similar function. A few, such as California, Colorado and Pennsylvania, are very active; others do almost no work of this kind.

Traditionally, the results of such studies have been published as part of scientific literature, through the various USGS publications (professional papers, bulletins, water supply papers, circulars, maps, etc.), and in state bulletins. The order to inform state and local governments about geological hazards institutionalized the responsibility of the USGS to transmit information on potential hazards, and will require the use of additional communication channels. This paper is devoted to a preliminary analysis of the initial USGS attempts to develop that warning system.

Hazard Warning System

The purpose of hazard warning systems is to provide timely information which could lead to responses (hazard mitigation) to save lives, avoid injuries, and reduce property damage. The benefits of warning systems may be seen in the contrasts in death tolls between countries with and without them. Of the some 250,000 people who die each year as victims of natural hazards, 95% are citizens of poorer nations (Kates, 1980), where well-developed warning systems are lacking. Yet there is much room for improvement in our present warning systems, according to recent surveys (Mileti, 1975, McLuckie, 1973).

There is more to issuing a warning than simply announcing to the public that there is a hazard. Hazard identification, however well it is done, is only the beginning point. According to Mileti (1975), an integrated warning system consists of three processes: 1) evaluation, or prediction and forecast, based on interpretation of the physical evidence by trained personnel; 2) dissemination, the decision to warn, message formulation, and message conveyance, and 3) response, by those who receive the warnings. Many actors and agencies may be involved at various stages. While all may handle their subsystems relatively effectively, there are major problems in linking the separate subsystems. The entire system must be scrutinized to find ways to improve the movement of the message through it.

Figure 1 illustrates some important variables in the warning process. These include physical factors related to the hazard identification, as well as the form, number and credibility of the source of messages which affect the organizational links, and the social and psychological factors

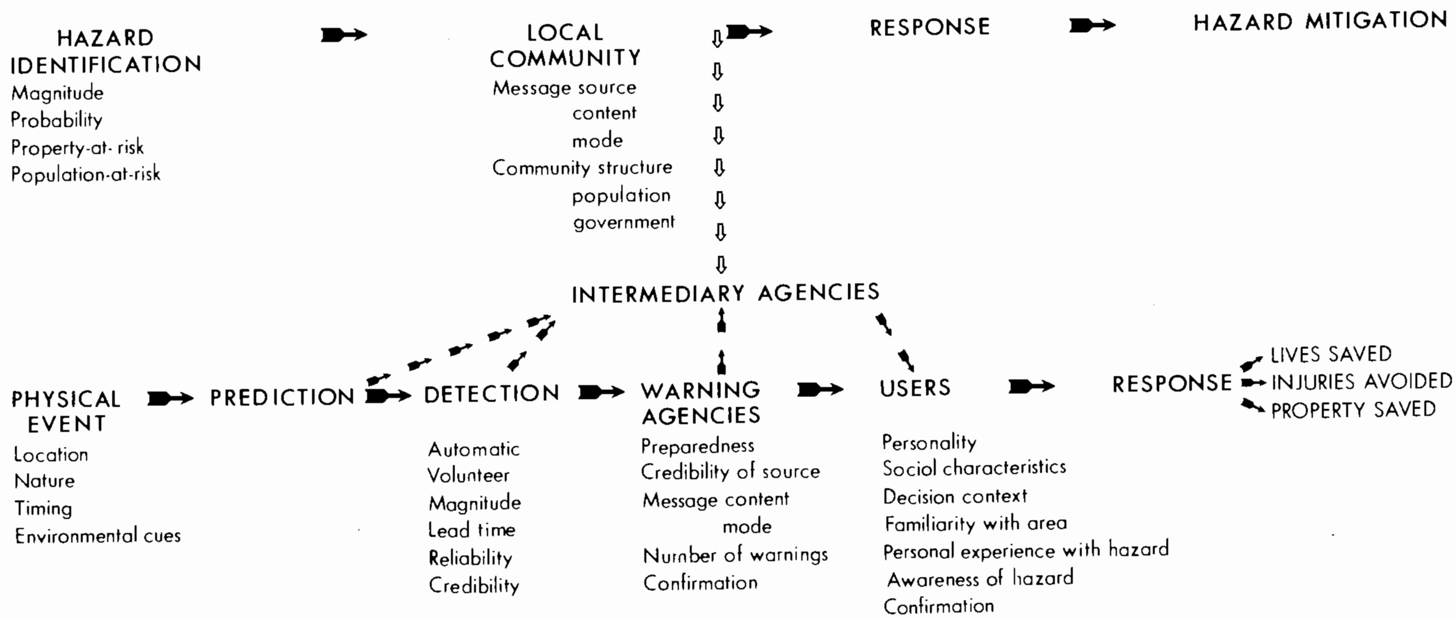

FIGURE 1

HAZARD IDENTIFICATION AND WARNING PROCESSES which play a role in individual responses (Saarinen, forthcoming). Research is in progress (Carter, Clark & Leik, 1979) and much remains to be done (White & Haas, 1975) before all such lines are clearly understood.

Major federal agencies such as the National Weather Service (NWS) and the National Oceanic and Atmospheric Administration (NOAA) have played a crucial role in identifying, monitoring, and forecasting weather-related hazards. To increase the effectiveness of their messages, they have gradually become more involved in all phases of warning. As the technology for forecasting geologic hazards develops (Federal Emergency Management Agency, 1980), the USGS may be expected to follow a similar pattern. It is hoped that it can benefit from the experience of other agencies. By studying the earliest phases of the USGS hazard notification process in this light, it may be possible to provide some perspective for future improvements.

The USGS Warning System

The USGS drew upon research and experience of other government agencies in meteorology and hydrology to establish a three-category system. Depending on the perceived magnitude of risk of the geological phenomena, the hazard notification was to be issued as a notice, a watch or a warning.

These three categories were defined as follows:

> Notice of potential hazard. The communication of information on the location and possible magnitude or geologic effects of a potentially hazardous geologic event, process, or condition.

Hazard watch. The communication of information, as it develops from a monitoring program or from observed precursor phenomena, that a potentially catastrophic event of generally predictable magnitude may be imminent in a general area or region and within an indefinite time period (possibly months or years).

Hazard warning. The communication of information as to the time (possibly within days or hours), location, and magnitude of a potentially disastrous geologic event or process.

By the spring of 1979 the USGS had issued the following hazard notifications.

Billings, Montana	potential rockfall into a residential area
Ventura, California	recently dated or studied fault with potential for causing damaging earthquake
Las Vegas, Nevada	potential faulting from land subsidence
Hilo, Hawaii	predicted eruption of Mauna Loa--endangered residential area
Southern California	Palmdale Bulge as possible earthquake precursor
Kodiak, Alaska	potential landslide
Mt. Shasta, California	potential volcanic eruption and associated hazards
Mt. Baker/Mt. St. Helens, Washington	potential volcanic activity
Wrightwood, California	cyclic landsliding, mudflow
South Central Arizona	fissuring and subsidence
Takataga, Alaska	potential earthquake based on Takataga "Gap"

The notifications regarding Mauna Loa in Hawaii and the Palmdale Bulge in Southern California preceded the official "notification program" but are included here to illustrate the geologic hazards dealt with in the development of thinking about how to provide notifications. The Mt. St. Helens notification was subsequently updated to a watch on March 22, 1980 and the volcano had a major eruption on May 18, 1980.

Notifications were released in varied forms and to a variety of officials. The USGS notified the mayor in the case of Billings, the State geologist for south central Arizona and Ventura, the state emergency services coordinator for the Wrightwood mudflow and the governor's staff for the Southern California Uplift.

The objectives of the Survey's Hazard Warning Program were defined by Donald R. Nichols, Chief of the Earth Sciences Application Program* (July, 1979)

(1) To increase the awareness of geological-related hazards among government officials, the private sector and the general public.

(2) To transmit timely and effective warnings (predictions, forecasts, information) on potential geologic-related hazards that come to the attention of the Geological Survey through its research and operating projects, programs, and staff; recommendations or order to take defensive actions rests with public officials authorized to protect public safety and welfare.

(3) To assist public officials in developing and instituting hazard mitigation measures.

Study Objectives

This study was contracted by the USGS in 1979 to analyze and evaluate the Survey's procedures and warning system program and the public response to them in the Kodiak case. The study was designed to

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*now Office of Earth Science Application provide the Survey with an independent appraisal of the warning program and advice as to how the program might be modified to better fulfill its mandate.

To accomplish these objectives, we decided to:

(1) Review the internal procedures of the Survey in issuing a hazard notification. This involved tracing the steps taken in issuing a hazard notification from its initial identification in the field to its final release to local officials, as well as identifying the roles played by individual, divisions, and groups within the Survey at different stages in the process.

(2) Determine the attitudes, feelings and responses of Survey personnel to the hazard program and their views as to how the Survey should proceed in its warning program.

(3) To carry out a detailed case study of one of the notices issued. The aims here were

   (a) to examine the procedures, approach and mechanisms used by the Survey in releasing the notification
   (b) to evaluate the impact of the notice procedures on the community affected
   (c) to determine the attitudes and responses of local citizens and local and state officials to the notice and the warning program

(4) To develop a method by which the response to notifications could be assessed and their effectiveness judged.

The May 10, 1978 notice of a potential landslide on Pillar Mountain, which posed a threat to the city of Kodiak, Alaska was chosen for the detailed study (Kachadoorian and Slater, 1978). We chose Kodiak because the notice there had generated the greatest reaction from the public and local and state officials of any issued to date. Our interviews confirmed the community was bitterly critical of USGS handling of the situation. The local newspapers and even the _Los Angeles Times_ carried articles about the landslide threat (1978). Local editorials were especially critical of the Survey.

We felt that an investigation of this controversial and politically sensitive case would help identify the problems with, and weaknesses of, the warning program.

Physical Basis of Pillar Mountain Landslide

Kodiak Island (Figure 2) in the Gulf of Alaska is in one of the most seismically active areas of the world. The rugged nature of the terrain may be seen in Figure 3. This region along the southern coast of Alaska is located in the interaction boundary zone between the Pacific and North American plates. The area has experienced much seismic and volcanic activity and will suffer further tectonic episodes in the future.

The most recent major earthquake was the 1964 Good Friday quake. This earthquake generated a tsunami, 3.9 m (12.8 feet) high affecting Kodiak, causing two deaths and property damage which was estimated at $25 million (Kachadoorian & Plafker, 1967). The tsunami destroyed 215 structures and all but one dock.

In addition, numerous landslides and avalanches have been recorded in Alaska--many triggered by earthquakes. The 1964 earthquake started a series of landslides and avalanches that severely damaged road and rail transportation over a large part of the state (Shreve, 1966). Because Alaska is very thinly populated and most slides and avalanches have taken place in areas where there are few or no people, deaths have been few and damages low.

However, the landslide which has been identified on the southeast face of Pillar Mountain, is located 1/2 mile (900 m) from Kodiak and poses a substantial threat to the city and surroundings.

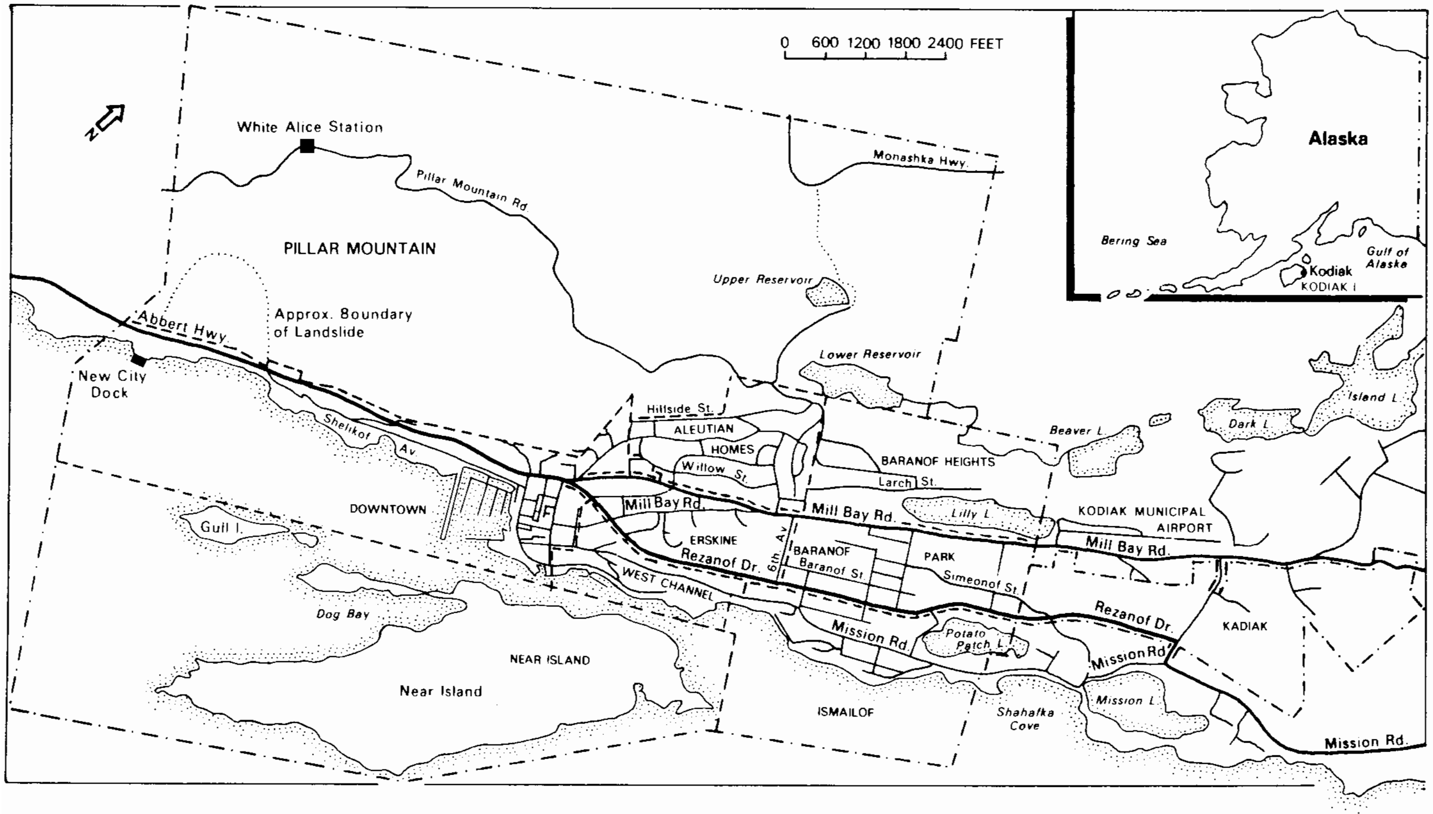

FIGURE 2

CITY OF KODIAK, ALASKA

FIGURE 3
Landslide in center, town on right

After the retreat of the Pleistocene glaciers from the area, a series of landslides was triggered along mountain faces to the northeast and southwest of the potential Pillar Mountain landslide. These were probably a result of oversteepening by the glacial ice. However, not all the mountain faces failed and the Pillar Mountain landslide is believed to be an ancient slide which has not moved to the bottom of the mountain (Kachadoorian and Slater, 1978). The Pillar Mountain slide is approximately 520 m (1700 feet) wide at its base and extends to an altitude of 343 m (1125 feet). The approximate limits of the slide are shown in Figure 4.

The bedrock underlying Pillar Mountain consists of fine-grained slate and argillite interbedded with graywacke. The beds of slate and argillite vary from less than 25 mm (1 inch) to 0.3 m (1 foot) thick, while the argillite and graywacke beds are up to 6 m (20 feet) thick (Kachadoorian and Slater, 1978). Dames and Moore identified at least four major joint sets* on the mountain (Dames and Moore, 1973).

The potential mass of material which might fail has not been accurately determined. Kachadoorian and Slater (1978), on the basis of limited drilling, have postulated the existence of two possible failure planes (see Figure 2). In the most extreme case, they believe that 3.8 to 7.6 million cubic meters (5-10 million cubic yards) of material could slide into Kodiak Harbor. If this were to occur suddenly (i.e., triggered

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*One set strikes N 38° E to N 48° and dips S 70° E to vertical, a second set strikes N 61° E to N 81° E and dips N 68° W to S 75° E, a third set strikes N 75°W to N 83° W and dips 75° to 81° NE while the fourth set strikes N 25° W to N 36° W and dips S 68° W to vertical.

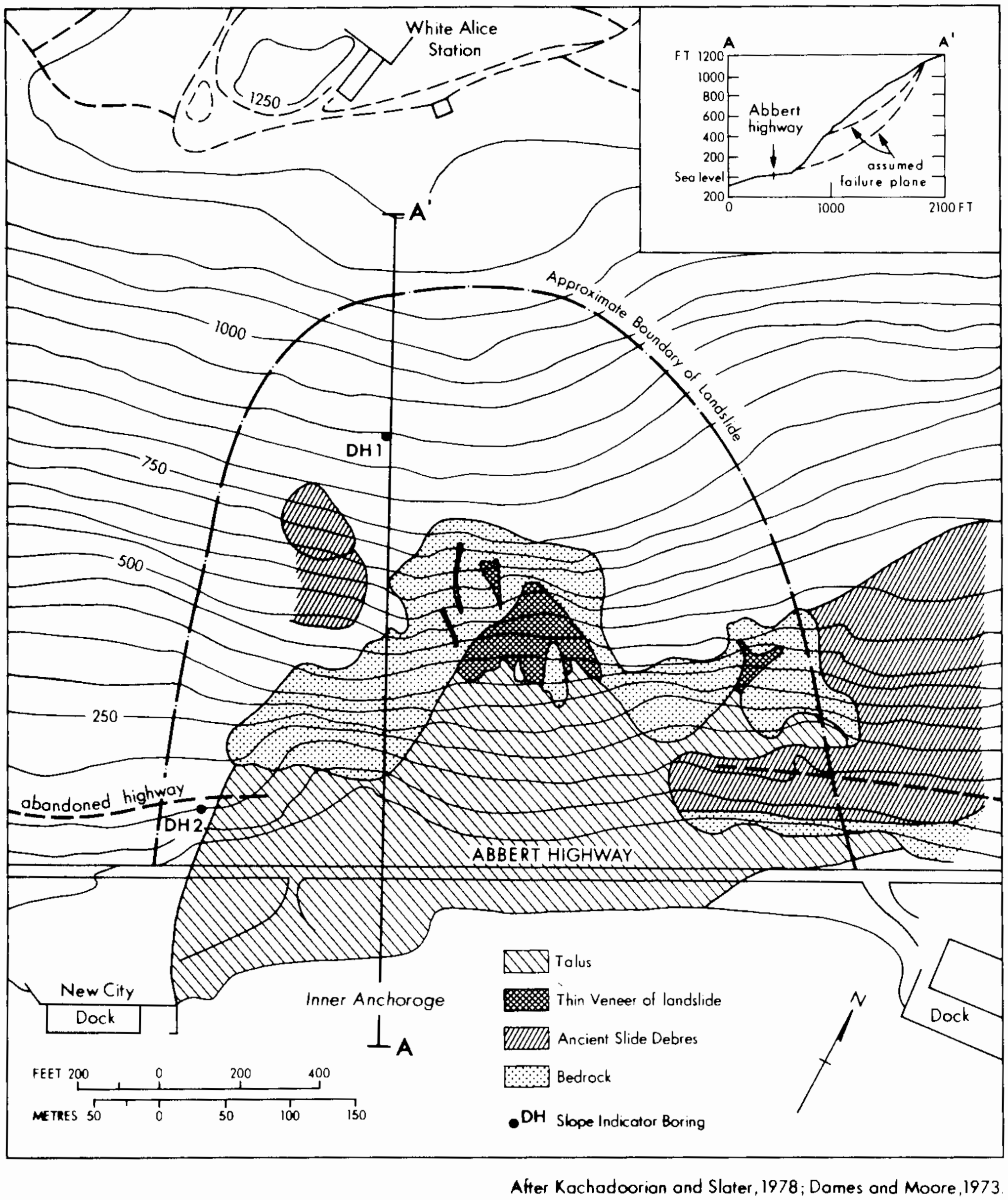

FIGURE 4

PILLAR MOUNTAIN LANDSLIDE, KODIAK, ALASKA by an earthquake it could generate a 3.05 m (10 foot) tidal wave almost as big as the 1964 tsunami.

The Pillar Mountain Geotechnical Committee,* formed in December 1978 to advise local officials on the problem, reported in June 1979 that a critical priority was to determine the lateral and vertical extent of the mass undergoing displacement. To date this has not been done, but such an effort is under way.

Local residents and officials have been aware for decades that the southeast face of Pillar Mountain was unstable and have had to cope with minor slides and rock falls onto the highway below the slide. Officials were aware they did not fully appreciate the potential magnitude of the landslide hazard.

Interest in the slide was renewed and intensified when evidence of movement was observed on December 5, 1971 following the removal of some 230,000 cubic meters (300,000 cubic yards) of material from the base by a contractor. Aerial surveys of the upper section of the mountain on December 9th and 14th, 1971, revealed the development of a series of large cracks extending to an altitude of 381 m (1250 feet). Ground observations on December 14, 1971 showed that the cracks were up to 1 m (3 feet) wide. By August 1976 surveys by Kachadoorian and Slater revealed that the cracks were now as much as 1.3 m (4 feet) wide and they also observed a new crack at 343 m (1125 feet).

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*The Committee was appointed by resolution No. 78-76-R of the Kodiak Island Borough in December 1978 and supported by City of Kodiak Resolution 4-79 in January 1979. The list of members and their affiliations is shown in Appendix B.

Boreholes drilled in the fall of 1972 (points DH1 and DH2, Figure 2) were monitored in February 1975 and indicated deep-seated, continuing movement of the slide. The borehole near the head of the slide (DH1) showed movement to a depth of at least 55.2 m (181 feet) with a 127 mm (5 inch) displacement between the top and bottom of the hole (Figure 5). Kachadoorian and Slater concluded that the casting for the hole (DH2), near the base of the slide, had been so badly distorted that it was not possible to take readings. However evidence made available to the Geotechnical Committee studying the slide suggests DH2 is located beyond the limits of the slide.

Monitoring of the upper surface of the slide initiated following the notice of potential hazards, indicate the slide is still moving, although the rate has slowed since the first observations in December 1971.

No estimate has been given by scientists studying the slide of when failure might occur or of the probability of a slide. Kachadoorian and Slater (1978) have stated that Kodiak is an area of high seismic risk and that the removal of material from the base, which appeared to be associated with renewed movement in 1971, took place after the 1964 earthquake making it impossible to predict the effects of a similar earthquake. That the slide survived the 1964 earthquake is no guarantee it will survive a similar or even smaller future shock. They also observed that the cracks which have developed could collect sufficient water in a heavy rainfall year to saturate the landslide mass and lead to accelerated sliding.

Present knowledge regarding the geologic risk posed by the slide has been summarized in the Pillar Mountain Geotechnical Study Committee report of June 15, 1979. The committee points out that with the data available,

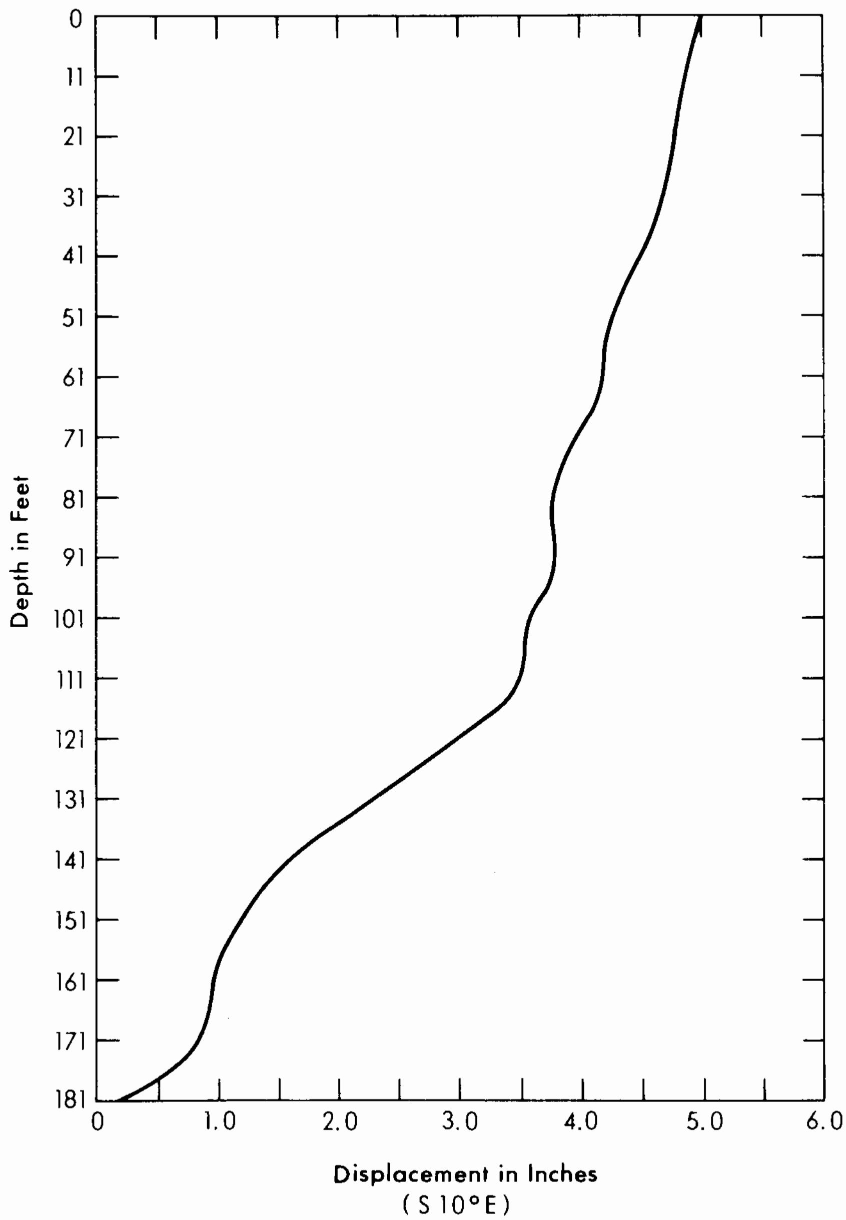

FIGURE 5

SLOPE INDICATOR DATA - DH 1

Showing amount of displacement between
Sept. 25, 1972 and Aug. 3, 1976
Source: Kachadoorian and Slater 1978

it is impossible to determine the lateral and vertical extent of the slide and therefore its mass. Further, the present and future mechanisms of movement have not been determined, which makes it difficult to predict the degree of instability of the slide mass. They recommended to the local authorities a program of data collection and remedial action.

The recommendations of the Geotechnical Committee were implemented in part in 1980 with a grant of $500,000 from the State of Alaska. These funds were spent on new topographic maps, geological and hydrological mapping, strength testing of selected samples and on the drilling of one new instrumented borehole, DR3. This hole, adjacent to DH1, is located above the most active area of the slide and was drilled some 274 m (900 feet) to approximately sea level.

REVIEW OF THE USGS INTERNAL PROCESS FOR HAZARD NOTIFICATION

> The mere fact that we possess some capability to predict the occurrence of these phenomena (natural hazards) fastens on us a responsibility for using it to warn those who may be affected by them. Yet, the capability at present is so primitive and poorly developed that our attempts to exercise it may easily do more harm than good (U.S. Department of the Interior, 1979).

The opening quote illustrates the dilemma faced by USGS in issuing hazard warnings for geophysical phenomena.* Although giving warnings is a new role for the USGS it is now mandatory. Even as the earliest warnings are being given, the Survey is still in the process of determining the extent of its hazard notification and warning system.

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*For a discussion of the state of the art for various types of geophysical predictions, see National Academy of Sciences (1978).

This chapter deals with the internal review of the USGS hazard warning system. It reports the findings of a questionnaire survey of a large proportion of the USGS personnel who were involved in the first series of hazard notifications issued under the new mandate. The survey included 12 field personnel, ten who served on peer review committees, 14 who were in administrative roles, and another 14 whose roles involved them with the hazard warning system. This latter group included people who handled news releases, were involved in the publication process, or were associated with particular hazard notifications. Just fewer than 50 persons were interviewed. A few individuals were involved in more than one role.

Development of the Geologic Hazard Warning System

The process of issuing warnings began in 1977 under the 1974 Disaster Relief Act, but factors other than the official mandate already had provided impetus for issuing warnings. Interviews with USGS personnel revealed many forerunners of the current hazard notification process as well as programs aimed at providing information directly to the public.

To some degree, geologists at the USGS have probably always provided the public with scientific information pertinent to planning. The earliest geologic hazard warning mentioned in the interviews was by G. K. Gilbert in the late nineteenth century. In a scientific article, and later in a Salt Lake City newspaper, he warned of a possible earthquake on the Wasatch Front. Another early warning system mentioned was the Volcano Observation Program to monitor Kilauea on Hawaii. It was begun about 1912 by the Massachusetts Institute of Technology and transferred to the USGS in the 1920s.

More recent events which affected the thinking of geologists with respect to communicating their results to the public were the Alaska Earthquake of 1964 and the Teton Dam disaster of 1976. Many USGS personnel interviewed mentioned an engineering geology study published in the late 1950s that described the possible effects of an earthquake and landslide in Anchorage, Alaska. They wondered whether broader circulation of these findings might have prevented some of the damage caused by the earthquake. Similarly, several cited the Teton Dam disaster in which some geologists had expressed doubts about safety of the structure. Geologists were put in a bad light for failing to speak up quickly, according to some respondents. It may have been these kinds of events which prompted V. D. McKelvey, then Director of the USGS to remark, in 1972:

> ...Taking a hard look at the work of the Geological Survey several months ago, I suddenly realized that the maps and reports of which we have been so proud --justly I think--have been released in a form in which they are understandable only by other earth scientists. Little wonder that insufficient use has been made of our results by land users and land use planners, and little wonder that the public lacks understanding of fundamental resource and environmental problems (U.S. Department of the Interior, 1976).

Public Information Program in the USGS

Many programs in the USGS aim to provide the public with information for planning. A major step in the direction of carrying scientific information directly to the appropriate planners was the San Francisco Bay Region Environment and Resources Planning Study began in 1970, jointly supported by USGS and the Department of Housing and Urban Development, and linked closely with the Association of Bay Area Governments (Borcherdt, 1975). This study attempted to identify problems in earth sciences related to planning for the Bay Region, and to provide planners with necessary earth science information in a useful and understandable form. It was a major innovation in communicating scientific results to a user group. It also marked the first time a planner was hired to work for the USGS, until then almost totally comprised of geologists, hydrologists, and engineers.

The perceived need for improved communication of scientific information was formalized with the establishment of the Land Information and Analysis Office (LIA) in April 1975 as a focal point for multidisciplinary programs designed to bridge the gap between earth sciences and land resource planners and decision makers (U.S. Department of the Interior, 1976). It is within this program that the Geologic Hazards Warning and Preparedness Program of the USGS operates.

These programs are major steps forward in communicating information directly to public officials, but they are apparently not well known in the Survey, nor have they resulted in any significant changes in the professional makeup of its members.

Knowledge of Geologic Hazard Warning Systems within the USGS

The level of knowledge of the geologic hazard warning system tended to be low among the Survey personnel who were interviewed. Over 60% answered "no" to the question "Do you know of any other geologic hazards suggested for geologic hazard notifications which were not finally selected?" Given that those interviewed had already been involved in the hazard notification process, it seems likely that those who thus far have not been involved directly might know even less about the process.

Those who knew of hazards which had been suggested tended to be aware of only one or two and were not generally familiar with the full range of hazards included. Furthermore, details such as the dates, personalities, and events were forgotten by those who were involved. Thus to have a complete record for later analysis it is important to collect such data before it is too late.

Many who knew nothing about the hazard notifications beyond their own involvement were very interested in learning more, which suggests that more could be done within the USGS to keep employees aware of the program. This, in fact, was suggested by several people, including one who said:

> They should have a yearly reminder of what the hazard notification process is and how an individual can contribute to the system, perhaps one page to demonstrate ongoing concern. This should come through the regular chain of command, not directly from Nichols, (The Hazards Information Coordinator) to show support. It should include the number of notifications to date.

Passage of a message through the chain of command is not a uniform process within the Survey. There are at least two divisions for which the hazards notifications would be relevant, the main one being the Geologic Division. Within it, there are 36 branches, each with a branch chief. Information sent down the regular chain of command was not always handled the same way by each branch chief. Some placed it on bulletin boards, others circulated it and others may have ignored it. Thus, the 50 to 100 professionals within each branch may have had widely different degrees of exposure to the information. One respondent remarked:

> the lower down in the ranks the less is known about warning systems.

Perhaps more explicit instructions as to who should receive the geologic hazard information, and a brief one- or two-page format to increase readership would aid in transmitting the message to all appropriate personnel. Certainly those directly involved should routinely be kept abreast of further developments. More than one channel of communication is probably ncessary. Others might include the USGS Newsletter or other internally circulated informal newsletters such as The Cross Section of the Geologic Division. The system must be widely known so that USGS employees may alert the public to developing geologic hazards.

Hazard Selection

Response to the question, "How did the process leading to the issuance of a hazard notification for _____________ begin?", indicate that hazard notifications do not always develop from a routine systematic process. Random events rather than systematic criteria have determined the sites selected. Those responsible for selection of hazard notification sites do follow a systematic process by which to appraise new USGS reports in terms of hazard potential. But selection of projects for field studies are not part of this process and it is with field studies that the hazard notification process usually begins. Why the field studies were initiated and whether these result in a geologic hazard notification hinges on many chance factors. This may be seen in a synopsis of some of the sites for which geologic hazard notifications have been issued.

In certain cases the hazards were identified as part of continuing programs of the Survey. The volcanic hazards of Mt. Shasta and of Mt. Baker/Mt. St. Helens were identified as part of the volcanic program which began 15 years ago. The reports proceeding through the regular review process reached completion in time to be included as part of the hazard notification process. Also studied as part of this program was Mt. Lassen. It was not included as a hazard notification site because the report appeared prior to the initiation of the hazard notification process. Perhaps Mt. Lassen and other geologic hazards could be identified and placed in the hazard notification system by a review of earlier reports to identify hazards. The Wrightwood slide area in California was included in a continuing research program and the hazard notification was really a description of a predictive technique. The hazard notification in Ventura, and the incomplete one from Livermore resulted from the regular earthquake hazards mapping program. In contrast, the selection of the Billings rockfall was accidental, based on the initiative of a geologist who noticed it near the airport while awaiting departure. The Las Vegas subsidence hazard was pointed out by an engineering geologist who had documented a similar process in Arizona. The Kodiak landslide notification developed from a request from the state highway department to assess the stability of a known landslide.

Answers to the question, "Do you think the USGS should make an effort to be totally systematic in assessing geologic hazards and providing notification of the most serious ones?", revealed the difficulty of doing so. More than half of the respondents answered no, another fourth said, if possible, expressing doubt that it was. The most common reason given for an inability to be totally systematic was insufficient staff and money. In any one year, only certain portions of the country are covered, at a regional scale rather than the local scale at which hazards might best be identified. Perhaps a closer liaison with state geologists who work at a more local scale could help. One suggestion was that systematic coverage would have to be done on the basis of broad scale synoptic maps. Other individual reasons given for less than systematic coverage reflected the strong focus on research on the Survey such as;

> It is haphazard and will continue to be. Many of us are turned off in relation to government paper-work and don't want to submerge ourselves further. Unless it affected many people in a short time I would be reluctant to report it

or

> Many geologists work on topics (landslides, for example) and do not see it in a hazard context.

About one-fourth of the respondents thought a more systematic assessment process should be developed. Some spontaneous comments among those answering yes to this question were:

> We should be as systematic as possible to reassure people to have faith in regular government procedures,

or

> it's mandatory otherwise we get into all kinds of difficulties.

Some such difficulties are illustrated by the comment from a state official in Alaska who stated sarcastically that the Billings rockfall is the number one geological hazard in the United States because it came first on the list, or by the question which is inevitably raised in a hazard notification, "Why were we singled out?"

This question is important for there may be many geological hazards or more significant than some of those for which warnings have been issued. This may be seen in the replies when respondents were shown a list of the hazard notifications and asked, "Do you know of any other geologic hazards of equal or greater hazard which might warrant further consideration as hazard notification sites?" Almost half (45%) answered "yes" and several specific areas were mentioned.

Assessments of Internal Flow of Information

People in the geologic hazard notification process appeared to be satisfied with the internal flow of information. About two-thirds answered "yes" to the question, "Given the advantage of hindsight would you say the internal notification procedure was totally satisfactory?" Most of the remainder said they didn't know, underlining the need for more information about the system. The lack of formal information channels is compensated partially by informal communication among colleagues, for USGS scientists learned of particular hazards at all stages from first field work to final report.

The normal review process for geologic hazard notifications is modeled after standard USGS manuscript processing. In this system, the author first submits the manuscript to his branch chief, who assigns reviewers. Their comments are returned to the author who revises the manuscript and resubmits it to the branch chief. The branch chief then sends the manuscript forward to the technical report unit for more formal editing before passing it on to the division chief for approval. From there it goes to the publications division to prepare the text and illustrations for publication.

There is potential for delay at each stage of the process. This is particularly true in the USGS, where each scientist may be involved in several projects. Writing chores in the hazard notification process could well be neglected for long periods of time if the prestige or importance of the process fails to outrank other projects. One form of streamlining for the hazard process which has been tried is to gather members of the peer review process to work out disagreements or problems.

Communicating with the Public

The nature of the Survey's publication efforts were revealed in the answers and spontaneous comments to the question "When you write your reports do you directly design them to inform the public or is this incidental?" Thirty-eight percent answered "yes", and comments in response to this question suggest that most reports are written for scientists but that more effort should be devoted to communicating with the public. This may be seen in such comments as:

> The vast majority are written for the scientific community. Survey should move toward more interpretive work as in LIA individuals to interpret for the public; but not the scientists--it would divert them from their work.

Some individuals by virtue of their position were obligated to write with the public in mind as in:

> whole purpose of this office is press releases--national or local.

This would be true of members of the Land Information and Analysis Office (LIA) and those dealing with publications. Others indicated a willingness to do so if the report seemed to be of public interest. While the bulk of the articles were thought to be for the scientific record, communications designed for the public were also seen as important. As one put it "we need both kinds for credibility." A curious and common answer was that individuals said that they tried to write for a broad public audience but thought most of their colleagues did not. There are differences in the degree to which geologists write with the public in mind, and it may be that those who have already been involved in the hazard warning process include: individuals more likely to be concerned about communicating to the public.

It was apparent that the trend was toward more concern about communication with the public, as seen in such comments as:

> Several years ago I became aware that public use of geologic information with few exceptions was limited. I began efforts to be sure we did get information into a public form in which it could be understood by the public. The hazards system was specifically designed this way.

This message seems to have gotten across with respect to hazard notifications. When asked in relation to specific hazards, "Did you think the public should be informed?" 88% answered "yes".

Some respondents, who deal with manuscripts daily, expressed the opinion that a shift toward writing more directly for the public would not be easy for several reasons. First, it takes less time to write for a scientific audience since less time is spent rewording. Second, many scientists do not want to do it. Finally, some do not have the ability to write for a general audience.

A related question was, "Do you think it is important to have persons trained at some intermediate level of analysis to communicate the earth scientists' results to the decision maker?" The results show support for this idea with 65% saying "yes" and 35% saying "no," but reactions revealed in comments range from rejection to enthusiastic support. One scientist felt that:

> An extra intermediary would only impede communication. This comes out in press releases. When an extra person does the interpretation they usually are disappointing.

Another said that the small percentage of scientists good at such interpretation should be encouraged.

Positive comments included:

> There is a strong need for such individuals

and

> Absolutely. This is a big problem. Probably a widespread idea in the Survey, lip service at least, not necessarily at the funding level.

Others who agreed such a person might be useful said it might not be a USGS responsibility:

> Should leave a lot of that in the private sector or with state and local government. It has to be at a detached local scale and the Survey should work at the regional and national level. A small cadre should be present in the Survey.

Should USGS be Involved Beyond the Warning Stage

"Do you think the hazard notification should indicate specific actions people or agencies should take to alleviate suffering or damage?" is a question which has not yet been resolved by the USGS. This is apparent from the short answers and spontaneous comments it generated. Although 68% answered "yes" and 32% answered "no," there were strong qualifications added to the simple answers. The issue was one most geologists thought should be approached with caution as in the comment:

> The Survey must be very careful about that, must communicate what we know and make ourselves available to help. We could list options. We must be careful about advocating an action that is not our responsibility.

The most common comment was that the Survey was not qualified to suggest mitigation measures. Such comments were forthcoming from just under one-fourth of the sample. One respondent stated this strongly:

> We would too quickly step out of our expertise and become advocates making value judgments we are not trained to do. No bigger asses than scientists that speak with

> certainty and pomposity about things beyond their knowledge. You also run the risk of alienating people whose responsibility you usurp.

Others suggested that "elected representatives should make those decisions" or "other agencies concerned with disaster response" or "consulting engineers," or the Corps of Engineers. Strong reluctance to suggest decisions which involve social, political and engineering factors was evident. The second most frequent type of comment, advanced by 15% of the sample, was that the Survey should only make general suggestions on a list of possible actions:

> Should list possible actions but not try to play God and say this is what local government should do.

A final type of response which appeared in 10% of the replies was that the USGS role was simply to provide factual information:

> Our role is providing sound and unbiased scientific information where we can speak authoritatively.

One good reason for not suggesting mitigation measures is the difficulty of knowing what to do. This may be seen in the responses to the question "What do you think would be the optimum public response to this hazard notification? Only in the rather simple Billings case was there a consensus on what mitigation measures should be employed by the local governments. In the other cases, a variety of suggestions were made, among them greater awareness, an emergency response plan, an advisory committee. A similar range of answers was received to the question, "What action would you personally take if you owned a house in the area?" These included wait and see, buy insurance, do nothing, look for a way out, urge public officials to do something, never buy a house there in the first place.

There may be some discrepancy between the USGS and the local community views as to how far the USGS responsibilities should go. To measure the USGS views, respondents were asked "Do you think the USGS should have any responsibility for alleviating the situation once a hazard notification is issued?" Sixty-three percent said "no" and 37% "yes".

The main role seen for the USGS was providing geological information. This was true among those who answered "yes" and "no". Some mentioned keeping geological information current, and several suggested a continuing interpretive role:

> We must clarify information if geological advice is needed to make a decision

or

> Should work on a continuing basis with the public officials involved and see it through to the end.

The latter two views are in the minority within the USGS sample. Most felt the USGS should not have responsibilities beyond hazard notification.

Among the reasons provided for this view were the lack of resources for anything beyond scientific work, a possible conflict with private enterprises or encroachment on their territory, a feeling that it was beyond the scope of the Survey and in the realm of engineering or politics, and that it was the responsibility of local governments.

Experience with hazard warnings may change opinions as to how far USGS responsibilities should extend. This seems to have been true for those involved in the landslide warnings for Kodiak, the most controversial hazard notification to date. Among this group, only 30% thought the USGS responsibilities should end once the hazard notification is issued, a percentage less than half that of the total sample. Those who thought the Survey's responsibility should end with the notification were individuals in the peer review process who had little direct exposure to the public reaction in Kodiak. Apparently, the public reaction there was strong enough that the others could see reasons why the USGS should maintain a role beyond the original notification. Several felt the USGS was morally obliged to continue its involvement in Kodiak. One official suggested that the ethics of the situation required further thought and suggested convening a National Academy of Sciences committee to look into the question.

Sending an official notice of a potential geologic hazard puts people on the spot. This can be very disturbing particularly if there is no clear line of action to be followed.

> It's like finding you have termites in your house when you are behind in the mortgage payments

and

> It's like finding you have a serious disease.

were some analogies suggested. Until geologic hazard notifications are seen as an official and regular process, some interpretation will be necessary. This might involve increasing public appreciation of a geological time frame and providing better probability estimates. The USGS would have to have funds allotted for this purpose.

Probability Estimates

Public officials find it difficult to make decisions regarding a hazard without some estimate of their likelihood. For this reason the following question was posed: "Do you think the USGS should provide a probability estimate of the risk involved in each hazard notification?"

Since the question was added only for the last wave of interviews, only 14 responses were obtained. Of these 9 (69%) answered "yes" and 4 (31%) answered "no". Perhaps more interesting are the reasons provided for positive or negative answers.

Those who thought probability estimates should not be provided usually said they thought it was beyond the state of the art:

> That's something to work toward but not something we know now. The weather forecasting has been attempting to do that in recent years. They have a broader and deeper base of knowledge yet are not as yet doing it well. We're not close to that capability.

The difficulty of providing probability estimates for geologic hazards was acknowledged by those who thought such estimates should be provided. This was seen in comments which stressed the need for at least "a judgment of the uncertainty," "an opinion" or "intuitive probabilities." Advantages and disadvantages of such estimates were expressed:

> Helps to keep it in perspective but numbers may imply more knowledge than is present and mislead.

Several were emphatic:

> Without question. If it (the Survey) doesn't, someone far more ignorant will have to do it. If there is enough technology to say there is a hazard we should say what the probability is.

Legal Liability

The isolation of USGS personnel from the public arena is reflected in their answers to the question, "Does the question of legal liability enter into your deliberations in either releasing or withholding information on geologic hazards?" Almost all (87%) answered "no", usually without hesitation. Clearly they are more concerned with the production of accurate scientific reports than with possible public reactions to them:

> I am convinced there is an adequate precedent for an official acting in good faith

and

> There is an overriding feeling that if we have information that could possibly save lives or property that it should be released in a responsible fashion. Most feel well protected.

The few who said the question of legal liability entered their deliberation were either very high level officials or individuals who had experienced controversial hazard notification reactions. As more hazard notifications are issued, it seems that increased experience will lead to increased concern about legal liability.

Summary

While the mandate to issue geologic hazard warnings was thrust upon it from the outside, it is evident that forces within the USGS were moving in the same direction. Even so, the issue of more directed public information programs did not appear to be a salient one for most USGS personnel interviewed. While they strongly supported the idea of providing the public with information on geologic hazards, they tended to have a hazy knowledge of their own hazard warning system. Even specific details of individual involvement faded rather quickly.

Part of the reason for the lack of saliency of the geologic hazard warning system may be attributed to the nature of the USGS internal reward structure. The main emphasis seems to be on producing professional quality earth-science studies. Any new, potentially time-consuming activities are not appreciated. The geological and scientific orientation may be seen in the training of the personnel, the strong emphasis on writing reports for the scientific community, in the reluctance to extend the role of the Survey beyond physical data to the implications of such data for the public, and in the general lack of concern about legal liability.

To improve the USGS hazard warning system, better internal understanding of the system is necessary. Even those who have been involved in the process for one hazard are not usually familiar with the total system or other issued hazard warnings. A brief yearly reminder and summary of warnings issued would alert potential hazard identifiers and emphasize the importance of the program.

Another reflection of the need for more internal communication is the lack of consensus among USGS personnel on important questions related to the geologic hazard warning system. A major problem is the terminology of notices, watches, and warnings: it is not an easy task to convey the exact shade of concern when terms may differ in technical and general usage. Even on issues where a majority agreed, there are strong dissenting views and a lack of commitment. This includes such issues as the hiring of specially trained people to communicate earth science results to the public, and the use of probability estimates with hazard warnings.

While a unanimity on all issues is neither likely nor desirable, much greater awareness of warning system issues seems necessary. Those with wide experience differ with the inexperienced. This suggests that the type of experience and reasons for any shift in attitude should be more widely communicated within the USGS. Many years of debate may be necessary before a consensus emerges.

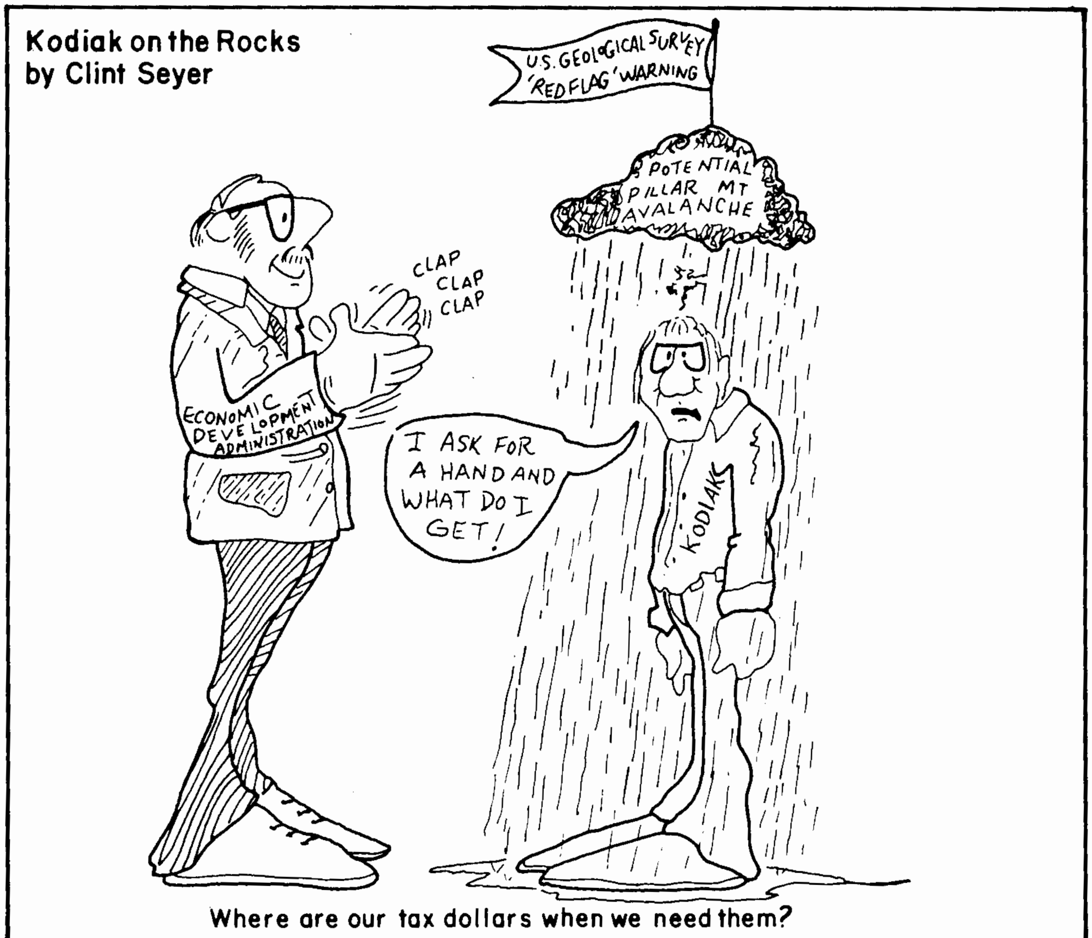
PUBLIC ATTITUDES AND RESPONSE TO THE KODIAL LANDSLIDE NOTIFICATION

When a hazard notification is issued it inevitably influences (sometimes profoundly) the economic, social and political life of the community threatened. The degree of impact varies depending on the specific geological event and the risk associated with it. In the case of Billings, Montana, where several houses are threatened by a rockfall, few people are in danger. The Mt. St. Helens volcanic eruption menaces a large area, and the Southern California Uplift could place many communities in jeopardy.

The form and content of the message, the manner of transmission and the nature of the interaction which develops between the USGS and the community is important to a resolution of the problem. It is in the best interests of all that this interaction should be harmonious and the relationship as productive as possible.

A review of the Kodiak newspapers indicated that the community was angry and upset about the Pillar Mountain landslide notice and (see Appendix A) antagonistic to the Survey. A cartoon published in one of the local newspapers (Figure 6) expresses this sense of resentment and frustration very well.

In July 1979, we interviewed a 2% sample of the city's population (29 males and 35 females) to determine awareness, attitude, feelings, and response to the landslide notice. The subjects were chosen so that each neighborhood was proportionately represented. People from a range of occupations were sampled, including fishermen, clerks, typists, cannery workers, various professionals and housewives. Most of those interviewed were white, native-born Americans who owned their own homes and were



Kodiak on the Rocks
by Clint Seyer

Where are our tax dollars when we need them?

Source: Kodiak Times, May 11, 1979

FIGURE 6

between 25 and 50 years old. Over half had lived in Kodiak for more than a decade.

Public Attitudes Towards Kodiak

Most rated the city an excellent or good place to live, only 5% rated it poor or very poor. Advantages cited were low crime rate, freedom from pollution, small-town atmosphere and the outdoor lifestyle. Disadvantages mentioned included a sense of isolation (although this was also quoted as an advantage) and the weather. Earthquakes, landslides, tsunamis, avalanches and storms of various kinds are all potential dangers in Alaska. It is not surprising, therefore, that 56% of the interviewees had direct personal experience with natural hazards. Of those, 53% had experienced earthquakes, 20% tsunamis, 22% windstorms, 3% landslides, and 2% floods. Most of the earthquake and tsunami experience was a result of the disastrous 1964 earthquake.

When asked whether they considered Kodiak a more or less hazardous place to live than other places in the United States, the majority (62%) considered it less hazardous, 14% thought it was about the same, 13% did not have an opinion. Eleven percent believed it was more hazardous. Those who said Kodiak was less hazardous cited less traffic, no freeways, isolation, less crime, no pollution, fewer people, safe town and isolation as reasons. The people who considered it more hazardous mentioned dangers inherent in the fishing industry and problems with the weather. Only one person stated Kodiak was a more hazardous place to live because of the Pillar Mountain landslide risk.

Awareness and Knowledge of Pillar Mountain Landslide

Almost all (96%) of those interviewed knew about the Pillar Mountain landslide. One of those who did not was a recent arrival, the other spoke poor English.

The main sources of public knowledge of the slide were the local newspapers--the Kodiak Daily Mirror and the Kodiak Times. Seventy percent of the people said they learned about the slide from the newspapers, while only 20% mentioned radio coverage and 11% a variety of other sources. From January, 1978 to the present, the newspapers have provided detailed coverage of the threat. Pillar Mountain has been the subject of 16 feature articles, or editorials in the Mirror, usually on the front page, and eight articles in the Kodiak Times.

Nevertheless, interviews showed that the citizens possessed hazy, incomplete or erroneous information about the Pillar Mountain situation. Most (62%) could not remember who made the original statement about a possible landslide. Of the 34% who claimed they could recall the original statement, only one mentioned Reuben Kachadoorian of the USGS, and one attributed it to Kachadoorian and Stuart Denslow, the borough manager. Responsibility for the original report was attributed to a wide variety of people and organizations including the local newspaper, the Coast Guard, some geological or engineering group, rumors the borough manager, someone from outside, surveyors, engineers and city council.

Residents also were ignorant of the evidence which was the basis of the notification. No one mentioned information given in the Kachadoorian and Slater report or the meeting held in Kodiak in December, 1977 at which the findings of the report were discussed with city and burough officials. Instead, residents, when asked what the evidence was, made statements such as:

- it was a federally conducted survey
- stones are falling
- because we had a slide once, Denslow went into a panic and called in some engineers
- area had a history of sliding there - was obvious it would slide because so loose
- something about red markers
- engineers surveyed mountain
- they had put some posts or pillars on mountain, Roy Edurd local surveyor did it recently
- some government agency measured amount of slip and it was moving
- had studies made of it - think it is ridiculous to make studies

Asked if they could recall hearing how damaging the slide was supposed to be, 70% of those who could remember said the slide would generate a tidal wave which would result in varying degrees of damage to the town. The remainder cited a number of other effects, including damage to the road system and damage similar to the 1964 earthquake (Table 1).

TABLE 1

PERCEPTION OF LANDSLIDE DAMAGE

Perceived Damage	Percent
Tidal wave	30
Tidal wave and destroy whole town	14
Tidal wave and destroy downtown	10
Tidal wave and destroy docks	16
Road wiped out	4
Same as 1964 earthquake	6
Other	20

The residents were also unsure whether a specific time frame had been given for the landslide. When asked whether a date was projected, 45% could not remember, 26% believed none was given, and 11% gave a date. Two people considered the slide imminent, one thought it would occur in May or June 1980, one within the next 5 years, another within the next 10 years and one believed it would happen in 1981.

Between January, 1978 and July, 1979, the local newspapers published some 24 articles on Pillar Mountain. A review revealed that none presented a comprehensive, clear and easily understood discussion of the Pillar Mountain landslide threat. Furthermore, no description was given of the USGS warning program or of its responsibilities or role in hazard notification. The articles mainly reported comments made at meetings held about Pillar Mountain and contained numerous quotes from a variety of local officials, consultants, government personnel and official reports. It would have been extremely difficult, probably impossible, to obtain an informed view of the Pillar Mountain problem by reading the newspapers. Because the articles were spread out over 18 months, it is not surprising that the public had a hazy and incomplete appreciation of the technical information concerning the slide.

Public Perception of Threat

Residents were asked a series of questions to find out how seriously they viewed the threat of a landslide, and to discover their attitudes and reactions to the notification.

The replies showed that the people did not take the notification seriously and had strong feelings about the issuing of such a notice. Only 11% said they took the landslide notification seriously, while another 11% said they regarded it as being fairly serious. The remainder did not consider the threat very serious, or did not consider it serious at all. The latter group was particularly vehement in its opinion that the notification was not worth even thinking about.

The question, "What was your first reaction on hearing about Pillar Mountain," provoked very emotional and often strongly worded and colorful replies. Many respondents expressed disbelief; others considerable anger and annoyance. Some answers:

--Bunch of B.S.
--Even if it slid not enough water in the bay to do any damage
--Just a bunch of junk
--They are trying to pull something
--Full of baloney might slide a little but not create another tidal wave
--Think it is a big laugh
--Utter nonsense

Only a few people expressed fear of a slide. One woman from the Philippines said she had transferred to another cannery to be safer; another person said, "Every time I drive down the road I look up at the hill and drive faster through there."

Further insight into public perception of the landslide danger is provided by their estimates of the amount and type of damage which would result. The majority believed the landslide would result in nothing more serious than local damage, mainly to the road immediately below the slide area. Twenty percent thought only a few rocks would fall down the mountain, a continuation of the process that has been taking place up to now. Only 8% thought a damaging slide would cause a tidal wave.

TABLE 2

FIRST REACTION TO HEARING ABOUT PILLAR MOUNTAIN

Reaction	Percent
Hostility and disbelief	33
Apathy, indifference, fatalism	19
Doubt don't believe	17
No reaction	9
Scared	9
Questioned wisdom of removing gravel	4
Concern about social and economic impact	2
Confusion	2
Surprise at physical extent	2
Other	6
Total	100

Perhaps because they foresee little damage, 95% of the people intend to do nothing about the problem and the remaining 5% simply plan to seek more information.

Citizen Awareness of Official Response

Answers to the question, "Do you know of any action taken by public or governmental agencies in response to the Pillar Mountain landslide notification," show that citizens have no accurate idea of actions being taken by various levels of government. They do not know what has been done, what is being done, why it is being done, or by whom. There appears to have been no effective communication between public officials and the general public.

Sixty-seven percent of the interviewees said they were aware of action taken by the government, 30% were not aware of any action and 3% had no opinion. However, when questioned about the type of government action, most vaguely referred to surveys, studies, and consultants of one sort or another:

> They keep having geologists come in to survey. Seems a waste of a lot of money.
> Nothing outside of calling those people in to check it out.
> Have studies and placed stakes on the hill to see it move - they spent a hell of a lot of money on it.
> Several studies going on right now--most being financed locally from Kodiak.
> Various theories proposed to prevent it going--everything from terracing to blasting.
> Just studies and stakes; have not really been interested in it.
> Had a consulting firm do a study--consulting firm advised I think another study.
> City has had Geological Survey people over and decided what to do about it--state legislature funded money to fund suggested changes.

A substantial number also referred to money being spent on surveys. The replies included comments such as:

> Have spent $800,000 on a survey--have not done anything except to tell us it will slide down.
> Lots of studies and people getting rich of studies.
> Spending lots of money--someone getting rich on it.

Almost no one had a realistic idea of how much was being spent on the surveys or where the money was coming from.

State, city, borough and local government agencies appear to have made no attempt to tell the public what the situation was and what was being done about it. The first meeting between Kachadoorian and local officials in Kodiak, in December, 1977, was closed. Afterwards, Kachadoorian refused to comment to the press about the situation saying, "The meeting was designed for the responsible officials, and the discussion was for their benefit" (Kodiak Daily Mirror, 1978.) The borough manager asked those present not to discuss the meeting publicly (Kodiak Daily Mirror, 1978).

The failure of public officials and the press to ensure that the public was accurately, honestly and completely informed from the start (and throughout the process), coupled with the sense of secrecy created by the earliest meeting(s), may partly explain the suspicious and hostile attitude of the citizens. It also created a climate which was encouraged hearsay and rumor. At the acrimonious open meeting in April, 1978, some local people exhibited rudeness and hostility, shouting down the outside experts so that not all of them had an opportunity to speak (Kodiak Daily Mirror, 1978a). A friendlier response was evident at the meeting in December 1978 when USGS officials came to Kodiak at the request of local officials. A positive result was the formation of the Geotechnical Committee to assess the risks and advise the community.

Public Perception of Scientific Predictions

A series of questions was asked to find out how accurately the public thought scientists could predict landslides, how certain the prediction should be before a public announcement was made and whether the decision to issue a notification for Kodiak had been good or bad.

There was no consensus among citizens about the ability of scientists to predict landslides. Only 25% thought scientists could predict landslides accurately. Thirty-one percent felt predictions could be made somewhat accurately, 20% not too accurately, 4% not at all. Twenty percent did not know. The residents also believed there should be strong certainty before a public statement is made about a possible disaster (see Table 3).

TABLE 3

HOW CERTAIN SHOULD PREDICTION BE BEFORE GOING PUBLIC?

	No.	Percent
Definitely (90-100%)	20	31
Quite (60-80%)	11	17
Fifty Fifty (40-50%)	14	22
Somewhat (20-30%)	5	8
Not Very (0-10%)	3	5
Don't Know	7	12
Other	4	5
TOTAL	64	

Should Public Notifications be Made?

Half the people interviewed felt the public announcement of the Pillar Mountain slide was beneficial, 26% thought it was bad, 15% did not know and 9% had other opinions. Some comments:

> People should know what is going on--they keep too much stuff secret around here,
> Good, make it public because it concerns us,
> Good--some publication is necessary.

Some who believed it had been a bad decision to release the notice were worried that it might scare people. Some who felt notification should not have been made feared loss of insurance or increased rate, a fall in real estate values or emmigration from Kodiak. Others were worried that it might slow economic growth, stop development or cost the taxpayers money.

The majority of the citizens (58%) believed that it was the responsibility of some level of government to inform the public about a possible hazard. Only 23% believed that the scientists who had identified the risk should make the announcement. Eleven percent opted for a combined announcement by public officials and scientists.

Summary

In Kodiak, the percentage of the population with direct natural disaster experience is much higher than the national norm. This, and their appreciation of the risks of fishing Alaskan waters and living in an isolated community, has made them less fearful of natural disasters and more willing to accept and live with the excesses of nature. Accordingly, the possibility of a landslide on Pillar Mountain is not as frightening as it might be to other communities. This in part explains the public's reluctance to consider Pillar Mountain a serious threat.

Interviews revealed that the public is aware of the possibility of a landslide. However, it is an awareness based on ignorance. The residents have no real understanding of the evidence on which the warning was based, who was responsible for raising the alarm, what is being done by whom, or what it is costing and who is paying. They have no knowledge of how this notification relates to the overall warning system of the USGS. Further, they have not been informed of the responses of each different level of government.

Government officials and agencies did not make an organized attempt to ensure that the public was accurately advised. Instead, information was filtered through the local newspapers. There was, at the beginning, a lamentable lack of direct communication between public officials, government agencies and the public. This contributed to an atmosphere of disbelief and suspicion, and led to hostility, anger, rumors and erroneous impressions of what was taking place.

In the future, when a warning which will affect the life of a community is to be issued, a concentrated attempt should be made to accurately advise the public about the situation. This may not gain their support and cooperation, but it will clarify the issues of ensuing debate. It will probably be necessary for the agency issuing the warning, either by itself or in collaboration with legal government officials, to devise an information campaign.

The interviews also showed that the public expects the issuing agency to have at least 50% certainty that the event will take place before making a public announcement. In Kodiak, no risk assessment was given, making it difficult for the people and decision makers to evaluate the threat to their town and creating feelings of frustration. Future warnings should, therefore, include an assessment of the risk in terms that people can understand.

RESPONSES OF KODIAK OFFICIALS TO THE LANDSLIDE NOTIFICATION

The initial notice of a potential landslide for Kodiak went first to the Governor of Alaska and the state geologist (see Appendix A). At the same time, copies of the letter were mailed to a wide range of public officials at the local, state and federal levels, who, it was thought, might be interested or affected. This list included representatives of the Army, Navy, Air Force, and of commerce, agriculture, and the Alaska oil and gas industry. Congressmen and senators were also notified. Public officials in Kodiak has been informed of the notice in prior meetings with USGS personnel.

Many officials, especially at the local and state levels, were decision makers whose perception of the risk, and their responses, were expected to have economic and social impact on the community.

We interviewed a majority of these key local, state and federal officials to discover their attitudes, awareness of the problem and feelings and responses to the landslide threat. We learned that some of the people who received or saw the notice could not remember having been informed and were so far removed from the landslide problem that they wondered why they were contacted.

The notice to less interested or involved officials changed their opinions of Kodiak. Compared to officials close to the problem, they were more likely to take the warning seriously and to support its dissemination. Further, the notice caused them to perceive Kodiak as a more hazardous place to live than other cities.

The responses of 16 state officials interviewed varied widely. For many, the notification was peripheral to their functions and interest was accordingly low. For others, with statutory responsibilities related to hazards, there was a keen awareness and concern. For example, the Director of the State Division of Emergency Services felt he should have been informed earlier and more directly than was the case.

Our analysis focussed on the local officials who were most involved and reacted most strongly to the notification. This sample of 28 includes city and borough officials and a few other key local decision-makers.

Prior Knowledge

Community knowledge of a potential landslide on Pillar Mountain existed before the USGS notice, according to interviewed officials. A common remark in response to a question on prior awareness was that there has always been some raveling or sloughing, but nothing major. The dark area on Pillar Mountain is obvious to anyone coming to Kodiak, though its significance as a slide may not be. There is a striking contrast between the dark black slide area and the fresh green vegetative cover found even on steep slopes. "Can hear rocks raveling down if quiet there" is a typical reply to a question about prior awareness. Other comments indicating community awareness and response to the potential landslide hazard cited the use of rocks and wrecked cars to stop the falling rock, and attempts to bring the slide down by planting explosives, shelling the mountain from a destroyer, and bombing it. The latter action reportedly broke windows in town but had little noticeable effect on the mountain. Although aware of the slide, local officials were not concerned about danger from the slide or fully cognizant of its potential magnitude. After the 1964 Earthquake, they allowed contractors to use material excavated from the toe of the slide as fill for the harbor. Since the rock sloughing down was insufficient for this purpose, much blasting and drilling was necessary. The result was a landslide in the early 70s which blocked the road and disrupted communications with the airport for several months.

Initial Reaction

It is not surprising, then, that local officials and decisionmakers did not respond to the USGS notification with pleasure or gratitude.

Responses to the question, "What was your first reaction on hearing of this?" indicated disbelief and little concern about the potential landslide hazard (Table 4). The intensity of these reactions is indicated by the number of comments provided (close to two per respondent.)

TABLE 4

INITIAL REACTIONS OF OFFICIALS

Reaction	No.	Percent
Doubt, hostility	27	56
Concern about social and economic implications	8	17
Concern or surprise about physical extent of hazard	6	13
Indifference, fatalism, apathy	4	8
Confusion	2	4
Questioning of wisdom of removing gravel from base	1	2
TOTAL	48	100

There were strong expressions of disbelief mixed with hostility and a feeling that the danger had been exaggerated. Direct hostility toward the authors of the report or the USGS was expressed in such comments as:

> Whoever the dingbat was who said there would be another tidal wave should be turned around and sent back. We don't want those kind of agitators,

> I know that mountain ain't going to fall. When they said it, I called them a bunch of idiots.

One irate city council member ridiculed the notification as raising unnecessary fears declaring:

> I'd rather spend money on road improvements, upgrading the community rather than about a snake jumping out of the bush and biting us.

Along with the doubt and disbelief about the event, a few individuals went so far as to express cynical or even paranoid views as to the motives behind the notification:

> Government's trying to generate more studies,

and

> That's political, it seems to me it was magnified by the borough.

One individual characterized the issuance of the notification as "irresponsible grandstanding." Those comments were categorized as doubt, disbelief or rejection of the warning. They accounted for over half of all the responses to this question among public officials and decision makers.

A second category of comments expressed indifference, apathy, fatalism, or lack of concern:

> I wasn't concerned,
>
> If it goes, it goes,
>
> Doesn't bother me,

These accounted for 8% of the comments by public officials and the decision makers.

Social and economic implications of the hazard notification are seen in such remarks as:

> Dog Bay Harbor may be dead,
>
> Strangles the town economically,
>
> It was like a red flag to stop development.

Other officials were concerned about possible public reaction:

> I knew everyone was going to get alarmed

or

> I wanted to make a statement indicating that we were going to ask for expert advice as to what to do.

Another example expressed a major underlying concern of the community:

> I see the advantage of the USGS warning people but I don't think it's right for them to stop there. They must verify it for they could unjustifiably injure a community.

This category, reflecting social and economic concerns, included 17% of the comments by public officials and decision-makers.

The remaining categories of answers to the question about first reaction to the hazard notification display a greater degree of belief in the hazard notification. These made up about one-fifth of the sample. The first category contains expressions of concern or surprise about the magnitude of the hazard, such as:

> My suspicions were confirmed that there was a danger. I was surprised that it was larger than I had perceived it to be.

Such concerns comprised one-eighth of the comments by public officials. Two other categories were found. None exceeded more than 4% of the comments. The first included a few remarks expressing confusion about what to do, the second concern about the wisdom of removing gravel from the base of the slide area.

Community Awareness

Whatever their doubts, the decision makers in Kodiak are aware of the possible landslide. Reuben Kachadoorian, senior author of the USGS Report, met with city and borough officials in April 1978 a month before the official notification. Those in key civic and borough positions informed members of their councils. City department heads were informed in council meetings. They in turn informed members of their departments. One city council member called Washington to talk to Alaskan senators.

Responses to the question, "Did you discuss it with many people?" and, "Who did you discuss it with?" showed that public officials and decision makers repeated the situation to, among others, "old timers," local engineers, fishermen, the city staff, the Chamber of Commerce, the Fishermen's Association and people who came to Kodiak to do business. An intensive community discussion took place. Of the sample of public officials and key decision makers 85% indicated they discussed it with many people. Some who said they didn't tried to indicate their indifference and contempt by such comments as:

> I would ignore it if it came up for discussion, if it continued I'd walk away,

or

> I just laughed at it.

The intensity of the discussion in a situation where the problem and its solutions were not clearly defined led to much speculation and creation of rumors. Latent hostilities surfaced and scapegoats were sought, including the authors of the report and the USGS. Local conflicts between the city and the borough, Kodiak and various state agencies, and Kodiak and the Federal government. Loss of state and Federal funds and potential economic damages beyond any yet visited upon the area were blamed on the notification. Comments throughout the questionnaires attest to the strength of such feelings.

Comparisons of the responses obtained from the public and from public officials revealed that the decision makers were better informed on the details of the landslide notification as can be seen in Table 5.

TABLE 5

AWARENESS OF USGS NOTIFICATION

	Response	Public No.	Public Percent	Decision-makers No.	Decision-makers Percent
Do you happen to remember what evidence the notification was based on?	yes	27	42	20	71
	no	33	52	8	29
	no response	4	6	0	0
Do you remember whether a date was given for this landslide to occur?	yes	7	11	0	0
	no	29	45	7	25
	none given	17	26	21	75
	don't know	8	12	0	0
	no response	3	6	0	0
Do you remember anything about how damaging this landslide was supposed to be?	yes	43	67	25	89
	no	10	16	3	11
	no response	11	17	0	0

Thus we see that 71% of the decision-makers professed a knowledge of the evidence on which the notification was based compared to 42% of the public. Three-quarters of the decision-makers were aware that no date had been given for the landslide to occur compared to about one-quarter of public sample. However, a high proportion of the respondents in both samples remembered something about how damaging the landslide was supposed to be. This disparity, as pointed out in the previous chapter, is not surprising as many of the public officials had access to the Kaachadoorian report or had attended meetings with USGS personnel.

The comments forthcoming from each of the questions in Table 5 revealed further differentiation in level of awareness. We will confine our remarks to two issues raised in the comments to the last two questions.

The first issue is the ethics of issuing a notification without providing estimates of probability. The second deals with the general tendency of the public to remember certain details while forgetting many others.

Some serious ethical issues were raised in the emotionally-charged comments generated by the question "Do you remember whether a date was given for this landslide to occur?" This was particularly evident among the 75% of the decision-making sample who correctly answered that none was given:

> That's what infuriates me about the whole thing.
>
> Kachadoorian says potential exists for massive deep-seated movement. He was asked to put a probability on it but said he couldn't.

Anger about the lack of probability estimate was based on at least three factors. There is anger based on the uncertainty of the possibility:

> They said that it might; someday the world might come to an end; some day we could have another earthquake or tidal wave.

A variation was anger at the inconclusiveness of the scientific study:

> Might as well fly Jeane Dixon in to predict it as make a study.

Another source of fury was the inability or perceived unwillingness of the USGS to conduct the expensive studies necessary to more precisely delineate the hazards, thus leaving it up to the town:

> Aggravating that they can walk away and we have to spend money to substantiate their casual observations.

Lack of proof for statements which may have strong economic impacts also angered the public officials:

> Literally puts a lid on development. That's the danger of something like that, almost borders on being irresponsible. If they make a statement, they should have to substantiate it with evidence.

Community awareness of the magnitude of the event illustrates how information can get garbled. Although one of the best-informed officials indicated that USGS officials did an excellent job of presenting the technical details and describing a range of possibilities, these ideas did not usually come across. Instead there was a tendency to think of the magnitude in terms of the worst possible case. When asked "Do you remember anything about how damaging this landslide was supposed to be?" 89% of the public officials and decision-makers replied "yes." Further probing indicated that, of those answering affirmatively, 68% were thinking in terms of the worst case or an exaggerated version of the worst case; 32% indicated they were aware there was a range of possibilities. Frequent official statements by experts might help to slow down the rumor mill by lowering the level of uncertainty.

Community Belief in Notification

While residents of Kodiak are aware of the Pillar Mountain notification and the worst-case scenario, they do not all take it seriously. Like residents of other hazard zones, they find it hard to believe the magnitude of the maximum possible event. This is indicated by their responses to two questions. The first asked them, "How seriously do you take this prediction? Would you say very seriously, fairly seriously, not very seriously, or not at all seriously?" The second question was, "Concerning the landslide possibility, do you believe the landslide will cause a damaging tsunami, some local damage right below the slide area but not a tsunami, a few rocks will fall but nothing major, or no landslide will occur?"

Table 6 shows the response to the first question. One-quarter of the decision-makers take the prediction very seriously, though this group is heavily weighted by borough officials who are less firmly committed to a continuation of the developmental pattern in the same locations. On the other hand, over two-thirds of the decision-makers indicated that they did not take the prediction seriously. Almost three-fourths of the public sample expressed similar sentiments.

TABLE 6

HOW SERIOUSLY DO YOU TAKE THIS PREDICTION?

	General Public		Decision-Making Sample: City Officials		Borough Officials		Others*		Total	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent
very seriously	7	11	3	21	4	50	0	0	7	25
fairly seriously	7	11	0	0	0	0	1	17	1	4
not very seriously	15	24	5	36	0	0	4	67	9	32
not seriously at all	30	48	6	43	3	38	1	17	10	36
don't know	3	6	0	0	1	13	0	0	1	4
TOTAL**	63	100	14	100	8	101	6	101	28	101

*Includes two bankers, one insurance agent, one Indian Corporation official, one Coast Guard Commander, one newspaper editor.

**percent is not always 100 because of rounding.

Those who did not take the prediction seriously tended to be more outspoken and their spontaneous comments in response to this question provide vivid illustrations of the range of individual reactions. The prestige of the USGS is acknowledged in such comments as:

> I respect the men but need more studies to find out.

The power of the notification is evident in others such as:

> I take it seriously in terms of the impact on the community because of an erroneous report.

More common are forthright denials of any danger. Admission of various degrees of danger were accompanied by dismissal of such dangers as not worth worrying about as in:

> There is a possibility it could happen like Skylab falling in L.A. but the probability is very slim,

and

> It's possible but I don't worry about it. It hasn't affected the policy of the bank.

The latter comment is an interesting counterpoint to exaggerated fears of economic consequences of the notification. It indicates that at least local funds have not dried up. This was corroborated by the other banker in the sample.

The difficulty in accepting the potential magnitude of a maximum landslide event is supported by the results of the question on the size of landslide which the respondents considered likely to occur (Table 7).

A sophisticated understanding was evident in 14% of the decision-maker sample who, rather than select any of the alternatives offered, pointed out that there was a range of possibilities. This is illustrated by a comment from one of them that:

> It depends on physical circumstances; if extensive periods of rain or an earthquake, it is conceivable for the maximum condition to occur.

As was the case with the public sample, only a small number of decision-makers thought a tsunami was likely to be caused by a landslide. This was clearly a minority point of view, even though the maximum event was the one most often thought of as predicted by the USGS. It was the better informed group, the decision-makers, which included the highest percentage with this opinion.

TABLE 7

EXPECTED EFFECT OF THE LANDSLIDE

	Public		Officials and Decision-makers	
	No.	Percent	No.	Percent
damaging tsunami	5	8	4	14
local damage below slide area	27	44	9	32
only a few rocks	12	20	6	21
no landslide	6	10	2	7
range of possibilities	0	0	4	14
don't know	11	18	3	11
TOTAL	61	100	28	99

Some potential for lesser damage was recognized by most respondents. The most easily visualized was local damage below the slide area and the comments indicated this referred mainly to the road, the docks and the crane immediately below the slide, as seen in Figure 7. This was seen as most likely by 44% of the public sample and close to one-third of the decision-makers. Another fifth of each sample thought only a few rocks

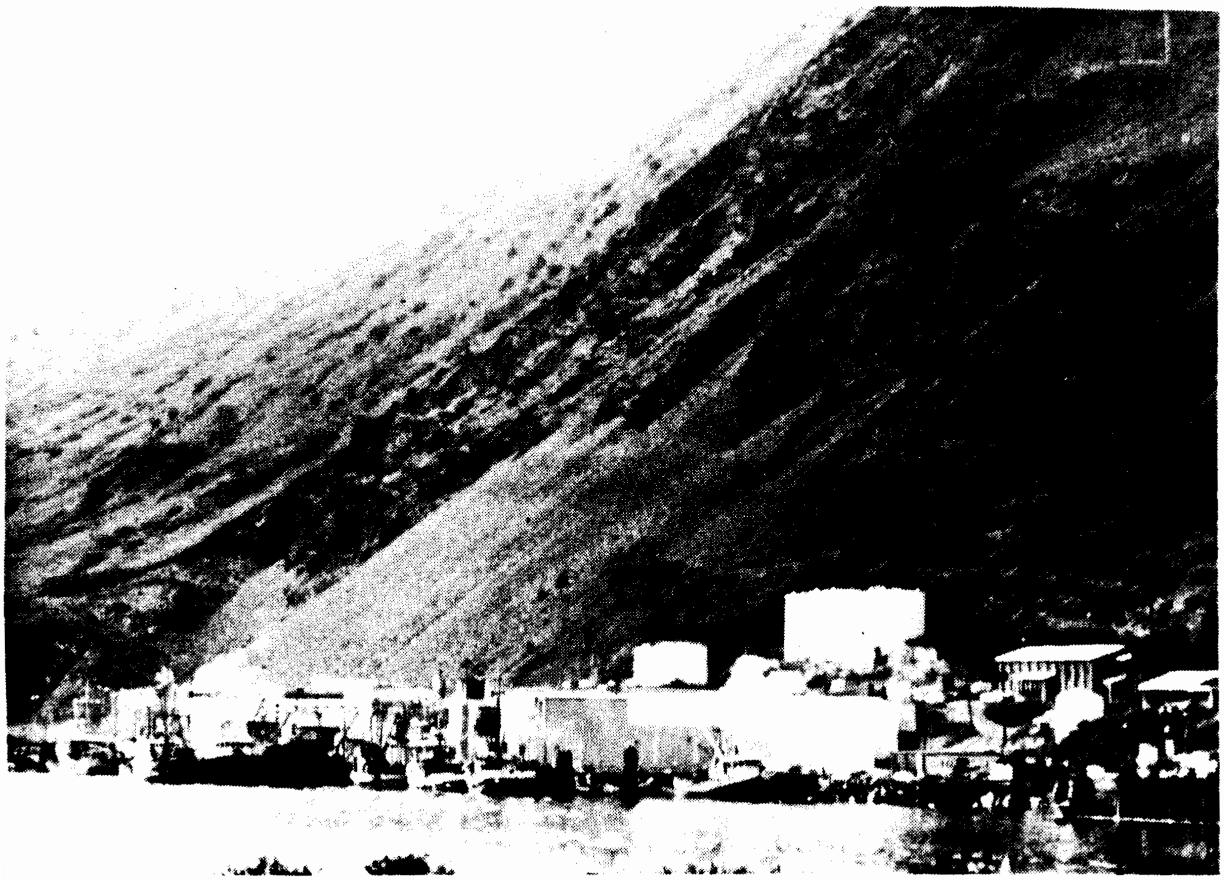


FIGURE 7

ROAD, DOCKS, CRANE AND STORAGE IMMEDIATELY BELOW SLIDE would fall while a smaller group denied any possibility of a landslide. Although comments from respondents showed the difficulty of visualizing the maximum event and adopting a geological time perspective, there was little difficulty imagining a continuation of past patterns of movement on the slide:

> Always been sloughing there; old timers say it goes back 50-60 years,
>
> Based on my observations of the mountain it would be a minor landslide, not enough move ment to cause a tidal wave, but the crane would be vulnerable.

Should Public Notifications be Made?

Difficulties deciding whether or not to provide public announcements or notifications of geological hazards were reflected in the answers to the question, "All things considered, do you think it was a good or a bad thing to have made public the announcement of a possible landslide on Pillar Mountain?" (Table 8).

TABLE 8

NOTIFICATION: GOOD OR BAD?

Response	Decision-Makers No.	Decision-Makers Percent
Good	10	36
Bad	12	43
Good and Bad	6	21
TOTAL	28	100

The decision-making sample was split on this question. About one-fifth was undecided, while 36% thought it good and 43% thought it bad. Those who thought it was a good thing to have made the announcement often followed this up with comments indicating the bad side and vice-versa.

Reasons most commonly cited for considering the announcement a good thing were the public's right to know and the scientist's obligation to tell the citizens. There was the expressed belief that it is "probably best in the long run to let people know," even in some instances if they don't like what they hear.

Many more reasons were given for considering the public notification a bad thing. These often referred specifically to the Kodiak situation, in contrast reasons supporting notification which seemed to consider the general policy of providing information. The most frequent comment was that the Kodiak notification may have been premature or based on insufficient evidence. Other reasons often mentioned were negative national publicity, adverse economic effects on the community, and an example of the latter, cancellation of insurance or an increase in rates attributed to the notification.

Should Harbor Development Proceed?

In the course of our study, we were told over and over that Kodiak was the second largest fishing port in the United States. Furthermore, because of the recent establishment of the 200-mile limit, great expansion of the fishing industry was expected for Kodiak, particularly bottom fishing not previously exploited on a large scale by Americans. The port already is considered overcrowded, and demand for more facilities continues to grow (Figures 8 and 9). For these reasons it is not surprising

FIGURE 8

FISHING BOATS IN KODIAK HARBOUR

FIGURE 9

CROWDING IN KODIAK HARBOUR

that the majority of the sample interviewed in Kodiak answered "yes" to the question, "Do you think the potential benefits of building a new harbor in Kodiak are great enough to warrant going ahead with the project in spite of the risk associated with the possible Pillar Mountain landslide?" Three-fourths of the decision-making sample said "yes" and more than a third of them added such comments as "absolutely," "unquestionably," or "definitely." The same pattern was found in the public sample though a higher proportion among them said they didn't know (Table 9).

TABLE 9

DO BENEFITS OF NEW HARBOR OUTWEIGH RISKS?

	Public		Decision-makers	
	No.	Percent	No.	Percent
Yes	44	69	21	75
No	4	6	4	14
Don't know	15	23	1	4
No Response	1	2	2	7
TOTAL	64	100	28	100

Reasons given for going ahead with the harbor project in spite of the potential risk included denial of any risk, the critical need for a new harbor, and growth of Alaskan fisheries. Some did see a need for resolution of the degree of risk involved and a few, mainly borough officials, advocated building a new harbor at some other site. In addition, some thought the hazard should be removed by physical alteration of the mountain. Those who did not think the potential benefits warranted the risk thought it more prudent to wait for a more definitive answer from the studies in progress.

The determination of Kodiak's decision makers to go ahead with their plans for further development may be seen in the unanimity with which they responded to the question on "What alternatives are there for mitigating the possible effects of the landslide?" The city officials clearly had agreed on a solution to this issue. Almost all described a plan which involved terracing the mountain and using the material removed for fill to buttress the base of the slide area. Very few other alternatives were suggested, only three by as many as two people.

Scientific Predictions and the Public Desire for Such Information

A series of questions was used to test respondents' beliefs regarding scientific predictions and to measure the public desire for such scientific information. While the Kodiak case does not involve a precise prediction as to time, place, and magnitude, the information in this section should be of interest to the Survey as they move toward such predictions.

The first question asked, "How accurately do you believe scientists can predict landslides at the present time?" (Table 10).

One-fourth of the public, but only 10% of the decision-making sample, believe scientists can make quite accurate predictions of landslides, while 30% of the decision makers, but only 20% of the public thought scientific ability to predict landslides was not too accurate. In both samples, sizeable portions said they did not know. Some qualified their positive assessments by such comments as, "Doesn't say they've done it in this case," or give a negative assessment accompanied by a remark like,

TABLE 10

PERCEPTION OF PREDICTION ACCURACY

	Public No.	Public Percent	Decision-makers No.	Decision-makers Percent
Quite accurately	16	25	3	10
Somewhat accurately	20	31	8	30
Not too accurately	13	20	8	30
Not at all accurately	2	4	0	0
Don't know	13	20	9	30
TOTAL	64	100	28	100

"based on experience here, on a low level."

A second question attempted to ascertain the degree of certainty considered essential before making public predictions about landslides (Table 11).

TABLE 11

CERTAINTY PREREQUISITE TO PREDICTION

Response	Decision-makers No.	Decision-makers Percent
Definitely sure (90-100%)	7	26
Quite sure (60-80%)	10	37
A fifty-fifty chance (40-50%)	5	19
Somewhat sure (20-30%)	0	0
Not very sure (0-10%)	4	16
Don't know	0	0
Other	1	3
TOTAL	27	100

Four-fifths of those who expressed an opinion felt the certainty should be fifty-fifty or better before making a prediction public. A similar response was obtained when the same question was put to the public. Fifteen percent of the decision-makers expressed the desire for all information at any level of certainty. This was often forcefully expressed.

A third question presented a situation in which scientists have information indicating that there is a 50-50 chance that a damaging landslide would occur in one year. The respondent was asked when and if the prediction should be made public. A strong consensus said the information should be made public immediately. Some qualifications noted were that it should be a consensus of opinion among many experts, that the scientists should get together with the local officials to decide what and how much should be said, and that it should only be announced it it was based on a thorough, completed study.

A final question about scientists and information was, "If the prediction that a damaging landslide will occur one year from now were to be made, who do you think should be responsible for informing the public?" (Table 12). A variety of opinions was provided in response to this question both in terms of who should give the warning and the reasons why.

City and local government officials were seen most often as the appropriate source of a warning. Close to half the decision-making sample agreed that local officials should issue the warning. The only other well-supported position, comprising over a fourth of the sample, was that the scientists should issue the warning. Their knowledge made them logical choices. As one put it:

TABLE 12

WHO SHOULD INFORM THE PUBLIC?

Response	No.	Percent
Scientists	7	27
Government officials (general)	3	12
Government officials (local)	11	42
Government officials (state)	1	4
Government officials (federal)	1	4
Both scientists and government officials	2	8
Don't know	1	4
TOTAL	26	101

> As high as possible in the USGS for they must have the expertise to know what they are talking about.

A more negative reason was expressed by one hostile respondent who said,

> I'd let the geologists make the prediction and if it didn't come off when predicted, bury the son-of-a-gun for scaring the hell out of a lot of people.

Several who thought the scientists should issue the warning made it clear that this should only be done after the local officials had received the warning:

> People making the prediction should notify the municipal government prior to making a public statement.

This was done in the Kodiak case.

The only other suggestion made by more than one person was a joint statement by scientists and government officials. This was stated directly by only 8% of the sample, but many more implied that cooperation between the two was essential.

Final Reactions

A striking characteristic of the interviews in Kodiak, particularly with the decision-making sample, was the intensity of responses. Much emotion was evident in the summer of 1979, over a year after the first public notification appeared. A total of 53 separate comments, some of them lengthy, from our 28 respondents, in response to the concluding comment,

> That's about all unless there is anything else you would like to tell me about your reactions to the Pillar Mountain landslide announcement.

The array of answers was condensed into the smaller number of categories in Table 13.

TABLE 13

CLASSIFICATION OF FINAL REACTIONS

	No.
Economic repercussions	10
Need to substantiate magnitude and probability	9
Need for greater sensitivity to small communities	8
Disbelief in seriousness of the danger	6
Risks everywhere, life must go on	6
Concern about cost of studies	4
Hostility toward experts	3
Determination to go ahead regardless	3

Most frequent were comments that focused on the economic repercussions of the notification. As one respondent said:

> It becomes an emotional issue if you take away someone's livelihood no matter how right it is scientifically.

There was a fear expressed that:

> we could be destroyed economically without a disaster occurring.

Other types of comments in this category insisted that funds were drying up and insurance being cancelled as a result of the notification. One respondent insisted that the notification has "eliminated any possibility of expansion." Many of these comments were simply assertions, hard to substantiate, and not backed by any measurement of economic impact. Whether true or not, the respondents seemed to believe them and were behaving as if they were true.

A second category of comments was labelled "the need to substantiate the magnitude and probability of the potential landslide threat."

> We in the community have been put in a very awkward position due to the red flag being put on Pillar Mountain before they are even sure it is going to fall,

and

> They say it could happen sometime but give no idea when.

Eight comments expressed the need for greater sensitivity to small communities on the part of the scientists and the federal government. One respondent expressed himself bluntly as being:

> not happy with the federal government: I feel strongly the Feds don't give a damn about local communities.

A complaint and a suggestion made was that they (the government)

> don't want to give assistance until there is a disaster. They should assist the community in solving the problem.

Disbelief in the seriousness of the danger or the conviction that risks are everywhere but life must go on were the themes of two other groups of comments.

> Visited all the older residents and they told him it had always moved but that it will never do anything more than just move a little.

Other comments were that Alaskans characteristically accept the high risks of their geologically active environment; that Kodiak was financially unable to meet the threat of a landslide; and that money spent on further studies of the problem would at best predict a slide, and might be spent on mitigation instead. Finally, some people expressed hostility toward scientists and a determination to proceed regardless of the risks.

Summary

As the USGS becomes more active in issuing hazard warnings, it must move beyond its scientific data and communicate effectively with local officials and with the public. The responses of public officials and decision-makers to the notice of a potential landslide in Kodiak demonstrate that the form and content of this communication must be based on considerations of the social and economic impact it may have on the community.

Because geological hazards are often known in communities, the USGS must do more than merely announce the existence of a hazard. The difficulty occurs in interpreting the magnitude and seriousness of rare events to people who have firm notions of the potential danger of their local hazards. These notions, though erroneous, may be strongly resistant to change and the process of interpretation may take a great deal of time. To be effective, such communication must be based on an understanding of the community.

Communication of technical information to the public requires special attention, for scientific perspectives are not easily transferred. This is seen in the general acceptance of the worst case as the only case, instead of awareness and knowledge of the probabilities of events of various magnitudes.

A critical requirement for optimum community response is some estimate, however crude, of the magnitude and probabilities of events involved in hazard notifications. By making official notifications and providing national publicity, there may be a tendency for the public to think of the likelihood of events, not in geological time frames, but as imminent. Geologists familiar with the processes find it difficult to estimate magnitudes and probabilities, yet they could do a better job than the public officials who must rely on estimates to determine the wisest policy for the community. Citizens in Kodiak might be more willing to assume risks than residents of communities elsewhere, which is another reason for applying social, economic and political data. Predictions based on general theories may not apply in specific communities.

The hostility expressed in response to the Kodiak hazard notification is not surprising since many people felt it threatened their livelihood. To overcome such a response, it probably will be necessary for the USGS to use specially trained people to present technical information to local officials. Even when done well, there is likely to be a negative emotional reaction if economic interests are threatened. The intense reactions and distrust of scientists which are likely to emerge in an emotionally-charged political atmosphere, may be unfamiliar to the USGS, and difficult to respond to. For this reason, individuals skilled in communicating under emotional conditions would be useful. Furthermore, this might overcome problems with individual personalities. Scientists who are hesitant to report geological hazards, or who find the attendant publicity distasteful, could then speak through expert communicators. Similarly, scientists more interested in publicity than their responsibility to the public could be kept in the background and prevented from inflaming an already tense situation.

In principle, people in Kodiak believed that scientific information on hazards, even if uncertain, should be released to the public. In the case of the landslide notification in their own town, they were less sure that the information should have been made public. In part, this is because the study results were not definitive. There was room for doubt and doubt arose. This emphasizes the need not only for good probability estimates, but for thorough studies. Because USGS studies usually focus on regional problems and conditions, and because small communities like Kodiak are often unable to fund their own studies of geological hazards, some funds may have to be provided for definitive local studies.

In such cases, the USGS must exercise great care, for its power and prestige can create impacts beyond the control of small and vulnerable communities.

Conclusions: The Role of the USGS in Hazard Warning

The primary goal of this study was to examine how the present USGS warning program is operating and to determine what changes are needed if the Survey is to fulfill its Congressional mandate.

Our interviews with USGS personnel and with public officials in Kodiak, Alaska, showed that the most urgent priority is to define and identify the role and specific responsibilities of the USGS. The Survey staff is undecided or in disagreement as to what its responsibilities should be. In Kodiak, the perception of the USGS role by citizens and public officials was far different than the Survey's interpretation of its responsibilities. The most basic question which needs to be answered is how involved the Survey should become in potential hazard situations.

People within the Survey favor a conservative role. Sixty-three percent felt that their main role was to provide geological information, but 68% also felt that the USGS has a responsibility to suggest possible mitigating measures. Survey personnel expressed reluctance, however, to give advice outside their area of expertise where others might be better qualified. For example, they said a planner, economist or political scientist might be more appropriate in recommending possible adjustments to a specific hazard. Engineers or engineering contractors might better suggest remedial measures.

The Kodiak case study illustrates problems which arise when information alone is offered by the Survey. There, the USGS carried out a technical survey, saw potential for a disaster and informed public officials. This procedure alienated the community and drew bitter criticism from a variety of sources. The citizens felt that the USGS, by issuing the notification, had placed a "red flag" on Pillar Mountain and thereby threatened Kodiak's economic development and well-being. Many people said the notice was a greater disaster than if the landslide had failed.

Much of the resentment arose because the Survey study and preliminary report left many geological questions unanswered. The report by Kachadoorian and Slater stated there was a risk, but did not establish the extent of the threat. The size of the mass which might slide was not accurately identified, nor were the positions of possible failure planes. Further, the report did not give any estimate of the probability of failure. The USGS justified this partial report, not on the grounds that it lacked expertise, but on the grounds that it had no authority or funds to conduct a complete study. The reaction and wrath of the people and officials of Kodiak indicate the kinds of future problems the USGS can expect if this approach is adopted as policy.

It seems incumbent on the Survey to establish, <u>to the limits of its geological capability</u>, the dimensions of a potential hazard. Authority and funds must be made available to the USGS if it is to provide responsible hazard warnings. Small communities cannot be expected to finance studies to confirm or disprove a hazard message. The costs are greater than the community can absorb. It also seems clear that the USGS must be prepared to assign a risk probability. In fact, 69% of the Survey personnel interviewed felt they should assign a probability. As one said, "If we don't do it, someone more ignorant and with less information will." In some cases, establishing a probability may be beyond the state of the art. In many others, one can reasonably be assigned.*

No immutable rules can be applied to determine how far the Survey should go in suggesting remedies. Here, too, it seems the USGS should proceed to the limits of its expertise. Having carried out the most comprehensive study of the hazard, the USGS is in a position to outline the best possible geological adjustments. Weighing possible solutions, i.e., technical versus socioeconomic, should, however, be left to community and local officials.

Whether the Survey should become involved in implementing remedial measures is a question of degree. The USGS is not equipped to function as a contractor, and perhaps should not compete with the private sector in this area. However, because it possesses the most complete data on a potential hazard, the USGS should be prepared to advise those involved in remedial work.

The question of how high the probability of a hazard should be before the agency notifies the public remains a thorny one. Many people in Kodiak resented the issuing of a warning when no probability or expected magnitude were announced. Conversely, the majority also felt that the public had a right to know about anything that might endanger its lives or property. The community was, however, united in its view that an event should have at least a 50% chance of happening before a warning was issued.

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*The importance of this was recognized when the Federal Emergency Management Agency assigned probabilities for California earthquakes in 1980.

The majority also believed that the USGS should not be the entity to issue such a warning. Most felt that local officials should take that responsibility, though a minority said the Survey and local officials should issue warnings jointly. Whichever method is chosen, the Survey should help local officials place the warning in the proper perspective. It is not enough to deliver technical information and then leave, for local officials may not understand its full implications, and hence may not have the tools to present clearly the full degree of danger without inducing undue fear.

The extent to which the USGS decides to become involved will dictate the extent of the changes needed in the organization. If the Survey elects to go beyond a purely technical role and communicate directly with the local community and its officials, the agency will require people who have the necessary skills to participate in sensitive public meetings and in other stressful situations. Such people may come from disciplines other than geology, in which case the professional and scientific flavor of the USGS will change. The Survey is now made up of technically-oriented professional geologists, hydrologists and engineers who perceive their function to be high-quality research. The internal reward system of the USGS encourages this perception. It will be important if some staff members become involved in public relations and communications, that the USGS support their work and not consider them second-class scientific citizens.

Whichever role is chosen, the USGS will have to make some policy and procedural changes if the mistakes of the Kodiak notification are to be avoided in the future. The Survey will have to become more sensitive to the views and needs of the affected community. Hazard notification has social, economic and political impacts on the community which must be considered. Before issuing a hazard warning, the Survey must determine what these impacts will be, perhaps by conducting surveys. As in Kodiak, it is possible that citizens will consider the notification itself more threatening than the potential hazard. The community may also be prepared to tolerate the high risk of living with a potential hazard. This, too, was true of the people of Kodiak.

A further advantage of gaining solid social and economic data on the communities involved is to avoid becoming associated with one camp in a local political squabble. In Kodiak, issues are often clouded by rivalries between city and borough or local community and state agency. The USGS blundered into the midst of the borough-city rivalry by allowing one party to arrange its first public appearance. Some of its ideas were thus discredited by association with what the rival faction would consider an undesirable local group. As a result, the messages imparted were not always judged on their merits, but as political ploys.

It is apparent, too, that the USGS must develop a better method of issuing warnings and communicating with the public. Kodiak illustrates the problems which can be expected when a purely bureaucratic approach is adopted. For Pillar Mountain, letters were sent to all public officials (state, local and federal) and to private interests that might be affected. Many of these letters, which simply stated there was a risk, were ignored.

The community in Kodiak had to rely on the local press for its initial view of the nature of the threat. Our interviews showed that although the people were technically aware of the possible landslide (as they had been for many years), they had no understanding of the real risk, or of what was being done about it. The local newspapers did not present a complete picture of the situation, but only reported bits of information over an 18-month period. Consequently, the public in Kodiak obtained an unbalanced review of the threat, focused on the aspect that affected them most--the construction of the proposed new Dog Bay boat harbor--and became angry and alienated.

If the development of this kind of emotionally-charged situation is to be prevented in the future, the USGS will have to realize that the public must be completely and accurately briefed and continuously appraised of what is happening. The responsibility for informing the public cannot be delegated to local public officials or left to the newspapers. Each of these may advance only its own perspective. The Survey will need to mount a campaign to inform the public, possibly through advertisements, special television programs, displays, or public meetings.

The Survey can also expect to be disbelieved when local interests are so strong that the community will not accept the threat. Interviews in Kodiak revealed that the community was not convinced that scientists have the capability to predict landslides. If it wishes to be effective, the USGS will have to convince officials of the community of the danger, and present its information in a form which is likely to persuade the citizens to take the risk seriously and do something about it.

The new responsibilities thrust upon the USGS by Congress will require organizational and attitudinal adjustments. Their extent will ultimately depend upon how far the organization is prepared to go in a particular hazard situation. However, it is apparent that the Survey, even if it limits itself to a technical role, is going to become more involved with local communities, and the Survey staff will be more in the public eye. By going beyond the letter of the law to include empathy for the communities involved, the USGS will stand a better chance of having a positive impact in the performance of its sometimes unpleasant duty.

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APPENDIX A

In Reply Refer To:
EGS-Mail Stop 720

Dr. Ross Schaff
State Geologist
3001 Porcupine Drive
Anchorage, Alaska 99501

10 MAY 1978

Dear Dr. Schaff:

As Governor Hammond's designee to work with the U.S. Geological Survey to reduce geologic-related hazards, we are bringing to your attention a possible hazard from landsliding near Kodiak, Alaska. The enclosed U.S. Geological Survey Open-File Report 78-217, Pillar Mountain Landslide, Kodiak, Alaska, by Reuben Kachadoorian and W. H. Slater, describes a large landslide, portions of which appear to be active. If the entire slide mass were to fail suddenly, it could generate a wave comparable in height to the tsunami that damaged Kodiak and environs during the Alaskan earthquake of 1964.

At the request of Mr. Harry Milligan, Planning Director of Kodiak Island Borough, Mr. Kachadoorian attended a meeting with a number of local, State, and Federal officials on April 11, 1978, to determine additional steps needed to better define the nature and degree of the hazard. The U.S. Geological Survey will continue to be available to provide technical assistance within our manpower and budget constraints. Because of the possible impact this landslide could have in the Kodiak area, we are sending copies of this letter to the persons listed on the enclosed pages.

Sincerely yours,

H. W. MENARD

Director

Enclosures 2

cc: Honorable Jay S. Hammond, Governor of Alaska

Letter to Dr. Ross Schaff regarding Pillar Mountain landslide, Kodiak, Alaska

bcc: Gen Files MS114
Dir Chron MS114
N. Deller, DOI
J. Nagel, DOI
AD-Env. Conserv., MS106
AD-WR
Cynthia Wilson, Special Asst. to Sec., DOI
Jerry Gilliland, Special Asst. to Sec., DOI
Regional Geologist, WR
Regional Hydrologist, WR
Area Oil and Gas Supv., Alaska
Chief, Alaskan Geology Branch, Menlo Park
Chief, Alaska District, WRD
R. Kachadoorian, Menlo Park
Bob Davis/Henry Spall
Don Kelly, MS119
Bob Alexander
T. Reed, MS112
LIA Chron
ESA Subj
ESA Chron
ESA RF

EGS:LIA:ESA:DRNichols:dl:5/2/78:x6961

Distribution of letter to Dr. Ross Schaff

STATE AGENCIES

Mr. Ernst Mueller, Commissioner
Alaska Department of Environmental Conservation
Juneau

Ms. Esther Wunnicke
Federal/State Planning Commission for Alaska
Anchorage

Fran Ulmer
Director
Division of Policy Development and Planning
Office of the Governor
Juneau

Mr. Gil Jarvela
Transportation Manager
Department of Highways
Kodiak

Mr. William R. Hudson
Director
Department of Public Works
Division of Marine Transportation
Juneau

KODIAK ISLAND BOROUGH

Ms. Betty J. Wallin, Mayor
Kodiak

Mr. Stuart Denslow, Manager
Kodiak Island Borough

Mr. Dan Busch, Chairman
Planning and Zoning Commission
Kodiak

CITY OF KODIAK

Mr. Tom Frost, Mayor
Kodiak

Mr. Ivan L. Widom, Manager
City of Kodiak

PRIVATE CORPORATION

Mr. Jack Wick, President
Koniag Regional Corporation
Kodiak

FEDERAL AGENCIES

U.S. Department of Agriculture

Mr. John R. McGuire, Chief
Forest Service

Mr. Wilson J. Parker
Chief, Resource Planning Branch
Soil Conservation Service

Mr. John R. Cox, Jr.
Farmers' Home Administration

Department of Defense	Mr. Seymour Wengrovitz Staff Director Plans & Systems Development Division Defense Civil Preparedness Agency
Department of the Air Force	Capt. Robert A. Larson Pentagon
Department of the Army	Lt. Col. Robert C. Sholar Pentagon
Department of the Navy	Cdr. J. W. Dropp Pentagon
Department of Health, Education, and Welfare	Mr. George E. Russell Emergency Coordinator
Department of Housing and Urban Development	Dr. Arthur J. Zeizel Office of Research and Technology
	Mr. Ugo Morelli Federal Disaster Assistance
	Mr. Joe Kemble Emergency Preparedness Staff Office of the Assistant Secretary for Housing-Federal Housing Commission
Department of Commerce	Mr. Walter Castle Office of Oceanic and Atmospheric Services
	Mr. Orin Fayle Chief, Project Management Division Assistant Secretary for Economic Development Office of Public Works
Department of the Interior	Mr. Stuart P. Hughes Division of Watershed Bureau of Land Management
	Mr. Julian R. Franklin Safety Manager Bureau of Indian Affairs

	Mr. James R. McGee Chief Office of Safety and Security U.S. Fish & Wildlife Service
	Mr. Gordon J. Hallum Chief APA Power Division Alaska Power Administration
Department of Transportation	Mr. Laurence J. Aurbach Office of Environmental Quality, ABQ-120 Federal Aviation Administration
	Mr. Emmett C. Kaericher Chief, Coord. & Disaster Assistance Branch Federal Highway Administration
	Cdr. Kenneth C. Cutler Search & Rescue Liaison Staff U.S. Coast Guard
Environmental Protection Agency	Mr. Doyle J. Borchers Ofc. of Air & Waste Management
Department of Energy	Mr. R. Raymond Zintz Chief, Emergency Preparedness Branch Division of Operational & Environmental Safety
U.S. Senate	Honorable Ted Stevens
	Honorable Mike Gravel
U.S. House of Representatives	Honorable Don Young

APPENDIX B

PILLAR MOUNTAIN GEOTECHNICAL COMMITTEE

Name	Affiliation
Banks, Don	Chief, Engineering Geology & Rock Mechn. Division Geotechnical Laboratory U.S.A.E. Waterways Experiment Station
Kachadoorian, Reuben	U.S. Geological Survey Engineering Geologist
Milligan, Harry B.	Planning Director, Kodiak Island Borough
Patton, Franklin D.	Consulting Engineering Geologist Consultant to City of Kodiak
Selkregg, Lidia	Consultant, Borough; University of Alaska
Schaff, Ross G.	State Geologist, Alaska Division of Geological and Geophysical Surveys
Slater, Willard H.	Chief Geologist, Alaska Department of Transportation
Stafford, John C.	City Engineer, City of Kodiak
Updike, Randall	Geologist, Alaska Division of Geological and Geophysical Surveys
Varnes, David J.	Engineering Geologist, U.S. Geological Survey