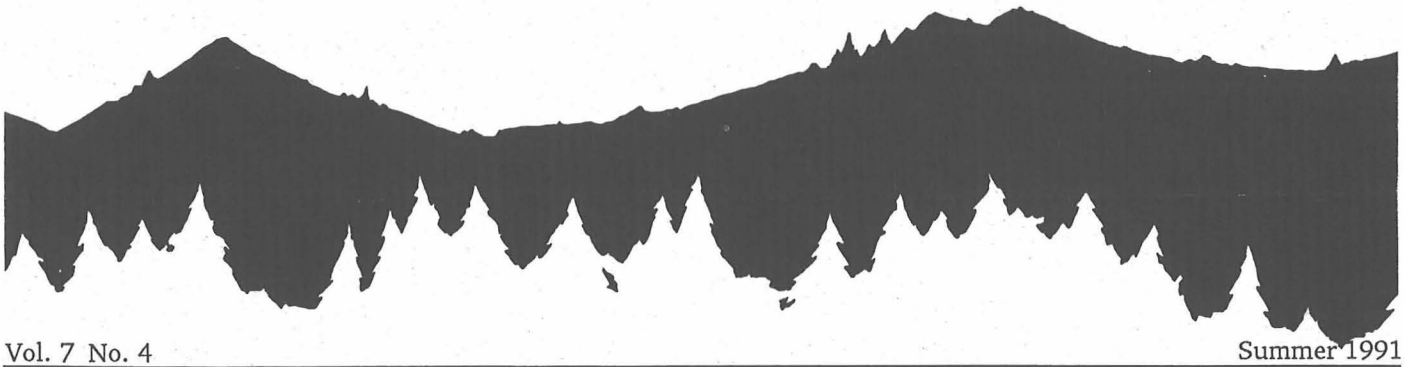
WASATCH FRONT FORUM



Vol. 7 No. 4 Summer 1991

EARTHQUAKE HAZARDS PROGRAM

The Wasatch Front Forum is published quarterly by the Utah Geological Survey. Information, contributions, questions, and suggestions concerning future issues may be sent to the Editor at the address listed below:

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Earthquake Activity in the Utah Region

April 1 — June 30, 1991

Susan J. Nava
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Salt Lake City, Utah

During the three-month period April 1 through June 30, 1991, the University of Utah Seismograph Stations located 308 earthquakes within the Utah region (see accompanying epicenter map). The total includes four earthquakes in the magnitude 3 range. (Note: Magnitude indicated here is either local magnitude, M_L, or coda magnitude, M_C. All times indicated here are local time, which was Mountain Standard Time.)

LARGER AND/OR FELT EARTHQUAKES

M_C 3.4, April 8, 10:53 p.m., 31 miles W of Ivins (see NW of St. George).

M_L 3.8, April 20, 6:56 a.m., 12 miles N of Paragonah (see NE of Cedar City), felt at Minersville (MMI IV), at Elsinore and Paragonah (MMI III), and at Hatch (MMI II).

M_L 3.1, April 26, 2:20 a.m., 12 miles N of Paragonah.

M_L 2.8, May 23, 1:38 a.m., 7 miles WNW of Orangeville (see SW of Price), felt at UPL Cottonwood Creek mine, and at Ephraim (MMI III).

M_C 3.0, June 25, 3:02 p.m., 45 miles WSW of Bluff (see SE Utah).

SIGNIFICANT CLUSTERS OF EARTHQUAKES

Southwest of Price (coal-mining related): Three clusters of earthquakes make up 23% of the shocks that occurred in the Utah region during the report period, including:

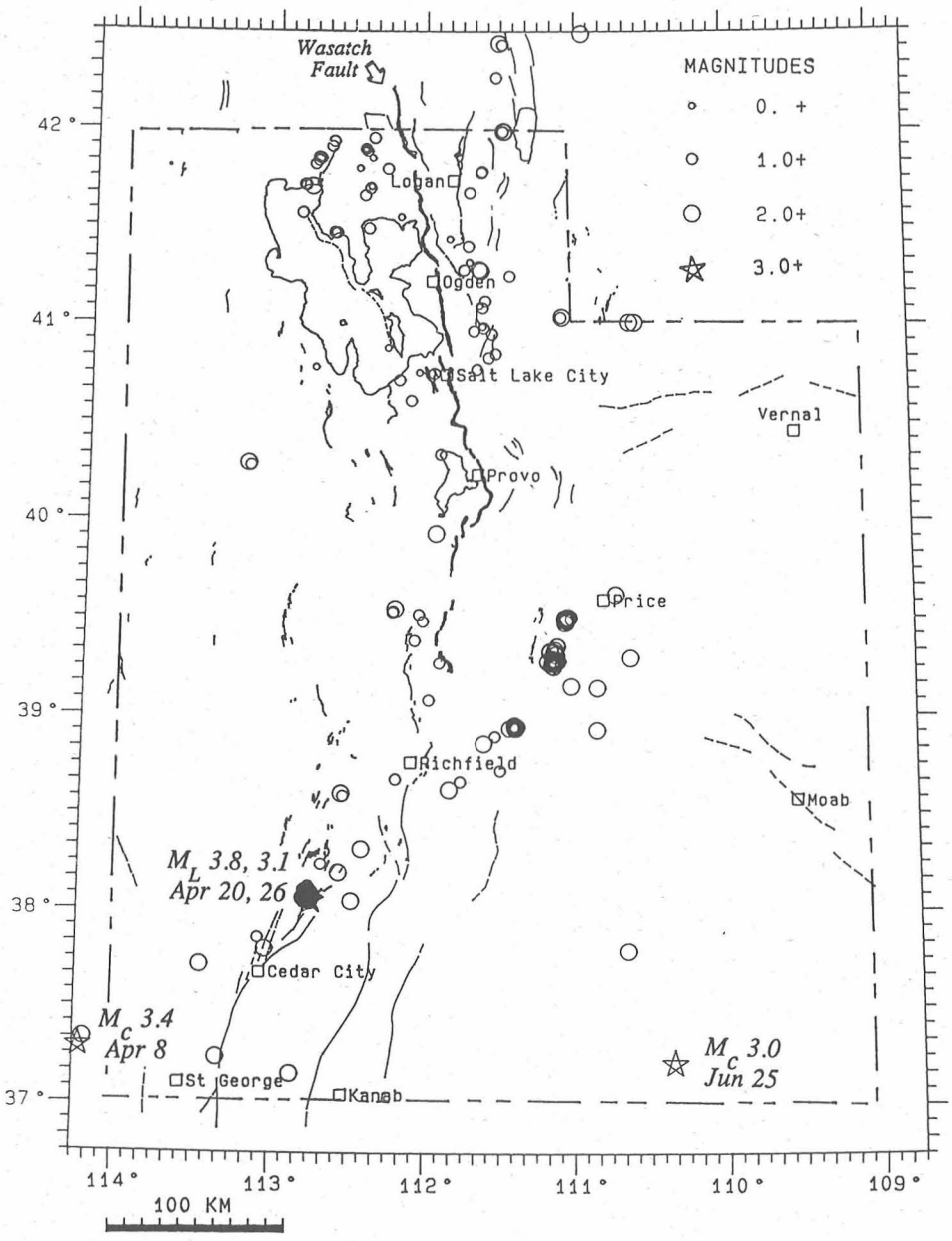
—8 earthquakes, magnitude 2.0 to 2.9, in the vicinity of the U.S. Fuel Company Gentry Mountain mine complex;

—53 earthquakes, magnitude 2.1 to 2.9, in the vicinity of the Utah Power & Light Huntington mine complex: and

—17 earthquakes, magnitude 1.8 to 2.6, in the vicinity of the Southern Utah Fuel Company Confusion Canyon mine complex.

North of Paragonah: A swarm of 119 earthquakes, located in the Parowan Valley of southwestern Utah, occurred mostly in late April 1991. The shocks ranged in magnitude from 0.9 to 3.8. Swarm activity such as this has been observed in southwestern Utah in the past and is not considered unusual.

Additional information on earthquakes within the Utah region is available from the University of Utah Seismograph Stations.



POSSIBLE FUNDING FOR STRONG-MOTION INSTRUMENTATION?

by Gary E. Christenson
Utah Geological Survey

Utah's existing strong-motion program consists of about 25 installations, principally in buildings and dams, concentrated in north-central Utah. Most, if not all, will require a moderate to large earthquake to be triggered. Instruments are maintained by the U.S. Geological Survey (USGS) and U.S. Bureau of Reclamation (BurRec). Compare this to 1000 state-installed instruments and another 1000-plus private instruments in California and you can see why Utah needs a much expanded program. The University of Utah Seismograph Stations (UUSS), Utah Geological Survey (UGS), and Utah Division of Comprehensive Emergency Management (CEM) have been working over the past several years to acquire funding from the Utah Legislature for additional earthquake instrumentation, including strong-motion instruments. These attempts have been successful in gaining support in the legislature, but not in acquiring additional funding. Because of the critical need for this instrumentation, other sources of funding are being explored by UUSS and UGS.

For strong-motion instrumentation, one possible alternate source is to seek money for the program through the Utah Geological Survey's (UGS) normal agency budget process. The UGS is not presently responsible for any earthquake instrumentation, but the Utah Policy Panel on Earthquake Instrumentation (UPPEI) recommended in 1989 that the UGS is the preferred location for a strong-motion program because of the long-term commitment required [see Recent Publications, this issue, Ed.] With that in mind, the UGS requested additional funding for strong-motion instruments and personnel in an agency "building block" request to the Department of Natural Resources (DNR). The requested funding would begin next fiscal year (FY 1993). The DNR included $100,000 for strong-motion instrumentation to UGS in their FY 1993 budget request, and that amount was included in the Governor's budget as a permanent increase to the UGS base budget. The Legislature's proposal is for $75,000. At the $100,000/year funding level, it would take about 20 years to deploy the number of instruments recommended by the UPPEI for a minimum program. However, this state money may be leveraged to acquire federal or private cooperative funds to speed up the program.

In addition to these funds, the Legislature proposed a $250,000 one-time expenditure from remaining FY 1992 supplemental funds for strong-motion instruments to give the program a head start. Both the $250,000 one-time supplemental and $100,000 base-budget increase still require legislative approval, and will probably not be decided until near the end of the legislative session in late February.

If funding is approved, the UGS will join the UUSS, USGS, and BurRec in Utah's cooperative strong-motion program. Details of the UGS role in the program remain to be worked out, but if any of this funding is approved it will represent a significant step by the state toward filling part of Utah's need for earthquake instrumentation.

ICBO COMMITTEE REJECTS WASATCH FRONT SEISMIC ZONE 4 AMEMDMENT

by Gary E. Christenson
Utah Geological Survey

In June, 1991 the Uniform Building Code (UBC) Commission of Utah proposed an amendment for the 1994 UBC to upgrade the Wasatch Front from seismic zone 3 to zone 4. The amendment was based on new earthquake ground-shaking studies which indicate a greater hazard than previously thought along the Wasatch Front, with levels of ground shaking that meet the criteria for seismic zone 4. The amendment was submitted to the Lateral Design Committee of the International Conference of Building Officials (ICBO) for consideration at the February 8, 1992 meeting in Indianapolis. The committee hears testimony, reviews submittals, and then either recommends acceptance or rejection to the ICBO. Although the amendment received local support in a public hearing in June, the majority of the testimony at

the Indianapolis meeting was in opposition to the amendment, including a letter of opposition from the Utah Section of the ICBO. A petition opposing the amendment and signed by many Utah structural engineers was also submitted.

Because of the apparent lack of uniform support from local Utah groups, the Lateral Design Committee voted to recommend rejection of the amendment. This recommendation will be printed in the Building Standards magazine in May, and can be contested in writing at that time. If the committee's recommendation is contested, the amendment will come up again for discussion and a vote of the membership at the ICBO meeting in Dallas in September. If not, the amendment is dropped and no further action is taken. Carl Eriksson (chairman of the Structural Advisory Committee of the UBC Commission of Utah) stated that, despite the new ground-shaking information, it appears there is little chance of successfully contesting the amendment's rejection, and that the issue will probably not be pursued further by the UBC Commission.

UTAH EARTHQUAKE ADVISORY BOARD ACTIVITIES

by Bob Carey
Utah Division of
Comprehensive Emergency Management

and Janine L. Jarva
Utah Geological Survey

Since the first meeting of the Utah Earthquake Advisory Board (UEAB) in September, 1991, the Technical and Socioeconomic Subcommittees have met to discuss goals and activities for the coming year and to prioritize current topics of concern to the state and local communities.

The elected chair of the Technical Subcommittee is Professor T. Leslie Youd of Brigham Young University's Civil Engineering Department, representing geotechnical engineers. Primary issues being studied by the subcommittee are: the creation and implementation of a strong-motion network in the state, certification and licensing of engineers, a change along the Wasatch Front (from Brigham City to Nephi) from Uniform Building Code seismic zone 3 to seismic zone 4, federal requirements for the seismic resistance of new buildings, and the seismic vulnerability of infrastructure systems and facilities. Important legislative issues which are supported by the Technical Subcommittee are the creation of a strong-motion instrumentation program within the Utah Geological Survey [see related article by Christenson, this issue Ed.] and the Professional Licensing Act.

The elected chair of the Socioeconomic Subcommittee is Mike Stransky of the architectural firm Gillies, Stransky, Brems, and Smith in Salt Lake City, representing the Utah Section of the American Institute of Architects. The following issues are being studied by this subcommittee: the process of school building design and construction, the seismic vulnerability of culinary and wastewater treatment facilities and systems, and the economic impact of a change to UBC seismic zone 4 along the Wasatch Front. Other issues of concern are environmental impacts and disaster response capability.

After considerable discussion at several meetings, the Technical Subcommittee decided that they should put together and publish a document similar in format to "California at Risk: Reducing Earthquake Hazards, 1987-1992" (see Recent Publications, this issue, Ed.).

In 1986 the California Legislature enacted the California Earthquake Hazards Reduction Act which directed the California Seismic Safety Commission to establish a program to significantly reduce statewide earthquake hazards by the year 2000. "California at Risk" is the 1989 report on the program. It reflects the Legislature's concern that a comprehensive, integrated, and sustained effort is being made. "California at Risk" outlines the steps that the state must take to save lives, reduce damage, and speed recovery after an earthquake. The heart of the program is the development and implementation of initiatives, clearly stated actions and reachable goals, to significantly improve the state's earthquake safety by the year 2000. Six criteria have been used to evaluate each initiative:

1. Casualty reduction - the potential to save lives and prevent injuries.
2. Damage reduction - the potential to avoid

property and economic losses.
3. Socioeconomic continuity - the potential to reduce economic disruption.
4. Social responsiveness - the degree to which the activity responds to and reflects social norms and values.
5. Opportunity - the relative ease with which the activity can be implemented and the degree to which the activity complements the other activities (the opportunity to leverage resources of institutions, groups, industries, etc., through a relatively small investment).
6. Cost - the dollar cost associated with the activity.

Finally, each initiative has to meet a "common sense" test that is intended to reflect the degree to which the initiative would be considered by both decision-makers and the general public as being practical, sensible, and feasible.

Using "California at Risk" as a model, the UEAB subcommittees will begin by focusing their energies on preparing problem statements/solutions for the issues that have been prioritized. Currently problem statements are being written for the issues of seismic instrumentation, utility infrastructure vulnerability, transportation infrastructure vulnerability, and communication systems vulnerability.

After the current legislative session the UEAB will meet again as a group to form consensus on these and other topics.

SEISMIC SAFETY ACTIONS IN OTHER WESTERN STATES

by Janine L. Jarva
Utah Geological Survey

In the last issue of the Forum (v. 7, no. 3, p. 3-6) we reported the formation of the Utah Earthquake Advisory Board (UEAB) as a major step forward for Utah's earthquake program (see related article in this issue). The UEAB will provide leadership in promoting and supporting needed actions with respect to reducing seismic hazard and risk in Utah. In this article, we wish to report on similar recent successes achieved in some of our sister western states. Only California has a long-standing earthquake advisory board (California Seismic Safety Advisory Council), which was established in 1974.

During the 1989-1990 legislative session, the Washington State Legislature created the Washington Seismic Safety Advisory Committee within the Division of Emergency Management, Washington Department of Community Development. Its mission is to assess current seismic vulnerability, risk mitigation, preparedness, and response capability in the state and to develop strategies and initiatives to address these issues. The Committee is composed of 16 members, including representatives from the State's Departments of Transportation, Health, Education, General Administration, and Community Development. In addition, the Washington Association of Counties, the Association of Washington Cities, the Washington Emergency Management Association, the Disaster Assistance Council, the Washington Hospital Association, the Fire Protection Policy Board, the Washington Association of Building Officials, the Structural Engineers Association of Washington, and the Washington Association of Sheriffs and Police Chiefs are all represented on the Committee. It is co-chaired by Raymond Lasmanis, Washington State Geologist and Bob Lewis, General Manager of Cellular One. The goals of the Committee are to:

* assess the seismic risk in Washington, particularly with respect to communications systems, and the structural integrity of public buildings, public schools, and hospitals
* determine the status of risk mitigation, preparedness, and response capabilities
* clarify and determine federal, state, and private roles with respect to each strategy and initiative
* identify needs for additional information, mitigation, preparedness, and response capabilities
* develop and prioritize state strategies and initiatives
* propose and prioritize policy-level actions

The development of a comprehensive plan and recommendations for improving Washington's earthquake preparedness were to be presented by the Committee in a final report to the Senate and

House of Representatives Committees on Energy and Utilities by December 1, 1991.

Also in 1989, an Executive Order by the Governor created the Oregon Seismic Safety Policy Advisory Commission. In the 1991 legislative session, the Commission received legislative approval with the help of several legislative activist-champions. A key factor in the success of the legislation was the provision that the Commission be no-cost. A number of State agencies participate. The 15 members of the Commission are appointed by the Governor. The Commission is charged with coordinating federal, state, and local agencies, private businesses, and organizations to work together to focus existing resources on a prioritized list of measures to improve Oregon's earthquake readiness. Roger McGarrigle, a private structural engineer, is Chairman of the Commission. One of the immediate policy recommendations on which the Commission is working is the revision of Oregon's seismic risk map to place all of the state west of the Cascade Mountains in UBC zone 3 (currently the entire state is in UBC zone 2B). The Oregon Department of Geology and Mineral Industries (DOGAMI) serves as administrative support to the Commission. The 1991 Legislature also provided general funds for an earthquake geologist position at DOGAMI. This converted a position that had been funded short-term under the National Earthquake Hazards Reduction Program.

In late 1990, the Hawaii State Earthquake Advisory Board was established by FEMA and the Hawaii Office of Civil Defense. Its 13 members are appointed annually by the Director of the Office of Civil Defense and include state agency representatives, engineers, and scientists from the University of Hawaii at Hilo and the University of Hawaii at Manoa. Gary Chock of the Structural Engineers Association of Hawaii is the Chairman and Brian Yanagi, Earthquake Planner in the Hawaii Office of Civil Defense, provides staff support. The functions of the Earthquake Advisory Board are to:

* develop goals and priorities for seismic hazard research and mitigation statewide
* gather information on seismic hazard, earthquake probabilities, and seismic risk
* help direct and provide funding recommendations for seismic hazard research and safety programs
* disseminate information on earthquake hazards and mitigation measures
* recommend policy and program changes and initiatives to state and county agencies which promote seismic safety, preparedness, and planning
* provide recommendations pertinent to civil defense activities in earthquake hazard mitigation, emergency response, and recovery.

The Hawaii Office of Civil Defense will sponsor the introduction of legislation based on policy recommendations of the Earthquake Advisory Board. Already the Earthquake Advisory Board has succeeded in reclassifying the island of Oahu as seismic zone 2A in the Honolulu Building Code, after recent seismic reassessment studies. A corresponding code change submittal to the International Conference of Building Officials has been made by the Structural Engineers Association of Hawaii.

After trying unsuccessfully for a legislative mandate, the Colorado Natural Hazards Mitigation Council was established by Governor's Executive Order in 1991. The Colorado Council is concerned with all natural hazards, including floods, wildfire, drought, landslides, and avalanches, as well as earthquakes. It is directed to:

* manage mitigation
* assess vulnerabilities
* evaluate and prioritize mitigation options
* seek funding for immediate needs
* coordinate all levels of government and the private sector in effective response

It is the first such natural hazards council in the U.S. It is composed of 35 official members appointed by the Governor. An additional 40 ex-officio members and 150 committee members assure that all interest groups are well-represented at every level. Eleven standing Committees include general committees for Steering, Project Development, and Public Information in addition to Committees devoted to individual hazards. A conference was held in November, 1991 where all participants met to determine goals and objectives.

UTAH'S CONSENSUS DOCUMENT

A Guide to Reducing Losses from Future Earthquakes in Utah: "Consensus Document", Walter J. Arabasz, editor, 1991, 32 p.,
is now available. The document represents a consensus view of scientists, engineers, planners, emergency management officials, and others involved in a five-year program (1983-1988) as part of the National Earthquake Hazards Reduction Program focusing on earthquake hazards and risk in Utah. It was developed in connection with the "Fifth Annual Workshop on Earthquake Hazards and Risk Along the Wasatch Front, Utah" (January 31-February 2, 1989, Salt Lake City).

The purpose of this document, as originally conceived, was to motivate and guide actions that will reduce losses from future moderate to large (magnitude 5.5 to 7.5) earthquakes in Utah, with primary emphasis on Utah's densely populated Wasatch Front region. In its present form, this document is viewed as an "intermediate-stage" product.

Public officials and decisionmakers in Utah need understandable and reliable information about Utah's earthquake threat. To meet their needs, it seems inescapable that one or more derivative documents-illustrated and simplified to meet the particular needs at hand will have to be created. For example, Appendix B is a pamphlet entitled "Utah's Earthquake Threat" prepared in February 1990 for an earthquake-preparedness exposition at the Salt Palace (attended by more than 10,000 people). A book for the general public entitled "The Earthquake Threat-and Challenge-in Utah," currently being written by W.J. Arabasz and D.R. Mabey and funded by the U.S. Geological Survey, will be published in 1992 by the Utah Geological Survey. The consensus view of scientists and engineers summarized in this document provides underpinnings for the book.

There are three basic parts to this document. Part One considers the question whether Utah is ready to take action to reduce its earthquake risk and it is argued that seven key ingredients now exist for timely action in Utah. In Part Two, four basic strategies are outlined for communities in Utah to reduce earthquake losses. In Part Three, information is presented summarizing the nature and extent of the physical effects and losses that can be expected from earthquakes in Utah. This summary is based on up-to-date information and represents the consensus judgement of scientific and engineering experts involved in studies of Utah's earthquake problems. Technically-worded statements prepared by the scientists and engineers are presented in Appendix A. A "layman's distillation" of those statements appears in Part Three, written by S.J. Nava and W.J. Arabasz.

The Consensus Document is available as Utah Geological and Mineral Survey Miscellaneous Publication 91-1 for $5.00 (Utah residents add 6.25% sales tax). Order from Utah Geological Survey Sales Office, 2363 South Foothill Drive, Salt Lake City, Utah 84109-1491, (801) 467-7970.

GEOLOGIC HAZARDS AND ATC 20, 21 WORKSHOP IN ST. GEORGE

In response to many requests for hazards workshops focusing on areas of Utah other than the Wasatch Front, the Utah Division of Comprehensive Emergency Management moved south in February. The Ramada Inn in St. George, Utah was the site for "Geological Hazards and Pre/Post-Earthquake Safety Evaluation of Buildings Workshop", February 20-21, 1992. Sponsored by EPICenter (Earthquake Preparedness Information Center) of the Utah Division of Comprehensive Emergency Management, the Utah Geological Survey, the Utah Earthquake Advisory Board, and the Federal Emergency Management Agency, the conference began with discussions of the geological hazards of Utah, Nevada, and Arizona. A presentation on state-level coordination of emergency response teams preceded the main speakers, Dr. Lawrence D. Reaveley, Vice President of Reaveley Engineers, Salt Lake City, Utah, and Robert A. Bruce, Technical Director at the Applied Technology Council, Redwood City, California, who focused on the application of ATC 20 and 21. ATC 20 presents procedures and guidelines for the post-earthquake evaluation of buildings. The

procedures and guidelines were developed specifically for volunteer engineers, architects, building inspectors, and others, who would be required to make on-the-spot evaluations of buildings. ATC 21 presents procedures and guidelines for the pre-earthquake preliminary screening phase for identifying hazardous buildings. The rapid visual screening is designed to be performed from the sidewalk without the benefit of entry to the buildings. ATC 21 will give concerned local governments and citizens guidance in developing a practical approach to a very serious problem.

CEM ANNUAL PUBLIC OFFICIALS CONFERENCE

by Bob Carey
Utah Division of
Comprehensive Emergency Management

The annual Utah Public Officials Conference was held September 30-October 1, 1991 at the Yarrow in Park City, Utah. As in past years, the conference covered several aspects of emergency management and disaster mitigation. Earthquake preparedness and mitigation was one of the topics, with emphasis on the role of Utah's school districts in assessing and reducing risk. Two of the largest districts in Utah have had engineering assessments completed on their school buildings to evaluate the potential for earthquake damage and have made the results public. The results of the engineering evaluations and subsequent plans formulated with input from parents, the School Board, and other interested citizens were covered. The conference was sponsored by the Utah Division of Comprehensive Emergency Management.

REDUCING EARTHQUAKE HAZARDS IN UTAH: THE CRUCIAL CONNECTION BETWEEN RESEARCHERS AND PRACTITIONERS

By William J. Kockelman
U.S. Geological Survey

[This is the sixth excerpt from the publication entitled "Reducing Earthquake Hazards in Utah: The Crucial Connection Between Researchers and Practitioners" to be reprinted in the Forum (see WFF, v.6, no.1-2, p. 16-25, 1990; v.6, no. 3-4, p. 9-17, 1990; v. 7, no. 1, p. 6-13, 1990; v. 7, no. 2, p. 7-19, 1990; and v. 7, no. 3, p. 9-17, 1991). Although the full paper will be included in USGS Professional Paper 1500-A, "Assessment of Regional Earthquake Hazards and Risk Along the Wasatch Front, Utah" currently in press, the editors feel the information to be timely and relevant enough to reprint herein. This information is available now as USGS Open-File Report 90-217. This excerpt originally included many figures which we could not reproduce in the Forum. We have modified the text slightly to reflect this, and readers are referred to the USGS publication listed above for the complete text, with figures. We have maintained the original numbering of figures that have been included here. Questions can be directed to Bill Kockelman at (415) 329-5158. Ed.]

EXAMPLES OF SUCCESSFUL TRANSFER IN UTAH

A remarkable effort is being made in Utah to transfer earthquake-hazard information to nontechnical users including real estate salespersons, financial institutions, and church groups. For example, in June 1985 three county geologists began providing educational, advisory and review services to five counties -- Weber-Davis, Salt Lake, and Utah-Juab. They were funded by USGS with other support being provided by the UGMS and the five counties. Financial support by local government for 1989 is an indication of the success of this type of transfer program.

According to Christenson and others (1987, p. 4), the goals of the county hazards geologist program are to:

- o Compile geologic-hazards information and produce maps to be used to delineate hazard areas where site-specific reports should be required.
- o Review engineering geologic reports.
- o Advise planners regarding hazards ordinances.
- o Provide geologic expertise as required.

These geologists are a part of the county planning departments under direct supervision of the planning director; the UGMS provides technical supervision and other support as needed. The geologists are also available to perform the same services to the cities within their county. Some of the educational, advisory, and review services provided and a complete listing of the data collection, hazards mapping, ordinance reviews, and many other accomplishments may be seen in Christenson (1988, p. 5-9; 1990). These types of services are identified in list 4 (WFF, v. 7, no. 3, p. 10-12).

Much of their work is directed toward reduction techniques (list 2, (WFF, v. 6, no. 1-2, p. 20-21)) and therefore is not discussed in this section on transfer techniques. According to county geologist Mike Lowe (unpubl. speech, 1986), examples of such work include the site investigation and hazard evaluation for South Weber City, city of Washington Terrace, city of North Salt Lake, Emigration Canyon (Salt Lake County), and the Lake Mountain and Pine Flat areas (Utah County).

Several Federal, State, and county planners, geologists, and emergency managers identified the "provision of education, advisory, and review services" as one of their most significant accomplishments to date (Christenson and others, 1987, p. 84). Examples of some of the transfer techniques used in Utah follow. Each one can be categorized as an educational, advisory, or review services, or a combination of two or all of the services. In most cases, the transfer agents are not only delivering translated information as defined and illustrated in previous sections of this paper but are assisting and encouraging its use for hazard reduction.

Workshops

During the period from 1984 to 1988, six workshops were held in Utah on assessing and reducing earthquake hazards, two of them in 1985. A field trip followed the one in 1986 and preliminary reports for a professional paper were released at the one held in 1987. Each workshop fulfilled a commitment made in 1983 to bring key researchers and users of hazard information together each year for the purpose of providing current information on the earthquake hazard, distributing translated reports and maps, describing how they can be used, and fostering an environment for use of the information for hazard reduction.

Each workshop had various sponsors including the University of Utah, Utah Geological and Mineral Survey (UGMS), State of Utah Division of Comprehensive Emergency Management (CEM), FEMA, and USGS. Five were attended by as many as 130 earth-scientists, engineers, planners, and emergency managers. One attended by over 400 persons addressed multihazards and comprehensive hazard reduction (May, 1988). An example of some of the topics addressed and reports made at one of these workshops may be seen in the table of contents of a proceedings edited by Hays and Gori (1987, p. iii-iv). This type of workshop is a good example of a successful transfer technique. The proceedings of two of the workshops were edited by Hays and Gori (1984, 1987) and published as open-file reports to ensure early release and delivery. The UGMS compiles examples of interim maps and reports available and uses the workshops as an opportunity to distribute them.

Serial Publications

Several serial reports designed to transfer earthquake-hazard information in Utah to nontechnical persons were continued or begun during the past five years. The attractive easy-to-read Survey Notes is published quarterly by the UGMS (Stringfellow, 1983 to present). For example, see the cover of v. 18, no. 4, 1985, an issue focusing on earthquake hazards in Utah. It features excellent articles such as the historic and scientific content of earthquake hazards in Utah by Mabey (1985). It reports on UGMS information programs (Smith, 1985a), earthquake activity recorded by the University of Utah Seismograph Stations, hiring of county geologists, new publications, and related activities of interest -- ongoing geologic projects, status of applied geology programs, personnel changes, and how

UGMS responds to disasters (Atwood, 1983).

The Wasatch Front Forum was specially created for the earthquake-hazards program and is published and distributed quarterly by the UGMS (Hassibe, 1983-86; Jarva, 1987 to present). It features timely articles on neighboring earthquakes (Crone, 1984), prediction in the Wasatch Front (Smith and others, 1985), earthquake-induced soil liquefaction (Keaton, 1986), disruption of critical facilities (Frank, 1987), and earthquake preparedness projects (Tingey, 1986).

This newsletter also reports on the regional earthquake hazards assessment program (Hays, 1984), accomplishments of the ground shaking hazards and loss estimation program (Rogers and others, 1986), Utah County Comprehensive Hazard Mitigation Project (Dewsnup, 1987), progress of geologic, seismologic, and engineering research (Tarr, 1984), earthquake activities recorded by the University of Utah Seismograph Stations, and their results of surveys on the perceptions of risk by residents along the Wasatch Front. Notices of scheduled professional meetings, recent publications, out-of-state workshops of interest, new research programs, and reprints of timely articles such as Rogers (1986) are included on a regular basis. For example, see the Wasatch Front Forum, v. 2, no. 4, p. 5 (Hassibe, 1983-1986). This type of newsletter is a unique example of a transfer technique in Utah identified as an educational service in list 4 (WFF, v. 7, no. 3, p. 10-12).

In addition, the Earthquake Information Bulletin (now Earthquakes and Volcanoes) (Spall, 1975 to present) written for nontechnical readers is published bimonthly by the USGS. It contains feature articles such as "Earthquake Potential of the Wasatch Front" (Spall, 1985), as well as reporting on earthquake activity by states and countries. Notices of state, national, and international workshops and conferences on earthquakes -- research, engineering, preparedness -- and recent publications are also included on a regular basis.

Outreach Programs

The Utah Museum of Natural History contributes to the geologic education of the general public through exhibits, classes, lecture series, film series, field trips, teaching kits, and teacher workshops. Since the fall of 1985, "Utah Geologic Hazards" has been a popular outreach program.

According to the Museum's earthquake safety instructor, Deedee O'Brien (written commun., 1988), the program has reached 3,000 students and adults for each of two school years (1985-86 and 1986-87). During the following year (1987-88), the outreach program was phased down in favor of training teachers to use the materials and teach the information to their own classes. See Utah Museum of Natural History (1985) for an example of materials, "Earthquake Hazards" and "Earthquake Safety," provided to students, teachers, and the general public under their outreach program. They are an innovative transfer technique identified as an educational service in list 4 (WFF, v. 7, no. 3, p. 10-12). Three workshops were held in 1988 with instructors from the Museum, CEM, UGMS, and the University of Utah. Seventy-nine teachers from five Wasatch Front school districts completed the course. They may check out a teaching kit which includes a two-foot square model, cardboard fault blocks, 150 slides with text, and a packet of follow-up earthquake safety activities.

In addition to the geologic hazards curriculum, Deedee O'Brien developed an earthquake-safety curriculum appropriate for kindergarten through third grades. This has been tested in approximately 30 classrooms and has been offered to teachers in two in-service workshops entitled "Earthquake Safety in the Elementary Classroom." Forty-eight teachers attended. These workshops were cosponsored by CEM. The museum continues to offer earthquake-safety in-service courses annually.

The Utah State Division of Comprehensive Emergency Management (CEM) has developed various hazards outreach programs which include educational and advisory services. A good example is an inexpensive booklet by Tingey (1989) which provides both an awareness of the earthquake hazard and suggested preparations to reduce the hazard. According to Tingey and Findlay (1987, p. T11), CEM has made many presentations and during one year alone distributed over 730,000 brochures on earthquake hazards and their reduction. One project completed in 1986 was the production of a

television program (video format) which succinctly covered the earthquake hazard, risk, and safety concepts specific to the Wasatch Front. Near the end of the project, the local CBS affiliate, KSL Television, produced an excellent half-hour program ("Not If ... But When") which was shown twice, in response to public reaction, during January, 1987. The program won a regional Emmy Award out of 150 entrants from seven western states. Several copies of the video are being used to make presentations to school, church, business, and other interested groups.

Integrated into the video were results of the latest research work on fault surface expression, segmentation, rupture, and geometry; ground shaking and amplification; liquefaction; and loss estimates for postulated events. Translation of this research was performed by CEM, UGMS, scientific and public safety-oriented agencies, and the producer of the video program. According to Tingey (1988, p. 102), the producer "has a terrific feel for the material" and was able to distill and translate complex ideas into concepts understandable by the nontechnical audience.

The Utah State Office of Education (Burningham, 1983) has produced an inexpensive, well-illustrated comprehensive booklet on natural hazards entitled "I can make the difference -- Emergency preparedness." In chapter 2 (p. 15-28), it addresses earthquake hazards through three personalized scenarios, questions and solutions, a quiz, and a word-hunt game.

The UGMS has provided one-page pass-out sheets for public use, for example, earthquake hazard situation, safety, and faulting in Utah by Kaliser (1984b, c, d). These sheets address scientific evidence, historic events, population exposed, past damages, expected magnitude, critical facilities vulnerability, retrofitting, topographic expressions, and other aspects of earthquake hazards and their reduction. Cogent, one-sentence "bullets" are used; see Kaliser's (1984a) "Building or Buying a Home in Utah".

The county geologists are continually providing various educational services. For example, as county employees, they are available to explain earthquake hazards and the techniques for reducing them to various county officials, staffs, and citizens. They have increased community awareness through a slide-lecture program presented to university students, community councils, civic groups, and other local government organizations such as the Ogden City Seismic Committee, citizens groups in Nephi and Provo (Lowe, personal commun., 1986), Salt Lake Board of Realtors, and various community councils in Salt Lake County. The UGMS and the Utah County geologist conducted a class and field trip on geologic hazards for the 1988 annual education meeting of the Utah Chapter of the International Conference of Building Officials.

Field Trips

Field trips for both small and large groups have been conducted. A particularly comprehensive one-half day trip to selected geologic features and buildings in southern Davis and northern Salt Lake counties sponsored by UGMS and USGS was arranged and conducted by Keaton and Reaveley (1986). Their well-illustrated text enhanced the opportunity for the nontechnical attendees to observe key geologic features and buildings in the metropolitan area.

Geologic features seen during the trip included surface evidence of movement along a fault plane, topographic scarps, and lateral spreads caused by earthquake-induced liquefaction. Vulnerable buildings visited included gravity-frame structures with masonry infill walls, potable water tanks straddling the Wasatch fault, sewage treatment plants subject to subsidence by tectonic deformation, and communications centers with little lateral force resistance. Seismic-resistant structures viewed included Salt Lake County Government Center buildings with concrete shear walls, braced and anchored brick-clad buildings, and the seismically-strengthened Veteran's Administration Hospital.

The three county geologists have conducted numerous field trips for their county commissioners, mayors, and other public officials to inform them of geologic hazards in their respective jurisdictions. The UGMS also conducts trips to trench sites for State and local government officials to inform them of research results and let them see the evidence first-hand.

News Media

The release of information and its subsequent publication and wide dissemination to television

viewers, radio listeners, and newspaper readers is one of the most effective ways of delivering information about earthquake hazards to nontechnical users. A typical press release by the USGS Public Affairs Office is represented by Jorgenson (1988) and illustrates a common but effective transfer technique. It is identified as an educational service in list 4 (WFF, v. 7, no. 3, p. 10-12). Typical local newspaper coverage of earthquake-hazard reduction activities is shown in O'Brien (1987), Salt Lake Tribune (1986), and Deseret News (1986). These examples are valuable information transfer techniques shown in list 4 (WFF, v. 7, no. 3, p. 10-12).

According to Sprinkel (1988), UGMS, USGS, and CEM targeted the news media as an effective means to inform the public of the positive accomplishments of the earthquake program, and to raise public awareness of the potential threat earthquakes pose to Utahans. The news media are invited to all field trips, and nearly always attend. In addition, county geologists participate in local radio talk shows. The Utah Department of Natural Resources also performs much work to ensure good press coverage. Sprinkel also observed that there is an eagerness by the Utah press community to cover most of the earthquake-related stories. The result is increased level of public understanding and awareness of Utah's susceptibility to earthquake hazards along the Wasatch Front.

Information Systems

At the inception of the regional earthquake hazards assessment program in Utah, Tarr and Mabey (1984, p. 148) specified the objective of the information system as follows:

- To make quality data readily available to meet the needs of researchers and policymakers.
- To create an information system that assures that new data will be available in the form most useful to meeting program objectives.
- To devise a system whereby potential users will have easy access to data in media, scales, and formats that will be most useful to them.

They suggested creating a "clearinghouse" with directories to its information. Much of what they envisioned is now reality (Sprinkel, 1988, p. 94).

During 1985-1988, UGMS compiled a comprehensive bibliography of geologic hazards in Utah. References were collected statewide from conventional sources of published information and some unconventional sources. All of the references were keyworded and entered into a computerized data base system for easy manipulation and retrieval. These sources were supplemented by many of the geotechnical engineering firms and government agencies in Utah that permit a review of their files for more site-specific information.

This compilation was initiated in October 1985 with the goal of not only compiling a computerized hazards bibliography but also producing generalized hazards maps for the State at a scale of 1:750,000. The hazards bibliography includes a comprehensive listing of all published and unpublished hazards information statewide. Information can be retrieved according to specific hazard, type of information, and geographic locality covered by each entry. When completed, the bibliography can be sorted geographically and printouts made available to various governmental entities (cities, counties, and multicounty agencies) so that they will be aware of what data are available for their jurisdictions.

In conjunction with the bibliography, UGMS maintains a file for each USGS 7½-minute quadrangle in the State which includes site-specific hazards reports (where appropriate), inventory sheets of each report's contents, and an index map showing the location of the sites reported on. Mapping and bibliography compilation are proceeding concurrently and are scheduled for completion in 1989.

The second phase of the UGMS hazards compilation project is a cooperative effort with the USGS and five Wasatch Front counties. The three county geologists serving the five counties have collected all pertinent hazards information and developed a hazards library for each county. They use this information, supplemented with additional field studies as necessary, to compile hazards maps for each county. Files of site-specific hazards information are being maintained and index maps showing locations of hazards information are being compiled.

Texts are being prepared to accompany each map to explain the hazard -- likelihood, location, and

severity. Discussions of possible engineering and site design techniques for mitigation are included, as well as guidelines for the types of information that would be included in site investigations reports. Christenson (1988, table 1, p. 7) shows the status of these texts and maps as of December 1988.

Public Inquiries

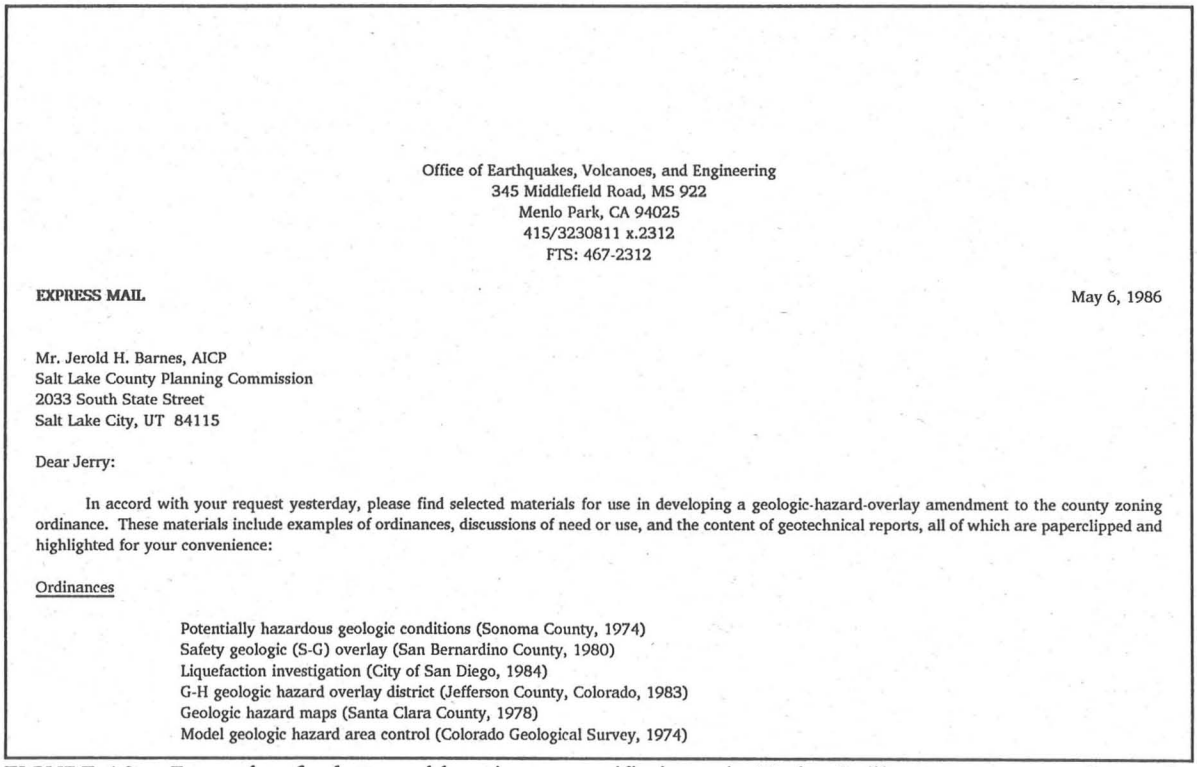
In addition to compiling and maintaining directories, the UGMS maintains a library, public inquiries section, and a sales office. According to Smith (1985b, p. 4), the library has several thousand items including materials on earthquake phenomena and hazards. The librarian has access to the computerized "Bibliography of Utah Geology" and can make searches by author, location, or type of study and is adding new titles to keep the list up-to-date.

The list of UGMS publications and maps is now on computer (PUBLIST). It is indexed by county and kind of study for easy location of specific publications. Its data processing section is preparing a new program to keep records of sales and inventories. All except the most recent UGMS publications are now available on microfiche so that no publication is ever completely "out-of-print."

The sales office fills mail orders for UGMS publications (over 70 percent of its business) as well as handling over-the-counter sales. Receipts for 1983-84 were $42,000; sales have been increasing annually. In addition, many materials are provided to the public at no charge. The UGMS staffs an Applied Geology Program to assist State and local units of government in assessing and reducing geologic hazards. The USGS operates ten public inquiries offices in the United States; one of them is in Salt Lake City.

Advisories

Specific advice on reducing earthquake hazards may be in oral or written form. Written information may consist of a general fact sheet



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EXPRESS MAIL May 6, 1986

Mr. Jerold H. Barnes, AICP
Salt Lake County Planning Commission
2033 South State Street
Salt Lake City, UT 84115

Dear Jerry:

In accord with your request yesterday, please find selected materials for use in developing a geologic-hazard-overlay amendment to the county zoning ordinance. These materials include examples of ordinances, discussions of need or use, and the content of geotechnical reports, all of which are paperclipped and highlighted for your convenience:

Ordinances

Potentially hazardous geologic conditions (Sonoma County, 1974)
Safety geologic (S-G) overlay (San Bernardino County, 1980)
Liquefaction investigation (City of San Diego, 1984)
G-H geologic hazard overlay district (Jefferson County, Colorado, 1983)
Geologic hazard maps (Santa Clara County, 1978)
Model geologic hazard area control (Colorado Geological Survey, 1974)

FIGURE 19 -- Example of a letter addressing a specific issue in Utah. It illustrates a type of transfer technique identified as an advisory service in list 4.

Discussions

Site investigations in hazardous areas (Brown and Kockelman, 1983)
Engineering geology at the local government level (McCalpin, 1985)
Landslide hazard zones (Weber, 1980)
Role of geotechnical consultants and reviewers (Leighton, 1975)
Geologic review process (Hart and Williams, 1978)
Hazard avoidance and mitigation (Unknown)

Geotechnical Report Guidelines

Guidelines to geologic/seismic reports (CDMG, 1973)
General guidelines for geological reports (Ventura County, 1974)
Minimum standards for geotechnical reports (San Mateo County, 1977)

I deliberately selected a wide range of materials to provide you with the greatest flexibility, for example:

- The ordinances range from Sonoma County's one-page regulation requiring a site investigation and recommendations for preventive and corrective measures to San Mateo County's 24-page resource management zoning district that reduces dwelling unit density in soil- and scenic-resource areas as well as fault-rupture and landslide-hazard areas.
- The discussions include a case history on "challenging a geologic-hazard zone, "use of a 1:12,000-scale hazard-overlay cadastral map, and land development goals from the viewpoints of the developer, the geologic consultant, and the public agency involved.
- The guidelines range from very general notes to four types of geologic reports requiring detailed data and descriptions, including county certification forms.

According to Jeff Keaton, the Utah Section of the Association of Engineering Geologists is preparing guidelines for engineering geologic reports, including surface-rupture, seismic-shaking, liquefaction, and slope-stability hazards. Genevieve Atwood advised me today that the UGMS is considering publishing these guidelines as UGMS notes.

As we discussed, it would be desirable to keep the geologic-hazard-overlay regulations succinct (as you did with the "hillside protection zone") and to adopt by reference both the official hazards maps and the required geotechnical reports. My experience indicates that such an approach makes it much easier for the public to understand; reduces direct pressure on the local government when references can be made to outside experts (State, Federal, university, consultants, and professional societies); and makes it easier to update them without amending the ordinance.

Caveat

The enclosed materials are in a raw form directly from my files and, of course, can not be endorsed or recommended by the U.S. Geological Survey. Although may of them have been in effect for several years without successful legal assault, others may have been revised, repealed, or not properly enforced. If a particular example seems promising for your needs, I would be pleased to make one or two inquiries concerning its status and provide you with the administrator's name and number for direct contact.

I hope these materials will be of some help to you, the commission, and Salt Lake County. Please call me if you have any questions or if I can be of any further assistance.

Sincerely,

Bill

W.J. Kockelman

Enclosures

cc: G. Atwood
J. Keaton

FIGURE 19 (cont'd) Example of a letter addressing a specific issue in Utah. It illustrates a type of transfer technique identified as an advisory service in list 4.

that is widely distributed or a letter addressing a specific issue that is requested by a planner or decisionmaker. Kaliser (1981) and figure 19 illustrate these two types.

The UGMS and county geologists provide various advisory services. One example is the providing of explanations and advice along with hazard maps and hazard-reduction literature to prospective real-estate buyers, sellers, lenders, and developers. Building officials and planners, both city and county, frequently request advice on specific sites where geotechnical problems are encountered or suspected. The UGMS also advises the Utah State departments of Community and Economic Development and Facilities Construction and Management regarding use of earthquake-hazards information in State-funded projects.

The county geologists' advice has been sought by and given to the cities of Salt Lake, Ogden, South Weber, Mapleton, Centerville, Riverdale, and Washington Terrace and the counties of Salt Lake, Utah, and Weber on the content of ordinances regulating the use of hazardous lands.

Guidelines

The Utah Section of the Association of Engineering Geologists (1986, 1987) has been preparing guidelines concerning the preparation of engineering geologic reports and the evaluation of various geologic hazards including surface fault rupture, shaking, liquefaction potential, and landslide potential. Two of these have been published and distributed by the UGMS; "Guidelines for evaluating surface fault rupture hazards in Utah" (Utah Section of the Association of Engineering Geologists, 1987) is a type of transfer technique from list 4 (WFF, v. 7, no. 3, p. 10-12). When adopted by state or local governments as a requirement, it becomes a reduction technique identified in list 2 (WFF, v. 6, no. 1-2, p. 20-21).

Sometimes a scientist/author includes a transfer technique along with his or her translated material. A good example is a recommendation included in the earthquake-induced landslide potential report by Keaton and others (1987) that accompanies their seismic slope stability map. The recommendations in matrix format for critical facilities and other land uses are shown in figure 21.

FACILITY CLASS	EARTHQUAKE-INDUCED LANDSLIDE POTENTIAL ZONE				EXISTING LANDSLIDE	HIGH LIQUEFACTION POTENTIAL
	HIGH	MODERATE	LOW	VERY LOW		
CRITICAL Hospitals, Fire Stations Police Stations Other Emergency Facilities	YES	YES	YES	YES	YES	YES
LIFELINES Communications Transportation, Water Supply Electric Power, Natural Gas	YES	YES	YES	MAYBE	YES	YES
HIGH OCCUPANCY PUBLIC-OWNED Schools, State Capitol City Hall, Airports County Courts, Convention Centers	YES	YES	YES	MAYBE	YES	YES
HIGH OCCUPANCY PRIVATE-OWNED Office Buildings Apartments, Hotels Shopping Malls	YES	YES	MAYBE	NO	YES	YES
	Appropriate Disclosure Required					
INDUSTRIAL-SEVERE CONSEQUENCE Refineries, Sewage Plants Hazardous Waste, Explosives	YES	YES	MAYBE	NO	YES	YES
	Appropriate Disclosure Required					
INDUSTRIAL-MINOR CONSEQUENCE Trucking, Shipping Light Manufacturing	MAYBE	MAYBE	NO	NO	NO	MAYBE
	Appropriate Disclosure Required				Appropriate Disclosure Required	
RESIDENTIAL SUBDIVISION	MAYBE	MAYBE	NO	NO	NO	YES
	Appropriate Disclosure Required				Appropriate Disclosure Required	
RESIDENTIAL SINGLE LOT	NO	NO	NO	NO	MAYBE	MAYBE
	Appropriate Disclosure Required				Appropriate Disclosure Required	

FIGURE 21 -- Example of a matrix with recommendations for site-specific stability analysis for critical facilities and other land uses in several hazard zones by Keaton and others (1987, table 4, p. 76). It is a special type of transfer technique in list 4. It was designed by the scientists/authors for nontechnical users. When adopted by state and local governments as a requirement, it becomes a reduction technique identified in list 2.

Guidebooks

Several guidebooks were specially prepared for reducing earthquake hazards in Utah. Four of these books are:

- Reducing losses from earthquakes through personal preparedness by Kockelman (1984).
- Suggested approach to geologic-hazard ordinances in Utah by Christenson (1987).
- Utah's geologic hazards -- a review for realtors by Christenson and Mabey (1987).
- Planning for natural hazards by the University of Utah Center for Public Affairs and Administration (1988).

The first guidebook introduces five phases of reduction -- pre-event mitigation techniques and preparedness measures, response during the earthquake, and post-event recovery operations and reconstruction activities. Several examples and citations are given for each. Because of the unique effort towards individual and community "self-reliance" in Utah, the guidebook emphasizes the relatively inexpensive actions that can be taken by responsible parents, neighborhoods, and employers. These include inspecting and strengthening the home, organizing the neighborhood, and securing contents and other nonstructural parts of buildings.

The second book encourages prudent land use in areas of geologic hazards, including earthquake hazards for the protection of the citizens of those cities and counties enacting ordinances. A concise discussion of hazards and availability of information is followed by a comprehensive survey of city and county geologic-hazard ordinances in Utah. An outline of the steps to be included in a hazard-reduction ordinance in jurisdictions having geologic-hazard maps and those without such maps is shown in Christenson (1987, table 1, p. 9). This is another type of transfer technique identified as an advisory service in list 4 (WFF, v. 7, no. 3, p. 10-12). In addition, the Salt Lake County planning staff drafted a natural-hazards-reduction ordinance (Barnes, 1988b) which follows the guidebook recommendations. It contains a guide to natural hazards reports required for various types of facilities or developments and has been used as a model by other cities and counties (Barnes, 1988a).

The third book was prepared to provide Utah's realtors with information that will enable them to place the State's geologic hazards in proper prospective and to communicate this risk to prospective home-buyers and business clients. The hazards considered include floods, slope failure, earthquakes, subsidence, and expanding soils. The authors emphasize the need for hazard assessment and then provide general information about the availability of hazard information, status of various hazard-mapping projects, ordinances dealing with hazard warnings or mitigation, and work accomplished by the UGMS Applied Geology Program. The report concludes that realtors "have a unique opportunity to inform the property owners of Utah and thus contribute to making Utah safer and more prosperous."

The fourth book offers a guide to the first steps that may be undertaken at the local level to understand potential hazards and plan for their reduction. It includes a discussion of local government responsibility and liability, an outline of the planning process, and State and county contacts for information and assistance.

Geographic Information Systems

For the purposes of this report, geographic information systems (GIS) are defined as the spatial representation of geologic, hydrologic, topographical, land use, land ownership, and other physical and socioeconomic information which can be readily combined, manipulated, analyzed, and displayed for various purposes by computer technology. The result is a quantifiable analysis of point, line area, and volume data. The nature and capability of GIS provides an excellent basis for presenting and combining not only the various earthquake hazards, but critical facilities that might be affected. In addition, an easily used geo-reference map can be provided for the nontechnical user.

For example, Alexander and others (1987), in demonstrating the use of digital mapping technology, entered surface fault rupture, liquefaction potential, and landslide potential into a GIS for the Sugar House Quadrangle in east-central Salt Lake County. In addition to the hazard maps used in their atlas, other maps were used to illustrate the kinds of information needed to reduce earthquake hazards, namely: political jurisdictions, roads, selected lifelines, and land

uses. They then combined hazards with specific land uses, for example; lifelines in potential surface fault rupture zones, schools and residential areas in high liquefaction potential zones, and schools and residential areas on lands with the lowest stability during earthquakes.

University of Utah Department of Geography professor Phillip Emmi has entered Salt Lake County's lifelines, other critical facilities, and building inventories, into a GIS to estimate earthquake loss probabilities. A CEM planner, Wes Dewsnup, entered all information for the Utah County Comprehensive Hazard Mitigation Project into the GIS operated by the Utah State Office of Automated Geographic Referencing. Salt Lake County uses the AUTOCAD system and, according to C.V. Nelson (written commun., 1989), this will greatly increase the transfer of hazard information which has been referenced to land ownership records.

Review Services

The State and county geologists are sometimes asked to provide the type of review services in List 4 (WFF, v. 7, no. 3, p. 10-12). For example, the Salt Lake County geologist has assisted West Valley City by providing geologic hazard information to be incorporated into their computerized data bank for land-use planning; the UGMS and Utah County geologist provided hazard maps and interpretations for a Utah Division of Comprehensive Emergency Management and county project in the Provo-Orem area to aid emergency response personnel; and the Weber County geologist assisted the city of Washington Terrace in including geologic hazards into its 1987 master plan.

Comment

In all of the examples, delivery of translated information was provided; in many others, assistance and encouragement in its use for hazard reduction was provided or offered. The users ranged from practitioners and professional societies to interested citizens, including children. Several of Utah's transfer techniques included suggested reduction techniques.

Special mention should be made of the unique efforts of the UGMS, USGS, university, and consulting researchers to release research findings early to practitioners and other users. This was accomplished through oral briefings, workshops, workshop proceedings (Hays and Gori, 1984, 1987; Gori and Hays, 1987, 1988), serial publications (Stringfellow, 1983 to present), newsletters (Hassibe, 1983-86; Jarva, 1987 to present), and "official use only" materials.

The commitment of the U.S. Geological Survey to the transfer of research in Utah and the evaluation of this effectiveness may be seen in a recent award for a proposal by William Spangle and Associates, Inc. (1989). The summary of their approach follows:

> This project is designed to assist local officials in cities and counties of the Wasatch Front region of Utah apply the information provided by the USGS regional assessment of earthquake hazards. The direct experience of the consultants in research, planning practice and information transfer will be shared with Utah officials, especially city planners, on a regular basis during the year. This will be done by participating in up to four meetings throughout the year and being available as needed for direct consultation with local (and State) officials about options for earthquake-hazard reduction. A final report evaluating the effectiveness of the process and opportunities for transfer to other regions will also be prepared.

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MEETINGS AND CONFERENCES

April 14-16, 1992, Seismological Society of America Annual Meeting, held in Santa Fe, New Mexico. For more conference information, contact SSA Headquarters, 201 Plaza Professional Building, El Cerrito, CA 94530.

April 26-29, 1992, Fifth Annual Symposium on the Application of Geophysics to Engineering and Environmental Problems (SAGEEP), held in Oakbrook, IL. For further information, contact Mark Cramer, 11100 East Dartmouth Avenue, Suite 190, Aurora, CO 80014, (303) 752-4951.

May 14-16, 1992, Geological Society of America, Rocky Mountain Section Meeting, held at the Ogden Park Hotel in Ogden, Utah. For further information contact Sidney R. Ash, Department of Geology, Weber State University, Ogden, UT 84408-2507, (801) 626-6908.

July 19-25, 1992, Tenth World Conference on Earthquake Engineering, held in Madrid, Spain, one week prior to the 1992 Olympics in Barcelona, Spain. The official language of the conference will be English. Abstract deadline is April, 1991 and the deadline to receive papers is May, 1992. Individuals wishing to receive the first, and subsequent, announcement circulars should request them from 10WCEE, Steering Committee, c/o Tilesa, Londres 39 - 1 B, 28028 Madrid, Spain.

August 24 - September 3, 1992, International Geological Congress, held in Kyoto, Japan. The 1992 congress will include sessions on the IDNDR, remote sensing of natural hazards, evaluation of seismic hazards, prediction and reduction of geologic hazards, and hazard mapping. Abstracts were due December 1, 1991. For a conference circular with information on abstract submission and registration, contact the Secretary General, 29th IGC, P.O. Box 65, Tsukuba, Ibaraki 305, Japan, 81/298/54-3627, FAX 81/298/54-3629.

October 3-9, 1992, Association of Engineering Geologists Annual Meeting, held in Long Beach, California. For information contact John Byer, Kovacs-Byer, Inc., 11430 Ventura Boulevard, Studio City, CA 91604, (818) 980-0825.

October 26-29, 1992, Geological Society of America Annual Meeting, held in Cincinati, Ohio. Abstracts are due July 8, 1992 and should be submitted to the Abstracts Coordinator, GSA, 3300 Penrose Place, P.O. Box 9140, Boulder, CO 80301. For general information about the annual meeting, contact GSA Meetings Department at the same address, (303) 447-2020.

June 1-6, 1993, Third International Conference on Case Histories in Geotechnical Engineering, held in St. Louis, Missouri. One of the themes of this conference will be geotechnical earthquake engineering. Abstracts were due by February 28, 1992. For further information on the conference or the call for papers, contact Shamsher Prakash, Conference Chairman, III CHGE, 308 Civil Engineering, University of Missouri-Rolla, Rolla, MO 65401, (314) 341-4489, fax 314-341-4729.

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