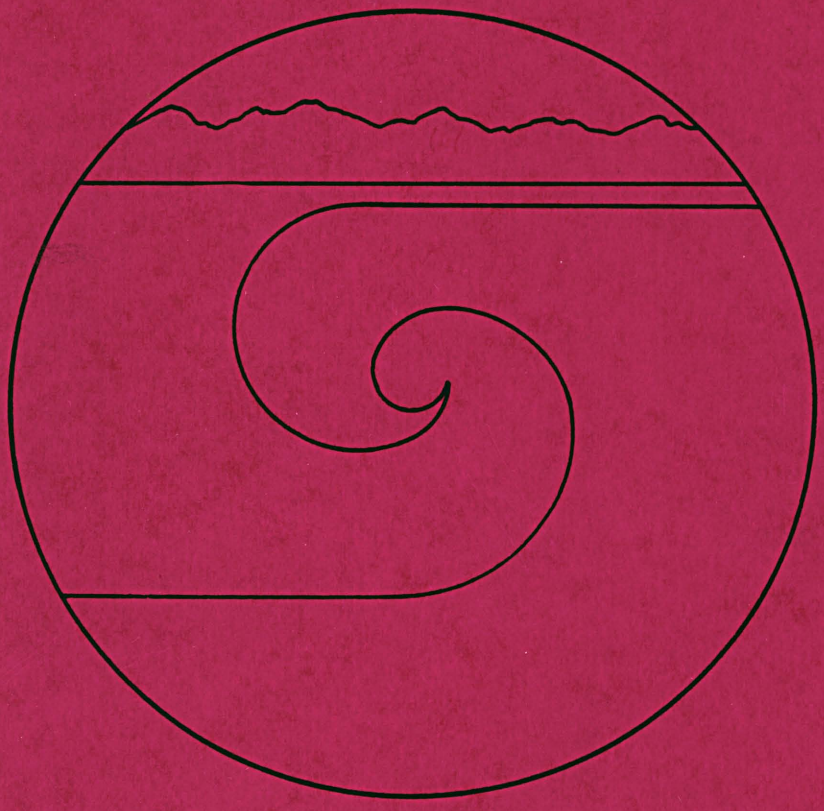
Eldredge

HAZARD MITIGATION PLAN

Utah 1985



COMPREHENSIVE EMERGENCY MANAGEMENT

a division of the

Utah Department of Public Safety

HAZARD MITIGATION PLAN

Utah 1985

COMPREHENSIVE EMERGENCY MANAGEMENT
a division of the
Utah Department of Public Savety
February 1985

"I have determined that the damage in certain areas of the State of Utah resulting from severe storms, flooding, mudslides and landslides beginning on April 1, 1984, is of sufficient severity and magnitude to warrant a major-disaster declaration under Public Law 93-288. I therefore declare that such a major disaster exists in the State of Utah . . ."

Signed

Ronald Reagan
August 17, 1984

— This was Utah's second Presidential Declaration in two years —

PARAGRAPH 10, FEMA/STATE AGREEMENT

The state shall review the status of implementation measures from the current State 406 hazard mitigation plan in the light of recent flooding, and modify or update such plan as appropriate to address new or additional hazard mitigation needs or issues. The State further agrees:

(A) To submit a report of this program review not later than 180 days after the declaration to the Regional Director;

(B) To follow up with applicants, within State capabilities, to assure that, as a condition for any grant or loan under the Act, appropriate hazard mitigation actions are taken; and

(C) To review and update as necessary disaster mitigation portions of the State emergency plan.

The Regional Director agrees to make Federal technical advice and assistance available to support the planning efforts and actions. The State understands that future Federal disaster assistance may be curtailed in situations where mitigation plans have not been implemented properly.

Signed

Scott M. Matheson, Governor
August 23, 1984

Table of Contents

PREFACE

The safety of people and property in Utah may be threatened by the effects of natural and man-caused disasters at any time. State government is responsible for developing and maintaining a high degree of preparedness for such conditions, including adequate protection and response plans. The state also provides assistance to local political subdivisions to establish, organize, and maintain disaster preparedness plans and programs.

The Utah Division of Comprehensive Emergency Management is the state's designated coordinating agency for disaster preparedness, emergency response, and hazard mitigation programs. As such, the division is continually reassessing its programs in an attempt to become more responsive to state and local emergency management needs.

The division assists county and local governments with planning, guidance, and funding for structural and nonstructural mitigation activities. During an emergency, the division coordinates response operations. The division's mission is to prepare and implement programs to minimize injury and damage caused by emergencies which threaten life or property.

This hazard mitigation plan represents a coordinated effort and ongoing commitment to mitigate potential future damages from natural and man-caused disasters. The presidential disaster declaration in 1984 mobilized many federal, state, local, and private entities for effective response and recovery activities. This plan goes beyond summarizing these activities to establish the groundwork for additional statewide hazard mitigation programs to prevent damages similar to those experienced in 1984.

I am pleased to endorse this document, as I did the State Hazard Mitigation Plan for the 1983 disasters, as a major planning effort directed at effective statewide hazard mitigation. The plan was prepared by the State Hazard Mitigation Officer, with assistance from other division staff members as needed. A State Hazard Mitigation Task Force was organized to assure appropriate input from state and federal agencies involved in the hazard mitigation process. Interviews were conducted with numerous state, county, and city hazard mitigation and disaster coordinating officials in the various agencies within the state. A questionnaire was provided to numerous other officials and response was favorable. These political subdivisions and government agencies are featured in this report.

This plan identifies opportunities and plans of action to reduce future disaster losses. Implementation will involve a multitude of individuals, agencies, and processes working together toward the common goals outlined in this plan. The intricate implementation process will be coordinated by the state's Hazard Mitigation Officer.

Lorayne Tempest
Director
Division of Comprehensive Emergency Management

ACKNOWLEDGEMENTS

The following federal, state, and local agencies provided valuable assistance in the preparation of this plan:

FEDERAL AGENCIES

Federal Emergency Management Agency
Robert Ives, Jr., Clancy Philipsborn, Nancy Stone
Federal Highway Administration.....Roy Nelson
Larry Klockenteger
National Weather Service .....Bill Alder
Ralph Hatch, Gerald Williams
U.S. Army Corps of Engineers .....Don Garrett
Lee McQuivey
U.S.D.A. Soil Conservation Service.Dennis Nielson
U.S. Geological Survey .....Ted Arnow
Rulon Christensen
U.S. Forest Service.....James Cole

STATE AGENCIES

Department of Administrative
Services .....Einar Johnson
Department of Agriculture.....Farnum White
Department of Community and
Economic Development.....Keith Burnett
Department of Health.....James Hendriksen
Department of Natural Resources and
Energy.....Dee Hansen, Genevieve Atwood,
Don Mabey, Bob Morgan, Stan Elmer,
Larry Anderson, Paul Summers, Lloyd Austin,
Dennis Strong, Clair Huff, Joel Huener
State Climatologist's Office.....Gail Bingham
Dept. of Public Safety.....D. Douglas Bodrero
Lorayne Tempest
Utah Division of Comprehensive Emergency
Management.....Fred May, Gerald Kaffer,
Lorin Larsen, Ralph Findlay, James Harvey,
Rex Bronson, Allen Short, Paul Ross,
Wesley G. Dewsnup, James Tingey, John Rokich,
Daniel Thomas, Elizabeth Zimmerman,
Bonnie Taylor, Evie Gonzalez,
Jean Segura, Debbie Sarris
State Highway Patrol.....Ivan C. Orr
Office of Legislative Research and General
Council.....Patricia Mulhern
Department of Transportation....Howard Latham
LeGrand Jones
Garn Hatch
Utah Attorney General's Office.....Paul Tinker
State Fire Marshall's Office.....John Elder
University of Utah Research
Institute.....Dr. Duncan Foley

LOCAL AGENCIES

Counties, cities, and towns affected by the 1983 and 1984 Presidentially declared disasters:

Jim Porter.....Sevier County
Marc McPherson.....Kane County
Brad Dee.....Weber County
John Zippro.....Davis County
Terry Holzworth.....Salt Lake County
Gary Clayton.....Utah County
Basil Lay.....Piute County
Denton Beecher.....Box Elder County
Keith Nelson.....Cache County
David Levanger.....Carbon County
Dale Peterson.....Uintah County
Rick Bailey.....San Juan County
Gayle Peterson.....Sanpete County
Bruce Harwood.....Garfield County
Al Mickelson.....City of Provo
Marion Carter .....Tooele County

We wish to acknowledge the assistance of county commissioners and other officials, too numerous to list, for their assistance in the assembly of this plan, especially regarding Great Salt Lake hazard mitigation.

BENEFICIAL DEVELOPMENT AREA CONSULTANTS (STATE LEVEL)

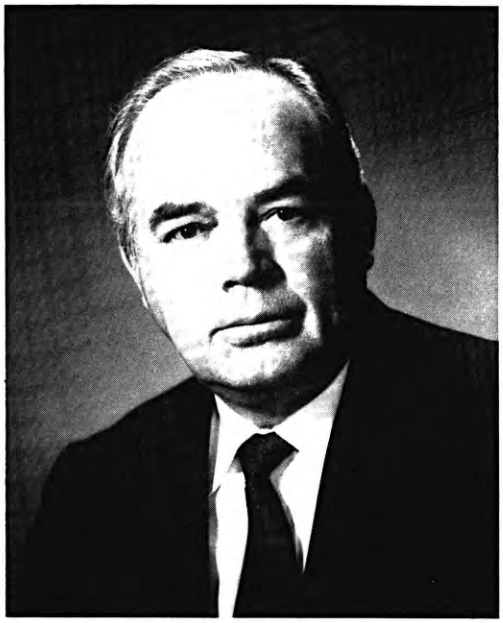
Ronald Delis, Department of Transportation
Howard Latham, Department of Transportation
Les Abbey, Department of Transportation
Howard Richardson, Department of Transportation
J.R. Chamberlain, Department of Transportation
Lorin Larsen, Comprehensive Emergency Management
Terry Green, Parks and Recreation
Lloyd Austin, Water Resources
Ronald Roberts, Department of Health
Don Mabey, Geological and Mineral Survey
Einar Johnson, Facilities Construction and Management
Stan Elmer, Lands and Forestry
Brent Hutchings, Wildlife Resources
John Salevurakis, Wildlife Resources
Keith Burnett, Disaster Relief Board

RELIGIOUS AND PRIVATE

LDS Church Emergency Services.....Dick Shea
KSL TV News.....Ernie Ford, Jim Dirker

In addition to these contributions, many individuals devoted their time, efforts, and expertise to help prepare this plan. Several staff members of the Division of Comprehensive Emergency Management provided written contributions and valuable feedback.

Norman Bangerter
Governor



GOVERNOR'S LETTER

On August 17, 1984, President Ronald Reagan determined that damages resulting from severe storms, flooding, debris flows and landslides beginning on April 1, 1984, had caused a major disaster in the state of Utah. Under the Federal Disaster Relief Act of 1974, a FEMA/State Agreement, designated FEMA-720-DR, was issued and signed by then Governor Scott M. Matheson. This agreement authorized the Federal Government to provide public assistance funds to the impacted twelve-county area in Utah. As part of this agreement, the State of Utah, through Governor Scott M. Matheson's certification, accepted the responsibility to review the implementation status of the previous State 406 Hazard Mitigation Plan and update the plan in light of the recent disasters, and to update the plan, also, as appropriate to address additional hazard mitigation needs or issues. The process of preparing the state's first 406 Hazard Mitigation Plan had been followed during the previous year, 1983, when 22 counties were impacted and included in the first Presidential Disaster Declaration in Utah's history. For this reason, 22 of Utah's 29 counties are currently involved with hazard mitigation activities resulting from the preparation of two consecutive 406 Hazard Mitigation Plans. The ultimate outcome of this effort will be minimized disaster losses, both in terms of life and property.

The Department of Public Safety's Division of Comprehensive Emergency Management, the Division of State Government most familiar with the concepts of disaster recovery and hazard mitigation, prepared this plan. By no means an individual effort, this plan encompasses the ideas, efforts, and commitments of several disciplines, agencies, and persons. In so doing, it strengthens Utah's ability to effectively mitigate potential future damages.

During the past two years, Utah has become a model for the rest of the country in responding to floods and earth movement problems. During 1983, the Thistle Landslide brought us notoriety for the ingenuity used in dealing with the monumental forces of nature, and the State Street River demonstrated how our communities can work together to minimize damage in the face of an emergency. Such problems associated with heavy precipitation seem ironic to long-time Utah residents, because Utah is considered to be the second driest state in the country. Flooding and other natural disasters have forced new responsibilities and demands on all levels of government and its citizenry. Utahns are gaining much experience and determination in hazard mitigation based on the effects of the last two year's disasters.

This plan will be a useful tool in formulating Utah's policy positions on hazard mitigation and guiding action at all levels. The implementation process will receive the highest priority possible.

We have learned from the experiences of 1983 and 1984 that coordination, planning, and cooperation are integral to successful disaster response and hazard mitigation planning. We dedicate this philosophy and a high level of commitment to continued planning and action.

Norman H. Bangerter

Governor

Executive Summary

On August 17, 1984, President Ronald Reagan issued a major disaster declaration for Utah, the second in the State's history, both such declarations occurring in consecutive years.

The most severe and extensive snowmelts in the history of Utah during the springs of 1983 and 1984 resulted in two consecutive years of presidentially declared disasters. Widespread flood, landslide, and debris flow damage, primarily associated with the Wasatch Mountains, impacted the state's major population areas and caused damage to roads and rail routes, private homes and businesses, agricultural lands, and public facilities. In 1983, the Thistle Landslide in Spanish Fork Canyon, additional landslides, widespread flooding from high runoffs, debris flows, and the failure of the DMAD Dam combined to create the worst statewide disaster in Utah's history. Prior to 1983, Utah had never experienced such magnitude nor combination of emergencies that greatly affected normal activities and proceeded to drain state and local emergency funds. The Utah disaster damage of 1984 was not as serious nor expensive as in 1983, but still warranted a Presidential Declaration for twelve counties. Disaster and recovery expenses for both 1983 and 1984 totaled over $500 million for combined federal, state, local, and private sectors. As a result of the presidential declarations, the State of Utah was able to obtain approximately $60 million in federal disaster assistance during both years with the requirement that the State prepare and implement a state hazard mitigation plan through the State Division of Comprehensive Emergency Management. Former Governor, Scott M. Matheson, certified that this would be done in an agreement with the Federal Emergency Management Agency (FEMA. This text comprises that plan. According to the FEMA/State Agreement, nonimplementation of the plan could result in curtailment of future federal disaster assistance.

The disasters of the past two years affected many areas. In 1983, 22 counties, involving 122 political subdivisions (cities, towns, counties, and water districts), were included in the Presidential Disaster Declaration. Twelve (12) counties were included in the 1984 Declaration, involving 81 political subdivisions. During 1984, Federal inspectors completed approximately 900 damage survey reports throughout the state. In 1983, over 1305 damage survey reports were completed. Although damage causes were fairly uniform among the affected areas, the type and extent of damage varied widely. Recovery efforts and resources also varied, but were planned to take advantage of effective mitigation opportunities. With few exceptions, the recovery effort from the past two years' disasters has been effective at all levels and hazard mitigation planning, though still in its infancy in Utah, is becoming instrumental in local and state government activities.

Utah will continue to experience disasters. The people of the State are still learning about the extreme climate and associated hazards that threaten life and property perhaps more than in many other states. History tells us that Utah can depend on a repetition of these kinds of disasters, making the implementation of this plan not only an obligation, but, also, an ongoing necessity requiring the attention of all state agencies and local governments. There may be those who will suggest that Utah can now forget about its hazards and get into a more comfortable posture. As we now look back on two consecutive years of expensive major climate-related disaster periods, we can ask ourselves what we have learned about Utah's vulnerabilities for the future; we are still in the recovery process from those two years. If the State does not utilize the experience of the past two years to plan for the future through hazard mitigation, then we have not profited from the experience.

Utah is involved with its initial efforts in comprehensive hazard mitigation, yet it has the need, resources, and capability to make Utah a safer place to live. Utah must approach hazard mitigation on the most professional of terms, creating ample space for hazard mitigation philosophy, activity, and funding in government. As hazard mitigation grows into maturity within the state, certainly we will see the rewards for such an emphasis. In the future, as life-loss and property damage occurs from Utah's natural hazards, the state can also look to estimated lives saved and property damage minimized through an exemplary hazard mitigation program.

After years of costly experiences with natural hazards and disasters in Utah, government agencies are seeking ways to enhance their planning and response capabilities. In addition to local mitigation activities underway in some counties, several federal and state agencies have designed and implemented hazard mitigation programs in Utah. Still, much needs to be done. The state's Division of Comprehensive Emergency Management coordinates these programs to meet statewide hazard mitigation needs and ensure that all available resources are used effectively. Some of these existing mitigation measures are comprehensive individual pro-

grams, ranging from FEMA's coordination of an interagency hazard mitigation team to the Utah Department of Natural Resources Management Plan for the Great Salt Lake. If there is any flaw in the existing measures, it lies in the ability to fund and fully implement mitigation measures to meet established needs.

This state hazard mitigation plan, sometimes referred to as the State 406 Hazard Mitigation Plan, was prepared due to a FEMA/State requirement. To obtain federal disaster assistance, former Governor Scott M. Matheson certified the State's intent to comply with Section 406 of Public Law 93-288 and signed an agreement with the Federal Emergency Management Agency (FEMA), both in 1983 and 1984, requiring the State to prepare a State Hazard Mitigation Plan with the understanding that future FEMA disaster funds could be curtailed if the plan were not implemented. This State Hazard Mitigation Plan has now been prepared and serves as the foundation for statewide hazard mitigation activities with the objective of minimizing future disaster losses for the State of Utah. The Utah Division of Comprehensive Emergency Management has the responsibility to oversee implementation and respond to FEMA inquiries on implementation requirements.

Two State Hazard Mitigation Plans will be discussed throughout this text. The first is the 406 Plan produced by Utah CEM following the first presidential declaration of 1983. This plan was published in 1984 and is referred to as the State Hazard Mitigation Plan - 1984. The second 406 Plan is this current plan resulting from the presidential declaration of 1984 and is being published in 1985. This will be referred to as the State Hazard Mitigation Plan - 1985. This second plan is an update of the first and includes the most recent recommendations resulting from an extensive interview and questionnaire response. It also contains an explanation of the status of the recommendations contained in the first plan. Utah, having now developed two State Hazard Mitigation Plans, is in an excellent state of understanding of the state's hazard mitigation needs. The implementation of these recommendations will greatly increase the state's capabilities in this regard at all levels, and will allow the state to continue receiving Federal Disaster Funds as such disasters occur.

This current plan is extensive, resulting from the cumulative experience of many people working on the disasters of the past two years. Experts, public officials, and laymen alike worked to analyze the existing problems, create solutions, and devise implementation strategies. The result has been a great number of recommendations, from the interagency team's report to 83 mitigation measures resulting from in-depth interviews with key hazard mitigation personnel in several government agencies and questionnaire responses considering the Great Salt Lake and many other central topics. Recommendations deal with public awareness of natural hazards, obligation of local governments to develop hazard mitigation plans, flood mitigation, earth movement mitigation, ground water mitigation, avalanche hazards, fire hazards, earthquake mitigation, funding and other issues. The status of mitigation measures contained in the previous 1984 Hazard Mitigation Plan (1983 disasters) are provided, including 52 action items generated by working groups at the Utah Governor's Conference on Geologic Hazards. Many of these previous action items are in the process of being implemented, and relate to topics such as landslide, seismic, and dam safety; hazard mapping; facility siting and inspection; emergency health care; education and information; funding; and miscellaneous topics. Thus, this current plan contains the results of data gathered for two State Hazard Mitigation Plans and is comprehensive.

This current plan is introducing the concept of the Beneficial Development Area (BDA), as a method for developing hazardous areas around lake shores to the maximum prudent use for the people of the state of Utah, while avoiding unnecessary disaster losses. This plan recommends the establishment of BDAs or other useful designations where known natural hazards and development are likely to coincide. Hazardous areas, such as the mouths of flood-prone canyons and the bases of landslide-prone mountain slopes, require special considerations prior to development, if they are to be developed. Past approaches to developing such areas have caused much dollar loss to private individuals and to government. Local Development Councils would decide on development strategies.

A Beneficial Development Area (BDA) should be established for the shorelines of the Great Salt Lake. The Great Salt Lake has become an especially important hazard mitigation consideration for the State of Utah in light of the potential cost of $110 million for West Desert pumping and other diking plans. Overall damage, to date, for the rising Great Salt Lake has been an estimated $176 million. The State Legislature is anticipated to meet this winter to decide these monumental Great Salt Lake mitigation alternatives. This State Hazard Mitigation Plan - 1985 contains the results of much deliberation on the lake, including a concensus of opinion between several key groups on establishing a Beneficial Development Area (BDA) around the Great Salt Lake shoreline. These groups include: the participants and sponsors of the recent conference (March 26-28, 1985) held in Salt Lake City on the Problems of and Prospects for Predicting Great Salt Lake Levels; FEMA; Utah CEM; and the Department of Natural Resources. This plan is proposing that a BDA be established for the known fluctuation surface of the Great Salt Lake, up to an elevation of 4217

feet; the lake has been to this level as recently as the 1600s. Local governments will take the lead in creating this BDA through the establishment of a Great Salt Lake Beneficial Development Council, an intergovernmental organization that will work toward the maximum prudent development, or usage, of the Great Salt Lake shoreline.

Hazard mitigation is a management strategy in which current actions and expenditures reduce the occurrence and severity of potential disasters. Utah has pursued hazard mitigation planning with a commitment to effectiveness and efficiency. This commitment has paid off in greatly improved mitigation plans and strategies designed to prevent the majority of damage which occurred in both 1983 and 1984.

This is the second hazard mitigation plan prepared for Utah; the first plan resulted from the 1983 disasters. This current plan reviews and updates that plan. Much of the basic historical information required to assemble a state hazard mitigation plan has remained unchanged, except that now the 1983 disaster information has also become part of the historical record in this current plan. Many of the original recommendations still being implemented are also included in this plan.

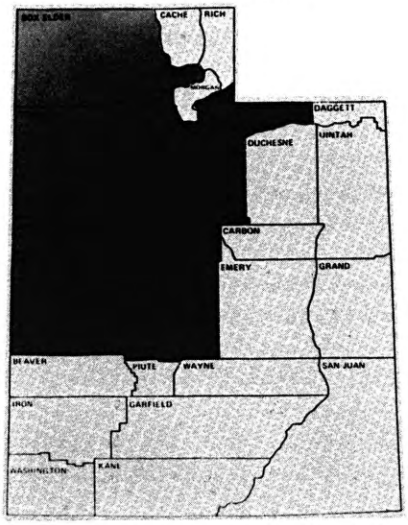
Fred E. May
State Hazard Mitigation Officer

Introduction

While a combination of geologic and hydrologic hazards constantly pose a threat to Utah's diverse landscape and settlements, the specific hazards presented by flooding, landslides, and debris flows became a harsh reality during the springs of 1983 and 1984. On August 17, 1984, President Ronald Reagan issued a major disaster declaration (under Public Law 93-288) for Utah. The initial declaration covered damages in Box Elder, Davis, Juab, Millard, Sanpete, Sevier, Tooele, Utah, and Wasatch Counties resulting from landslides, debris flows, and floods.

By December, three additional counties, Salt Lake, Weber, and Summit, were added to the presidential disaster declaration. Commencing on April 1, 1984, the incident period for the disaster declaration was not closed until July 1, 1984.

State of Utah



Map showing twelve-county-area declared during 1984 disaster period in Utah.

Authority

This hazard mitigation plan has been prepared under federal and state authorities. Its primary authority results from the FEMA/State Agreement for federal disaster assistance executed on August 23, 1984 between then Governor Scott M. Matheson, State of Utah, and the Federal Emergency Management Agency. This agreement, FEMA 720-DR, is mandated by the Disaster Relief Act of 1974, as amended; 42 USL 5121 et. seq.; and in accordance with 44 CFR 205.39. The actual requirement to prepare a state hazard mitigation plan following a presidential disaster declaration is found in Section 406 or Public Law 93-288, as amended.

Additional authority is derived from the following: (1) President's Executive Order 11988, Flood Plain Management; (2) President's Executive Order 11990, Protection of Wetlands; (3) Flood Control Act of 1950, Section 216, PL 81-516 (33 USC 7016-1); (4) National Flood Insurance Act

of 1968 as amended (42 USC 4001 et. seq.); (5) National Flood Insurance Program Implementing Regulations, 24 CFR 46962, promulgated October 26, 1976; (6) Utah Senate Bill 57, Disaster Mill Levy, 1983 General Session; (7) Utah Senate Bill No. 69, Disaster Response and Recovery Act, 1981 General Session; and (8) Utah Senate Bill No. 70, Emergency Management Act, 1981 General Session.

Purpose

In addition to fulfilling legal obligations under the aforementioned agreement and legislative mandates, this hazard mitigation plan serves the general purpose of planning for the safety of Utah's population and properties. The plan is a starting point and a guide to federal, state, and local authorities involved in actions to reduce future damage from floods, debris flows, dam failures, and other natural hazards. Mitigation efforts detailed in the plan are directed at minimizing the long and short-term impacts of these costly hazards.

Scope

Addressing issues relevant to the twelve counties impacted by 1984's spring flooding, this plan will maintain a broad scope and perspective. From a general county-by-county inventory of flood, and other incidents, and recovery efforts to an extensive report on statewide mitigation recommendations to be implemented and the status of the recommendations contained in the 1983 plan, this report will indicate the major parameters of Utah's hazard mitigation efforts for the present and future. Other geologic hazards in the state will be reviewed in brief.

The 1983 and 1984 disasters which affected more than half of Utah were unprecedented in both scope and severity; the 1983 disasters were more damaging than those of 1984. It is the ultimate goal of the state to avoid as much damage as possible from future disasters through an integrated campaign of planning, mitigation action, and public awareness.

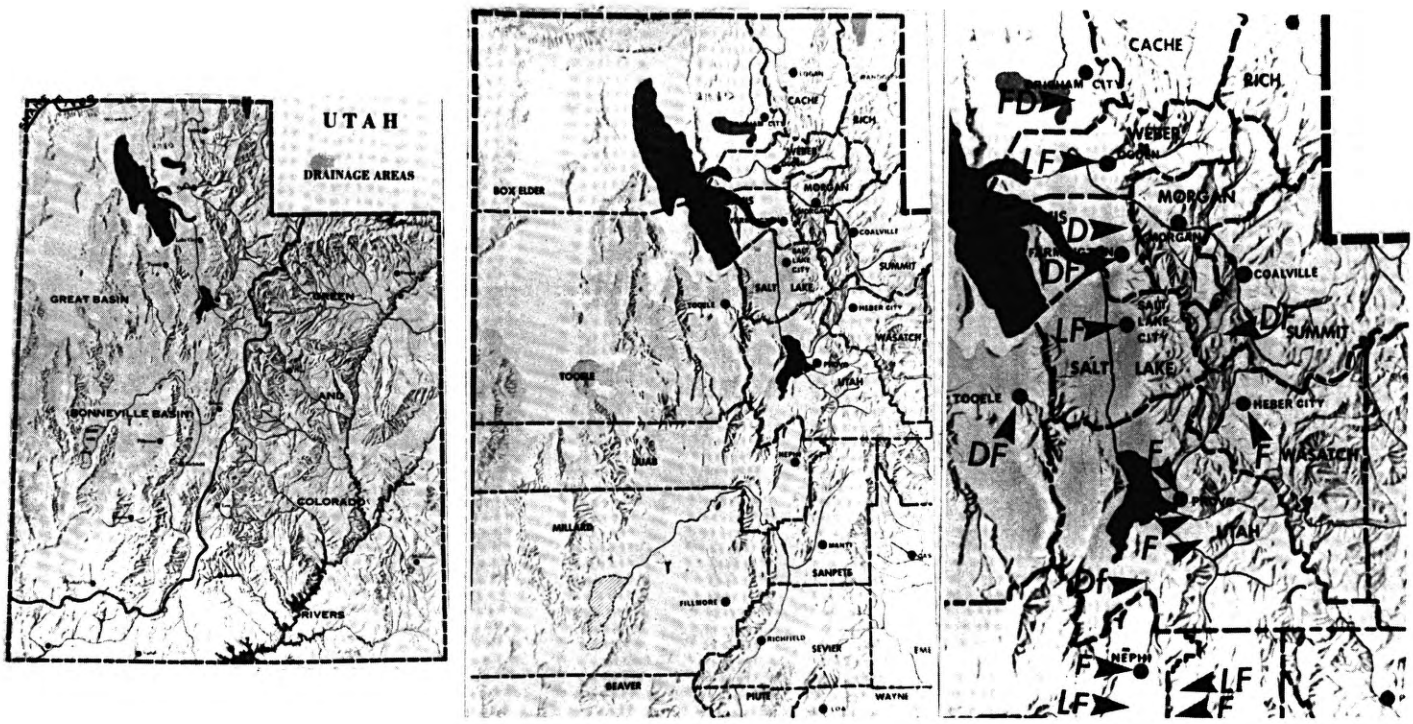
Utah's Presidential Declarations: 1983 and 1984

— Events of 1984 —

On May 8, 1984, Governor Scott M. Matheson implemented the state emergency plan and made an initial emergency declaration. On July 27th, 1984, Governor Matheson asked President Reagan to declare "a major disaster for Utah" as a result of 1984 flooding. Damage sustained by Utah amounted to approximately $41 million for private and public lands and facilities. Much of this damage was around Utah Lake where rising water forced the abandonment of many farms and homes. Most Utah damage occurred in Salt Lake, Utah, Davis, Wasatch, Weber, Tooele, Juab, Millard, Sanpete, Box Elder, Emery, Summit, Sevier, Rich, and Morgan counties.

The request for a Presidential Declaration was forwarded through Alton D. Cook, Denver regional director, Federal Emergency Management Agency. The request set in motion federal financial assistance programs.

> Governor Matheson wrote, "during the period from January 1, 1984, through July 1, 1984, heavy snowmelt runoff and numerous mudslides throughout Utah caused extensive flood damage to public, private, and agricultural property.
>
> I have determined that this incident period began . . . as the result of new flooding damage to private and public property caused by the rising level of Utah Lake.
>
> During January, Utah County and Provo City expended substantial funds for emergency preventive measures. At the same time, U.S. Army Corps of Engineers raised the diking to protect vital facilities adjacent to Utah Lake.
>
> Approximately 150 residences, roads, bridges, culinary water systems, sewage disposal systems, water control facilities and agricultural structures and lands have been affected. . .
>
> I have determined that this incident is of such severity and magnitude that effective response is beyond the capabilities of the state and affected local governments and that supplementary federal assistance is necessary."



(1) (2) (3)

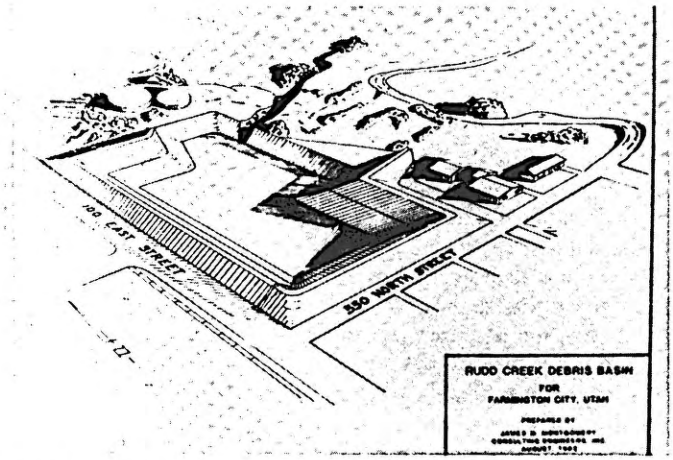
Maps showing counties in state of Utah: (1) entire state, (2) part of state having declared counties, (3) declared counties with kinds of disasters experienced: ***F*** *- flood;* ***D*** *- debris flows;* ***L*** *- landslides;* ***DF*** *- dam failure.*

The State's breakdown of the estimated damage included $500,000 in private non-agricultural losses, $8,680,029 in agricultural losses and $32,233,450 in public (state and local) losses. The Governor expected that some $6.9 million in losses would not be eligible for federal reimbursement.

On August 17, 1984, the President declared a Major Disaster Declaration for the State of Utah for the following counties: Box Elder, Davis, Juab, Millard, Sanpete, Sevier, Tooele, Utah, and Wasatch. At that time, the Federal estimate of eligible public damage in the nine counties was $11 million, of which $8.3 million was the Federal share. Later, on October 19, 1984, Governor Matheson requested reconsideration of Salt Lake, Summit, Uintah and Weber Counties for Public Assistance in the major-disaster declaration of August 17, 1984. On December 3, 1984, the counties of Salt Lake, Summit, and Weber were designated eligible for Public Assistance.

The major cause of the 1984 disasters was the unusually thick snow pack and continued record precipitation throughout the spring. By mid-March, some state precipitation amounts were at 194 percent of normal, with a snow level near 5000 feet. The Farmington upper snow course had 98 inches of snow containing 40.1 inches of water; Parley's Canyon Summit had 66 inches of snow, containing 23.1 inches of water; Horse Ridge had 66 inches of snow containing 25.8 inches of water. Although the National Weather Service predicted spring floods on several major rivers in Emery, Sanpete, Juab, and Sevier Counties, a dry spell in March led some to believe that spring flooding might be avoided. However, 65 degree temperatures in mid-March caused Salt Lake City storm drains to fill, blowing drain covers, and gushing water into the streets. By the end of March, the National Weather Service's April and May forecasts predicted heavier runoff than in 1983. By April 8, crews in Davis County were rushing to finish flood control projects and the National Weather Service's hydrometeorological flooding index was at 8.7 (on a scale of 1-10). Much of April was spent preparing for flooding in many areas. On April 19, Bill Alder (National Weather Service) reported that warming weather was marking the beginning of the flood season. The first notable flooding, on April 19, closed Hwy 89 from Manti to Spanish Fork Canyon, and on April 20 Salt Creek threatened a bridge near Nephi. To make matters worse, on April 26, the Salt Lake Valley received the heaviest spring snowfall ever recorded in a 24-hour period - 10.7 inches recorded at the Salt Lake International Airport; Springville recorded 12 inches and Mapleton 13 inches; the northern mountains received over 18 inches. The extra snow brought the total winter snowfall at Alta to over 727 inches, with 109 inches just during April; Snowbird recorded 666 inches total with 106 inches of new snow. By April 29, Bill Alder (NWS) had upgraded the flooding potential to 9.4. On May 3, rain floods closed Hwy 89 from Brigham City to Logan through Sardine Canyon. At this point it was noted that the first seven months of the water year were the wettest on record. While landslide problems were prevalent during March, April, and early May, flooding did not begin in earnest until mid-May. On May 16 the Spanish Fork River was measured as flowing at a record 3100-3700 cfs, menacing the town of Palmyra near Utah Lake. The Payson River flooded as did Salt Creek which destroyed parts of the Nephi water lines forcing the city to use pumped wells. For the remainder of the month of May, the flooding record is too extensive to list. As a measure of this flooding along the Wasatch Front, Sevier Lake which is normally a dry lake bed contained 35 feet of water; Great Salt Lake flooded freshwater marshes with salt water, killing the marshes and the food on which migratory

Rudd Creek debris basin, Farmington City, Davis Co., Utah.



Rudd Creek debris basin, partially filled in spring 1984 (Davis Co. photo).

birds feed. It was estimated that the Great Salt Lake would cause about $200 million in flood damage. Flooding diminished considerably during June, with minor flash flooding from thunderstorms and minor flooding along Big Cottonwood Creek and the Jordan River. Probably the most impressive example of hazard mitigation during 1984 was the successful utilization of a number of debris basins constructed in 1983 and 1984 that prevented major damage.

Flooding was only a part of the disaster scene. Landslides and/or debris flows occupied the attention of State disaster personnel during March, April, and May. Mudslides were being predicted as early as March 9. Although a slide occurred in Spanish Fork Canyon as early as January 6, the slide season began on March 13, also in Spanish Fork Canyon, blocking traffic on Hwy 6. Another slide in the same area again blocked Hwy 6 on March 16; the pass was reopened on on March 21. On March 29, a 100,000 cubic yard slide in Chicken Creek Canyon threatened the Levan water supply. On April 6, a landslide partially covered the Sundance ski resort, and in Ogden Canyon a landslide closed the highway from Huntsville to Ogden, threatening homes and the power supply to more than 6000 people; voluntary evacuation took place in Ogden Canyon near the slide. Numerous other slides resulted as the spring thaw proceeded, but perhaps the most spectacular was a massive debris flow that surged out of an unnamed canyon in East Layton. Six homes were engulfed forcing the evacuation of 30 residents; miraculously no one was injured. An example of a "close call" was a woman who went from her bedroom to get a drink of water just as the wall of mud struck her home, crushing her bedroom wall and filling the room with mud.

After carrying out emergency disaster recovery operations and assessing damage statewide, the State concluded that it did not have all of the needed resources to handle the overall recovery activities. On July 26, 1984, then Governor Scott M. Matheson requested a Presidential Major-Disaster Declaration for 16 Utah counties.

PUBLIC ASSISTANCE

Type of Damage

NOTE: "A" THROUGH "I" RELATE TO TABLE BELOW

A. Debris Clearance
B. Protective Measures
C. Road Systems
D. Water Control Facilities
E. Public Buildings and Equipment
F. Public Utilities
G. Facilities Under Construction
H. Private Nonprofit Facilities
I. Other

County	A	B	C	D	E	F	G	H	I	Cost	Total Cost
State of Utah	X	X	X	X	X				X	$267,870	357,160
Salt Lake	X	X	X	X		X	X		X	2,563,515	3,418,020
Davis	X	X	X	X	X	X	X		X	840,047	1,120,063
Utah	X	X	X	X			X	X	X	4,086,211	5,448,281
Juab	X	X	X	X			X			1,310,566	1,747,421
Sanpete	X	X	X	X	X	X	X	X	X	1,382,136	1,842,848
Millard	X	X	X	X						492,204	656,272
Weber	X	X	X	X		X		X	X	383,005	510,673
Sevier	X	X	X	X		X			X	185,545	247,394
Tooele	X	X	X	X	X				X	813,676	1,084,901
Wasatch	X	X	X	X			X			484,895	646,527
Summit	X	X	X	X	X	X				99,283	132,377
Box Elder	X	X	X	X						217,547	290,063
TOTAL										**13,126,500**	**17,502,000**

TOTAL FROM 1983 DISASTER (FOR COMPARISON) 46,448,945

Cost of the Disaster

With 16 counties having declared disasters between April 9 and June 13, 1984, the assessments of damage expense began to mount. The total cost of these disasters will not be fully realized for a long time. Indirect and intangible costs continue to surface and even direct costs change (invariably increase) as time and recovery progress. The most useful survey of disaster costs will not only put a pricetag on the events, but will instigate informed discussion on mitigation planning.

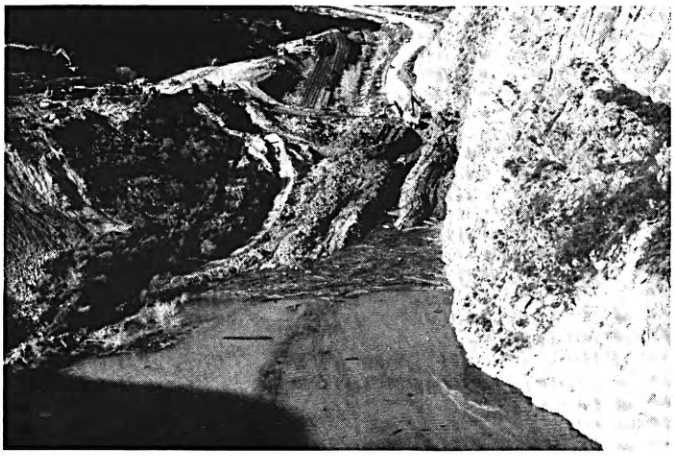
Total damage, loss, recovery, and mitigation costs are currently estimated at $41 million for 1984's floods and landslides. The table on the previous page details these costs on a county-by-county basis. Under the provisions of the Disaster Relief Act of 1974 (Public Law 93-288(, federal financial assistance is provided for recovery from presidentially declared disasters. Supplementing state and local government and private sector efforts and resources in response to a major disaster, this assistance can cover up to 75 percent of total public assistance costs.

The federal disaster assistance program provides public assistance (aid to state and local governments) and individual assistance (aid for disaster victims and their families). Public assistance grants are made for emergency protective measures, debris clearance, and/or restoration of damaged public and certain private nonprofit facilities. Public damages of this nature are put into nine categories: (A) debris clearance; (B) protective measures; (C) road systems; (D) water control facilities; (E) public buildings and equipment; (F) public utilities; (G) facilities under construction; (H) private nonprofit facilities; and (I) other public facilities. Public assistance in 1984 totaled $13,126,500. The table on the previous page details the amount of public assistance received in each of the 12 impacted counties and the state, and the categories in which damages occurred.

Other forms of individual assistance under the Disaster Relief Act include disaster unemployment and job placement assistance; legal services to low income families; crisis counseling; and referrals to appropriate mental health agencies to relieve disaster-related mental health problems. There was no individual assistance authorized in 1984.

Events of 1983

In 1983, the State of Utah received its first Presidential Disaster Declaration. The most severe and extensive snowmelt in the history of Utah, to that time, occurred during the spring of 1983. Widespread flood and debris flow damage along the Wasatch Front impacted the state's major population areas causing damage to major roads and rail routes, private homes and businesses, agricultural lands, and public facilities. Damages from the flooding totaled $478 million.



Thistle landslide and rising waters of Thistle Lake during spring of 1983. Utah CEM photo, Lorin Larsen.

Rising waters of Utah Lake flood I-15 in Provo. (Utah Co. photo).

Although the presidential disaster declaration was made on April 30, 1983, the major events leading up to 1983's severe floods began in 1982. During the water year ending September 30, 1982, 25.19 inches of precipitation were measured at the Salt Lake International Airport. That was ten inches more than the thirty-year norm and the most for any year on record. New monthly records were set in July, September, and October 1982. The unusual weather continued into the 1983 water year and produced a series of geologic events with a major impact on Utah.

Early flooding occurred in February and March, involving the Jordan, San Pitch, and Sevier Rivers. Utah Lake rose over sandbags to flood Utah Lake State Park. In April, the most expensive disaster in Utah history occurred in Spanish Fork Canyon.

The Thistle Landslide, which began to move on April 10, 1983, and continued through May, was by far the most costly geologic event in Utah's history. Direct costs exceeded $200 million and indirect costs were also high. The landslide, which occurred below the confluence of Soldier Creek and Thistle Creek in Spanish Fork Canyon, and the lake it produced, severed three major arteries: U.S. Highway 6, U.S. Highway 89, and the Denver and Rio Grande Western Railroad track. The unincorporated community of Thistle in Utah County was entirely inundated. Fifteen homes, ten businesses, and railroad switching yards were lost. The slide was responsible for the state's first presidential declaration on April 30.

May 1983 began with the formation of a new lake on western Utah's Salt Flats that was larger than Utah Lake. In Weber Canyon, a slide covered Union Pacific Railroad's mainlines.

Beginning on May 22, severe flooding erupted throughout the state. A landslide in Twelve-mile Canyon in Sanpete County closed the canyon and caused flash flooding as a 30-foot wall of water descended into Pinchot campground. Interstate and state highways were frequently interrupted by flood waters.

On May 26 sudden hot weather escalated the crisis along the Wasatch Front. Salt Lake County declared a state of emergency. All seven major Wasatch Front creeks (City, Emigration, Mill, Parley's, Big Cottonwood, Little Cottonwood, and red Butte) were at flood stage. In Salt Lake City, 13th South Street was turned into a river from State Street to the Jordan River to control flooding from Parley's, Emigration, and Red Butte Creeks.

Other severe damage occurred in Davis County. In Bountiful, flood waters from Mill Creek cut a hole 60-feet wide and 20 feet deep in a city road, Broke sewer lines, and caused flooding to homes and businesses; other flooding occurred in Centerville. Mudslides descended on Farmington on May 30 and 31, destroying several homes and damaging many others. In other parts of Davis County, some 13 homes were destroyed and about 400 others damaged from debris flows.

As June progressed, the runoff and flooding began to subside. By mid-June damage assessments were progressing and massive cleanup efforts were being coordinated. But June still held some surprises, as the duchesne County Lake overflowed from its spillway on June 22, washing out a state highway and threatening bridges. The DMAD dam near Delta in Millard County failed on June 23, sending 16,000 acre feet of water down the Sevier River. Two bridges were washed out and the town of Deseret was completely inundated with up to five feet of water.

The level of Utah Lake peaked on June 23, at 4.93 feet above compromise, and the Great Salt Lake peaked on July 1, 1983 at 4205 feet above sea level, having risen a record 5.2 feet since September of 1982.

History of Hazardous Events Prior to 1983:

It is difficult to prepare a relevant description of similar previous events — Utah has never before experienced the combination of emergencies which occurred during the springs of 1983 and 1984. The landslide in Spanish Fork Canyon, widespread flooding from high runoff, debris flows, and the failure of the DMAD dam combined to create the worst statewide disasters in Utah's history. Previous events have been smaller in both geographic scope and the damages incurred.

Utah's 84,916 square miles of land and water stand at an average elevation of 5,500 feet above sea level. The principle drainage of the state is either west to the Great Salt Lake and Sevier Lake or east to the Green and Colorado Rivers. Approximately one-half of the state drains to the sea via the Colorado River.

The Great Basin is separated from the eastern Colorado Plateau by a prominent escarpment that faces west and constitutes the western margin of the Wasatch Range in the north and the western edge of the Colorado Plateau in the center. The abrupt slope, which separates the eastern highland from the western lowland, is cut by short, deep, steep-walled canyons. Floods are characteristic of these canyons, as indicated by the formation of alluvial fans at each canyon mouth.

Sloping topography dominates the limited flat areas throughout Utah. Probably in no state west of the Rocky Mountains are plains as restricted in extent as in Utah. The steep gradient of the smaller streams, their confinement in narrow canyons, and the slopes are major factors in the destructiveness of cloudburst floods in Utah. Agricultural development and population settlements in Utah are also

concentrated at the base of these slopes, further increasing the damage potential from flooding.

Flooding:

Although Utah's precipitation is the second lowest in the country, her flooding history is significant. Over 1,400 cloudburst floods have been recorded in the last 135 years causing millions of dollars damage. Utah's 1.5 million inhabitants are clustered in relatively small geographic areas at the base of steep mountain ranges, with 90 percent of the population concentrated in the Wasatch Front region. Flooding along the Wasatch Front thus impacts a relatively small area, but a comparatively large population.

Major floods in Utah are almost always the result of rapidly melting snow in late spring and early summer, often intensified by accompanying rain. Intense summer thunderstorms have historically caused heavy damage in several localities. The snowmelt, combined with precipitation and climate patterns, also impacts the eventual level of the Great Salt Lake, which has no outlet and is thus controlled solely by evaporation. Due to the very flat land around the lake, large areas experience flooding from even small increases in the lake's level.

In Utah's long history of floods, individuals have suffered severe flood losses. Flood-fighting and recovery have imposed significant financial burdens at all levels of government. While existing flood control facilities have proven themselves effective by preventing thousands of dollars in potential damage, the need for continued improvement of statewide flood mitigation efforts and planning has been recognized and included in ongoing operations.

Prior to the flooding of 1983 and 1984, the flooding along the Wasatch Front in the spring of 1952 was the most severe in the history of the state. The snowmelt flood from Parleys, Red Butte, and Emigration Creeks flooded seventy-five city blocks in Salt Lake City causing $2,337,000 in damage. Major damages were also recorded along the Weber River ($1,350,000); Provo River ($649,000); Hobble Creek ($455,000); Bear River ($404,000); Jordan River ($274,000); and Ogden River ($97,000). The 1952 damage total was $6,746,000.

Other severe floods of record in Utah's Great Basin Region were the Bear River flooding in February 1962, causing $477,000 in damage; Farmington Creek in August 1923, causing $300,000 in damage; Coal Creek in August 1921, causing $218,000 in damage; and Dry Canyon in August 1965, causing $176,000 in damage.

Utah's Upper Colorado Region experienced its most severe flooding in June 1965 from heavy rain along Sheep Creek near Manila. That flood took seven lives and caused $802,000 in damages to roads, bridges, and campgrounds in the mountain recreation area. Other major flooding events in the region were the Price River near Helper in June 1917 ($380,000 in damage); Strawberry River near Neola in June 1952 ($297,000 in damage); Green River near Jensen in June 1957 ($155,000 in damage); and the Price River near Heiner in April 1952 ($120,000 in damage).

The most disastrous flood in Utah's Lower Colorado Region occurred in December 1966 when several days of light rain were followed by heavy rain and produced discharges of 22,800 cubic feet per second on the Virgin River at Virgin, Utah and 32,500 cfs at Littlefield, Arizona. Total damages of $962,000 were mainly to agricultural and public facilities. The largest known flood in the region occurred in September 1970 when heavy rains caused severe flooding on the lower reaches of McElmo Creek, Montezuma Creek, and the San Juan River. Industrial areas, utilities, and croplands suffered moderate damage, two people lost their lives, and damages exceeded $700,000.

Summer cloudburst-type floods occur almost every year someplace in Utah's Sevier Lake Basin, but flood damage has historically been minimal due to sparse population and lack of development. A 1973 snowmelt flood caused nearly $600,000 in damage on 5,000 acres in this basin. In 1921, one of the area's largest cloudburst floods caused $218,000 in damage.

In 1971, the Utah Geological and Mineral Survey identified approximately 600 landslides in the state of Utah. Primarily located from 6,000 to 8,000 feet sea level, these slides exist in the Wasatch Front's common slide zone elevation range.

Damaging debris flows from landslide activity have been documented for over one-hundred years. In addition to the Wasatch Front being in a seismically active zone, the steepness and consistency of the mountain strata facilitates sliding, especially in times of abnormally high precipitation and subsequent high water tables.

Many historical accounts of flooding in Utah note that large volumes of debris are carried with the water from a cloudburst flood. Surface runoff is rare from many mountain canyons thus the floods flush accumulated plant litter and soil particles (from clay pieces to boulder size) from the surface into the stream channels. At constriction points, the debris tends to accumulate and form temporary dams which later give way, sending the debris plunging down the canyon.

The Thistle landslide, which began to move April 10, 1983 and continued through May, was Utah's worst landslide of record, causing damages in excess of $200 million to roads, railways, homes, and businesses.

Prior debris flows recorded along the Wasatch Front include those from City Creek (1864) and Kenney Creek in Salt Lake City; Stone Creek/Ward Canyon in Bountiful;

Parrish Creek in Centerville (where a 1930 debris flow destroyed several homes and a school and covered State Highway 106 with 15 feet of debris); Ricks Creek/Ford Canyon (1923, 1929, 1930); Davis Creek (1923); Steed Canyon (1923); Farmington Canyon (1878, 1923, 1927, 1930); Baer Creek; Holmes Creek/Webb Canyon (1917); South Fork of Kays Creek in Kaysville (1912, 1923, 1927, 1930, 1945, 1947); Waterfall Canyon (1923); Ogden Canyon (1888, 1923, 1980); Willard Canyon (a 1923 debris flow destroyed the Willard Municipal Power Plant and in 1936 debris flows covered two blocks of the main road and completely buried seven homes); and Three-mile Creek/Perry Canyon (1923).

Landslides and Debris Flows:

Landslide and debris flows are recurring natural phenomena in Utah. The earth and water on slopes move downhill in response to gravity, causing slope instability and the eventual slides. Certain areas are far more prone to landslides and debris flows than others, and areas which have had movement in the past are likely to be hazardous in the future. In addition to movements on naturally unstable slopes, many landslides develop in areas where construction activities have destabilized slopes. Debris flows can occur with little warning and move very quickly and destructively. Active landslides move more slowly but almost inexorably.

Earthquake Disasters:

Historic records of earthquake activity in Utah date back to 1853, shortly after the region was first settled. Since that time, on the order of 1,000 felt earthquakes have occurred, the largest being intensity IX (Modified Mercalli Scale) and magnitude 6.7 (Richter Scale). Of these felt events in Utah, 119 have generated maximum intensity V or greater (MM), 19 occurring within the Weber, Davis, Salt Lake, and Utah County areas.

Eight historical earthquakes have caused significant damage within the four-county area. The 1909 event (MM VII), on the Hansel Valley fault system, sent seiche waves over the railroad causeway at the north end of Great Salt Lake, and broke windows in Salt Lake City. The 1934 Hansel Valley event (MM IX) severely damaged a brick building in Kosmo, produced two-foot scarps in recent alluvium (the only historic event in Utah to produce surface rupture), altered ground-water flow patterns, and initiated rock slides in the epicentral area. In Salt Lake City, walls were cracked, plaster fell and adjacent tall buildings swayed severely enough to make contact with one another.

Intensity VI earthquakes in 1910, 1943, 1949, and 1962, within the immediate Salt Lake City area, produced damage generally in the form of cracked walls, fallen plaster, toppled chimneys, and broken windows. The 1949 event ruptured a 10-inch watermain resulting in the loss of water to a sizeable portion of the city. An intensity VI event in 1915 caused minor damage in the Provo City area.

By far, the most damaging earthquake in Utah's history, was the 1962 event near Richmond, north of Logan in the Cache Valley. Weber and Davis Counties felt the earthquake with MM intensities of V and VI and V or less in Salt Lake City and Utah Counties. The earthquake was moderate in size (Richter Magnitude 5.7 and MM = VII) but produced damage in three-fourths of the houses in Richmond, nine being unsafe to reoccupy. Two small commercial buildings and a church were rendered nonfunctional. More than half of the chimneys on the houses in Richmond were damaged. Several large buildings in Logan, which was about 12 miles from the epicenter, sustained major structural damage due to cracked and distorted walls, fallen chimneys and parapets. Mudslides and rockfalls closed several highways in the foothills east of the epicenter and damaged water flumes and irrigation channels, causing minor flooding. The total dollar cost was estimated at $1 million.

Summary of Idaho Earthquake, 1983

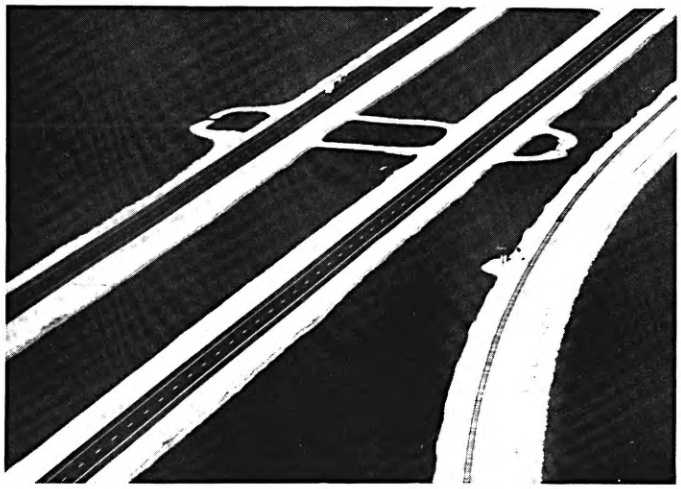
The most recent damaging earthquake (Richter Magnitude 6.0) near the Utah borders occurred in 1975 in the Pocatello Valley. Epicentral MM intensity was estimated to be VII to VIII. The population center receiving greatest damage was Malad City, about 13.7 miles northeast of the epicenter where an MM intensity of VII was observed.

In Central Idaho, the largest earthquake recorded in the United State since 1959 shook the tiny communities of Mackay and Challis; the earthquake measured 7.3 on the

Fault scarp measuring approximately 12' formed along Lost River Range in Central Idaho during major earthquake in October, 1983. (Fred May, photo).

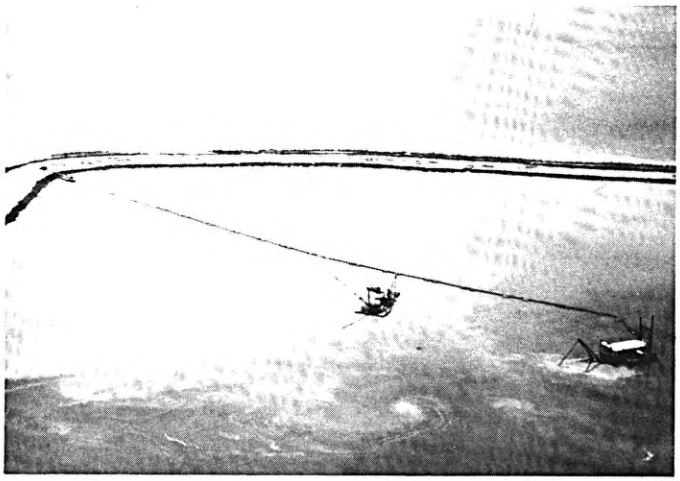
Hazard Mitigation Successes

Dikes constructed on both side of Interstate 80, April 1984.

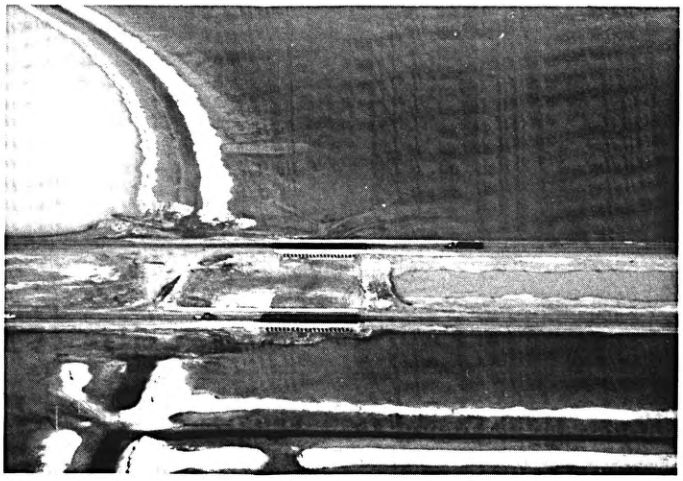


Completed dikes on I-80, August 1985.

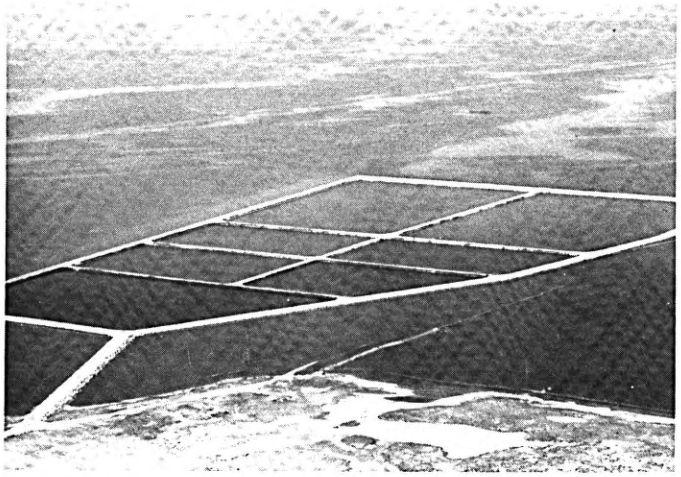
Dredging operation for repair of AMAX dikes, October 1983.



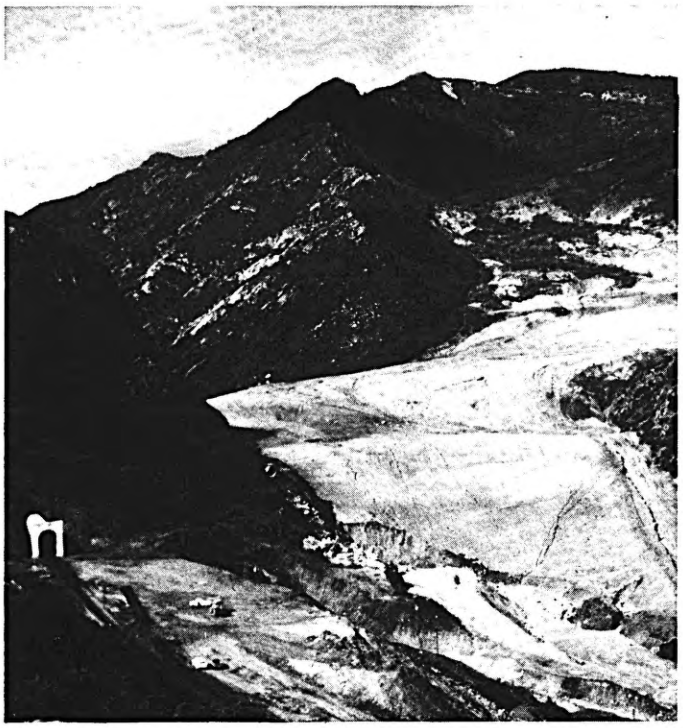
Repaired AMAX dikes, August 1985.



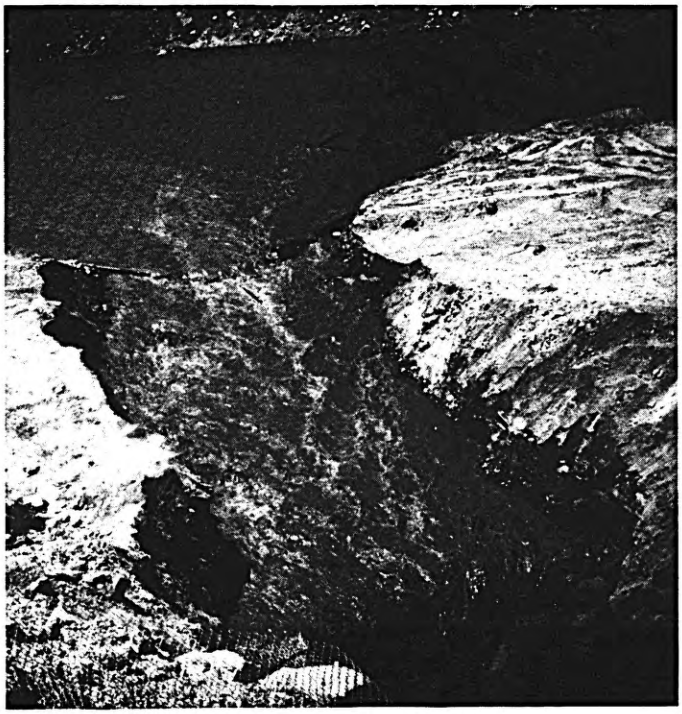
Equalizing water levels on both sides of Interstate 80 in Bonneville area, October 1983.



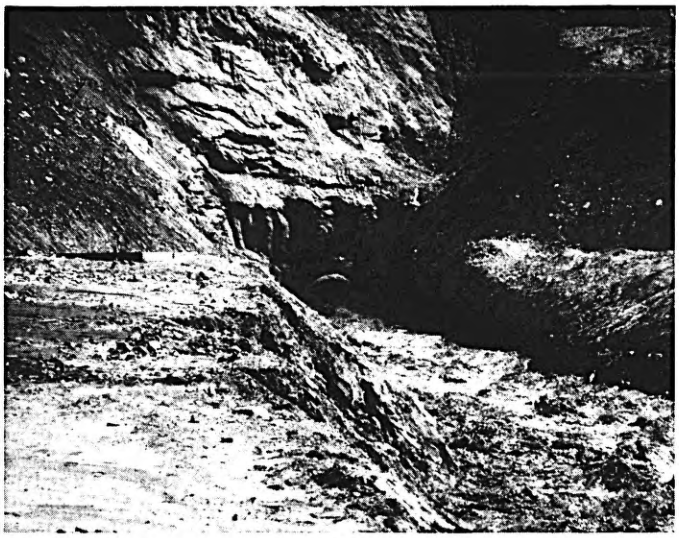
Perry Wash Water Treatment Plant repaired, August 1985. (Utah Div. Water Resources, Lloyd Austin, photo)



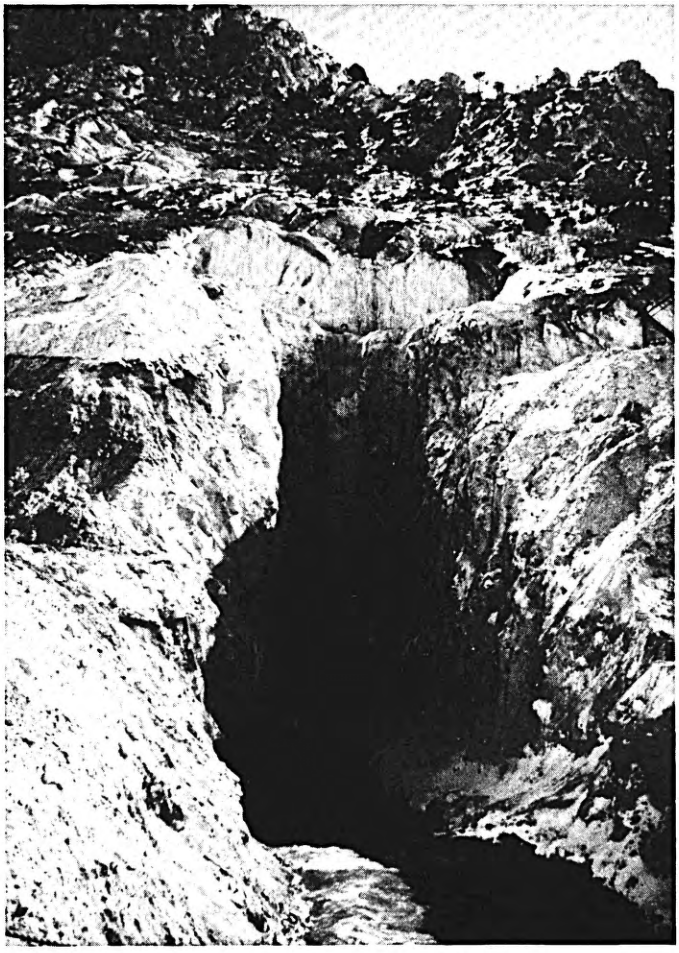
Mitigation activities at Thistle Landslide during spring of 1983 (Utah Co. photos)
Southwest view onto slide.



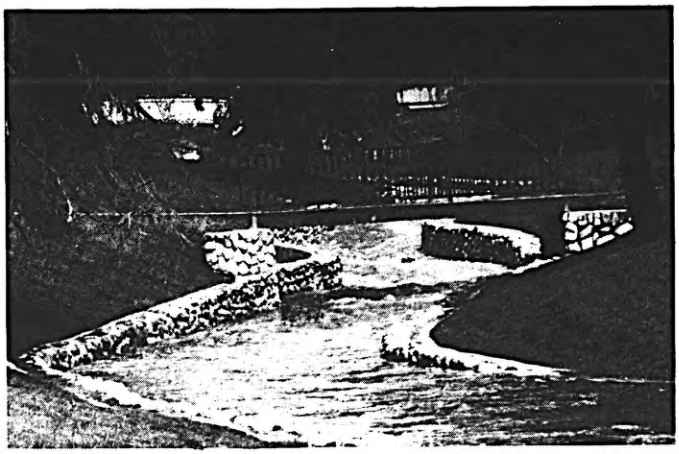
Thistle Landslide — intake for diversion tunnel.



Thistle Landslide — outlet for low level diversion tunnel.

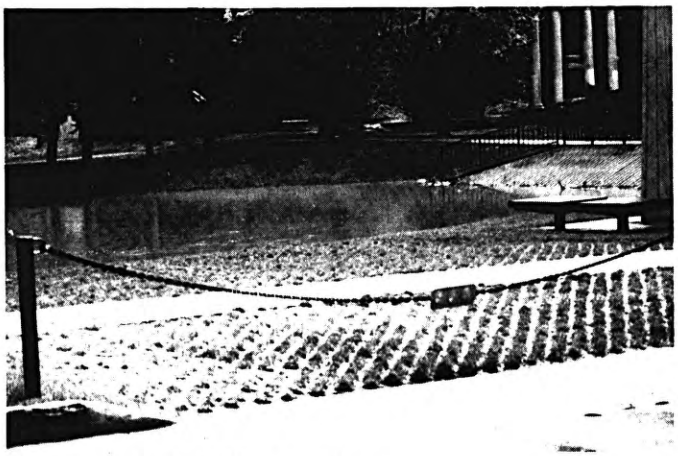


Thistle Landslide — intake for diversion tunnel.

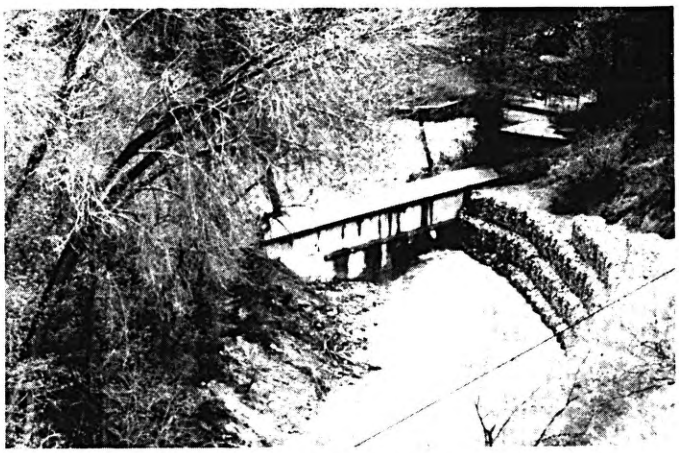


Various mitigation measures taken in Salt Lake County. (Salt Lake Co. photos)
Decorative river banks in Memory Grove to eliminate erosion.

Wire baskets containing rocks to protect stream banks.

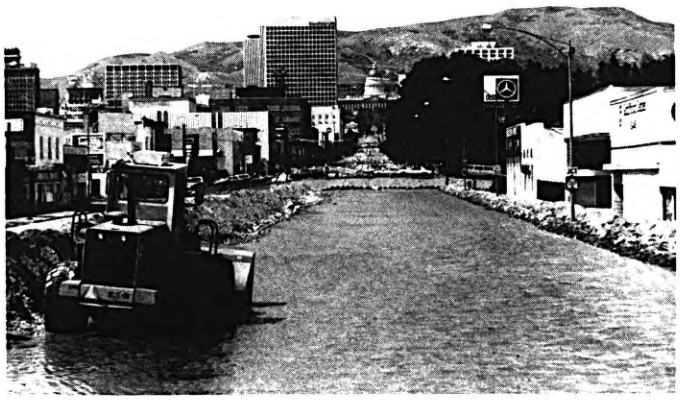


Catchment basin in Memory Grove.

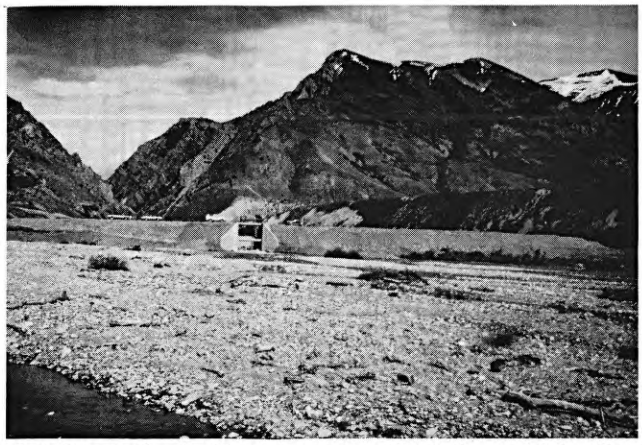


Wire baskets containing rocks to protect stream banks.

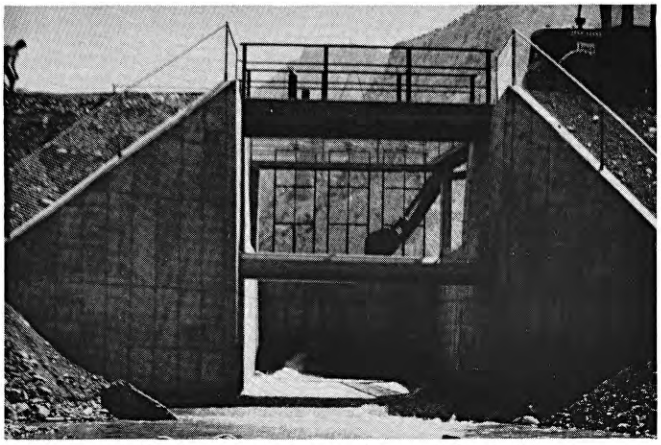
Catchment basin in City Creek Canyon



Temporary flood control measures on State Street in 1983.



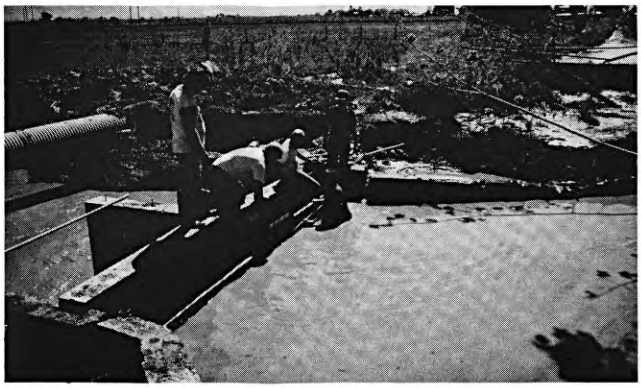
Utah County flood mitigation measures (Utah Co. and Allen Short, photos)
Flood control dam on Spanish Fork River.



Close up of flood control dam on Spanish Fork River.

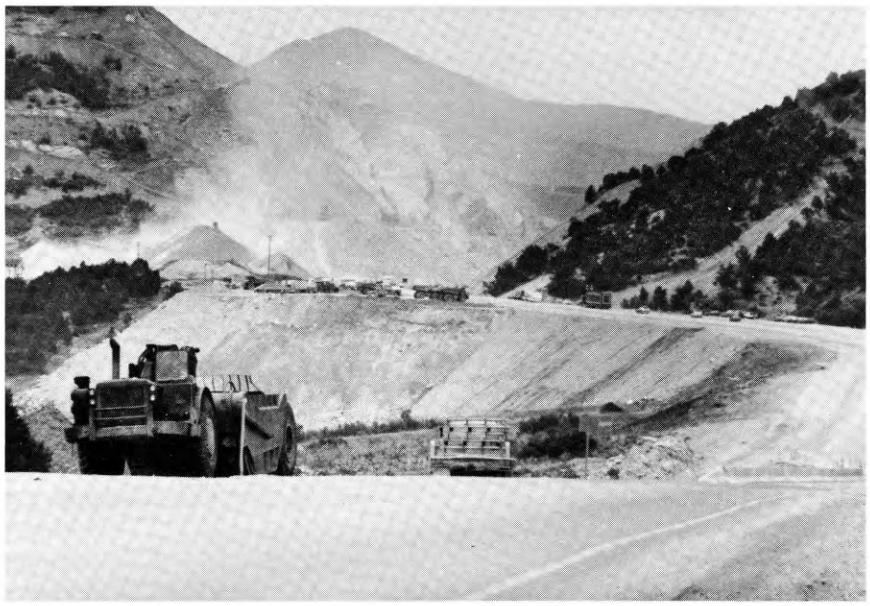
Diking and riprapping along the Spanish Fork River.

Diking and riprapping similar to that along the Spanish Fork River.

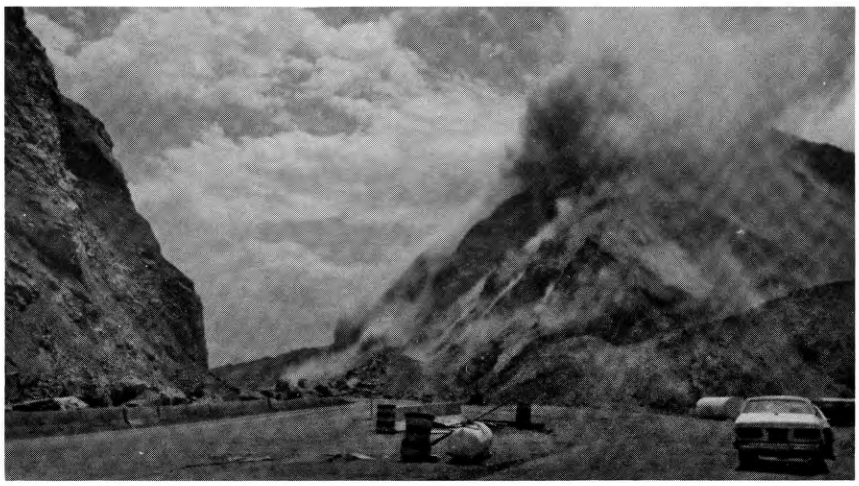


Installing a flood control structure in Utah County.

Sandbagging along a street in Provo during spring 1984 flooding.



Keeping U.S. 89-6 open during landsliding of spring 1984. (UDOT photos)



Dredging of Jordan River during 1984. (UDOT photo)

Diking of Utah Lake along I-15 during 1983. (UDOT photo)

Richter Scale. The epicenter was located about 17 miles north of Mackay near the base of Mount Borah (the highest peak in Idaho) on the west front of the Lost River mountain range. Ground breakage with single scarps up to 12 feet tall and multiple scarps totalling 20 feet in displacement extended for 20 miles north-south along the foot of the range. A graben up to 100 feet wide and 10 feet deep, sometimes called a zone of deformation, formed along the fault. In the Thousand Springs Valley to the west, ground water under pressure shot 20 feet into the air from fissures on the east side of Chilly Butte. Damage was estimated at $12 million in these small rural communities. In a more populated area the damage would have been extreme.

An important point regarding the Idaho Earthquake is that the geology there is very similar to that of the Wasatch Front in Utah, and that area in Idaho belongs to the same Basin and Range Geologic Province. The Lost River Fault, where the earthquake occurred, had been seismically quiet over historic times; the inhabitants had never felt an earthquake emanating from that area. However, at 8:00 a.m. on October 28, 1983 a major earthquake that was felt in seven states and Canada startled the residents of Mackay and Challis Idaho. From July 1 to December 31, 1984 171 aftershocks or associated separate earthquakes were recorded from this Idaho area at the University of Utah Seismograph Station.

Existing State Mitigation Measures

Although the state of Utah Maintains a philosophy of local responsibility for actual disaster preparedness and hazard mitigation, state government agencies provide an integrated network of support services and resources for hazard mitigation activities. As demonstrated during the 1984 disaster response, these agencies are well organized in their delivery and coordination of services. The following is a review of each state department with disaster responsibilities describing their existing and planned mitigation programs.

Utah Department of Agriculture

The Utah Department of Agriculture administers programs serving the state's large agricultural sector. In 1984, flooding caused over $12,894,425 in agricultural damages and loss throughout the state. The department's response role during and after the disaster period has been to coordinate damage reports for funding needs and provide loan and recovery program information and assistance to disaster victims.

A damage reporting network coordinated through the existing County Emergency Board was established during the disaster. Each county agent assembled damage reports in his area and transmitted them through a computer network based at Utah State University. The individual damage reports from each county were recapped in the Department of Agriculture and formed the basis of documentation for an appeal to the legislature for additional funds to mitigate the damage.

The department has prepared a handbook listing the types of loans available for flood damage to agriculture, the funding requirements, and application procedures. This includes loans from both state and federal sources. There are three loan programs operated by the agriculture department, all of which can be used for flood damage: 1) Rural Rehabilitation Loan Program (federally funded and operated by the state); 2) Agriculture Resource Development Loan Program (state funded); and 3) Emergency Loan Program (state funded).

The Department of Agriculture also administers the ongoing soil Conservation Program. In each of the state's thirty-nine soil conservation districts, three unpaid, elected supervisors offer technical assistance and consultation on watershed protection. The state offers limited technical and planning assistance through a staff member. The program works cooperatively with the federal Soil Conservation Service which provides most of the technical assistance. The ongoing program is not regulatory, but is directed at improved water use and soil conservation.

Because of the similarity between the events of 1983 and 1984 the department is now working on a permanent hazard mitigation concept known as "Disaster Easements," which may have widespread agreements with irrigation companies, water districts or water user associations for the purpose of routing flood water through town.

Following the floods of 1984 the Department of Agriculture made $1.8 million available through low cost loans to farmers. These loans in some cases were used to match grants and loans received from other state, private or federal programs such as SCS, ASCS and FmHa. Interest charged for these loans is generally 3%.

Department of Community and Economic Development

Utah's Department of Community and Economic Development is responsible for maintaining and promoting Utah's community and economic welfare. Seven separate divisions operate within the department, oversee-

ing programs which range from travel development to minority community economic development. Within the department, the Division of Community Development maintains primary responsibility for three funding programs affecting state and local hazard mitigation activities. As the agency selected to administer state disaster relief funds the Division of Community Development plays a critical role in state hazard mitigation through the delivery of funding to local government for mitigation activities.

Utah Disaster Relief Board

The Utah Disaster Relief Board was initiated by the Utah State Legislature in July 1983 to specifically address the needs of local units of government generated by the 1983 spring floods; the board has now been extended to the year 1990 under the same provisions. Former Governor Scott M. Matheson and the Utah State Legislature recognized that the payment of an estimated $45 million in damage costs, even with a high level of federal participation, would impose severe hardships on the financial capabilities of impacted counties and municipalities. Although the State of Utah itself faced financial difficulties on July 22, 1983, a special sesson of the Utah State Legislature passed the Disaster Relief Act of 1983. The division of Community Development was directed to administer the Act and associated program.

The salient points of the Act are as follows:

1. $10 million was authorized and appropriated to provide disaster relief to local governments.
2. The Utah Permanent Community Impact Fund Board (CIB) was designated as the Disaster Relief Board (DRB) to administer the funds appropriated in the Act. Such administration included reviewing applications for disaster relief grants and granting disaster relief funds for localized disaster areas. The amount of each grant was to be determined by the DRB in consultation with the state agencies familiar with relevant considerations to each application and within the limits set in the Act. All grants must pass approval by CEM.
3. Eligible applicants were counties and municipalities lying within federal- or state-declared disaster areas.
4. The DRB was authorized to grant funds to eligible applicants to help repair, reconstruct, restore, or replace public facilities which were damaged or destroyed by flooding or debris flows. These facilities include county-or municipality-owned flood control, dam, public power, sewage treatment and collection, water way, water supply and distribution, and watershed development facilities; non-federal and non-state streets, roads, highways, or bridges; other county- or municipality-owned buildings, structures, or systems, and any federal non-state road, highway, or bridge damage which is not covered by federal highway funding.
5. An eligible applicant would not be granted funds under the Act unless it or the county in which it lies has first levied a tax in the current calendar year of 1983 of at least two mills or 50% of local FEMA match, whichever is less, and applied the proceeds toward the costs of the flood or flood recovery.

On August 3, 1983, the Community Impact Board met for the first time in their role as the Disaster Relief Board. The DRB received a briefing from the Division of Community Development staff on the Disaster Relief Act and reviewed a draft program statement and application form. The staff was instructed to expedite processing of the program statement and application form through the state's administrative rule making procedure. Since the entire program was designed for disaster relief, the emergency provisions of the Ad-

Disaster Relief Board
1984 Projects and Funds
(As of January 1, 1985)

County	1984 FEMA Match Funds	Non-FEMA Projects Number	Non-FEMA Projects Funds
Box Elder	18,835	2	352,850
Davis	70,892	2	445,02
Juab	316,900	0	0
Millard	75,864	1	3,527
Salt Lake	5,002	3	661,231
Sanpete	249,915	5	227,408
Summit	399	3	477,595
Tooele	99,130	6	984,509
Utah	614,212	8	1,704,062
Wasatch	63,428	0	0
Weber	696	4	991,817
Sevier	38,726	1	14,221
Cache	0	2	181,945
Carbon	0	3	400,062
Daggett	0	1	19,726
Emery	0	2	467,302
Morgan	0	2	94,500
Piute	0	1	6,787
Rich	0	2	21,017
Uintah	0	1	50,000
TOTAL	**1,554,029**	**49**	**7,103,584**

ministrative Rule Making Procedure, which allows simultaneous publication and public hearings, was applicable.

The draft program statement and application form was filed with the State Archives on August 4, 1983, and a formal public hearing was scheduled for August 18, 1983. The public hearing was attended by 38 local elected officials and staff persons from throughout Utah. The draft statement and application were favorably received. Most of the comments dealt with time frames and the provision calling for local participation on a "two mill or 50% basis."

As finally adopted by the DRB, the program statement contained the following provisions for funding priorities and amounts. Funding priority was given to the following categories of projects: 1) five percent of total funds to be used in emergency situations where there is an impending health or safety threat (the chairman of the DRB, in consultation with the CEM Director, shall be authorized to commit these funds to such an emergency; funds commited in this manner will be reviewed by the full board at their next regularly scheduled meeting); 2) FEMA match projects; and 3) Non-FEMA eligible projects.

The amount of funding available for a project was to be determined by a funding formula based on either FEMA or non-FEMA projects. For FEMA eligible projects, the applicant is required to provide 50% of the FEMA match or an equivalent of 2 mills property tax, whichever is less. The "equivalent of 2 mills" language was adopted due to the potential difficulties from local jurisdictions attempting to modify their 1983 mill levies set in June. After consulting with the Legislative Analyst's office, the DRB concluded that the intent of the legislation was to set a minimum threshold of financial participation by the applicant and that this formula would accomplish that. As a general rule, the DRB will provide a maximum of 50% of the funds for non-FEMA projects. The DRB may, however, provide funds in excess of 50% if the applicant can demonstrate that obtaining the remaining 50% would be an extreme hardship.

Department of Natural Resources and Energy

Composed of eight distinct divisions and offices, the Utah Department of Natural Resources and Energy maintains administrative responsibility for the state's plentiful natural resources. An economically and environmentally important task, the department oversees each area of responsibility as an integrated resource management system. The five divisions most heavily involved in flood recovery and hazard mitigation planning in 1984 will be addressed individually.

The Utah Geological and Mineral Survey and the divisions of Parks and Recreation, Water Resources, Water Rights, and Wildlife Resources are the major participants in disaster response, recovery, and mitigation activities. Their roles in 1983 and 1984 as well as their continuing roles in the hazard mitigation planning process provide valuable information.

Utah Geological and Mineral Survey

The Utah Geological and Mineral Survey (UGMS) is the principal state agency concerned with geologic hazards. Through years of study, the UGMS has developed considerable information on Utah's geologic hazards. When geologic events occur or threaten to occur, the UGMS is consulted by other state agencies, local governments, and private organizations for assistance in defining the threat and developing mitigation plans. Two major elements of the natural disasters that affected Utah in 1983 and 1984 were landslides and mudflows. Considerable UGMS effort was concentrated on these phenomena, as well as the rise of the shallow ground-water level in populated areas.

During 1983 and 1984, the UGMS performed a variety of functions in disaster response, recovery, and mitigation.

UGMS geologist Bruce Kaliser examines one of the remote monitoring devices during installation in Farmington's Rudd Creek Canyon.

These functions included the following: (1) evaluation of individual hazards and structures at risk; (2) participation on local government and state agency technical teams; (3) preparation of inundation maps; (4) prediction of the performance of individual slides once they began to move; (5) coordination and awareness of research efforts undertaken by other agencies; (6) provide information on status of individual geologic hazards; (7) reconnaisance reports on status of hazards statewide (with USGS); (8) advise Division of Water Rights on geologic hazards associated with dam sites; and (9) provide geologic information for use during planning of remedial actions.

UGMS also designed and installed unique landslide and mudflow monitoring and warning devices at potential hazard areas in Facer Creek Canyon, Johnson Hollow, and eight sites in Salt Lake County.

Throughout the emergency and recovery period, UGMS has advised the Department of Natural Resources and other state agencies on problems related to geologic hazards. UGMS has also advised several local government agencies on actions to reduce the risk from geologic hazards.

The rise of the Great Salt Lake heightened interest in its long term geologic record. UGMS has provided information on the the total history of the lake and is preparing a report for publication. UGMS also arranged for early publication of a U.S. Geological Survey report on historic records of lake level changes. The impact of the rising lake on mineral extraction industries has been severe. UGMS measures brine concentrations and provides advice on problems related to lake industries.

High ground water has become a serious problem in several areas of western Utah. The UGMS is advising local and state agencies, particularly the Utah Division of Environmental Health, in this area. These agencies are concerned with evaluating the effect of high ground water on health and other problems and developing and implementing plans to control the ground water levels in local areas.

In addition to continuing projects initiated in 1983, UGMS has several new programs to help in identifying and mitigating geologic hazards. These include:

1. **Aerial photography of critical landslide vulnerable areas.** These photos are useful as a basis for more detailed mapping studies as well as for ongoing monitoring.
2. **Hazards Geologists for Wasatch Front Counties.** The Utah Geological and Mineral Survey (UGMS) and the U.S. Geological Survey (USGS) have approved a cooperative program to provide funding and technical assistance to counties so they can employ three hazards geologists to work in the five most populous Wasatch Front counties. A geologist will be employed by Weber county to work in Weber and Davis Counties. A geologist employed by Utah County will work in Utah and eastern Juab Counties and the third geologist will be employed by Salt Lake County. Each geologist will be part of the county planning department and their services will be available to other county departments and to the cities within the counties. It is expected that the geologists will be on board before the 1985 landslide and flood season. Funding of all salaries and benefits will be paid by a grant from the USGS to the UGMS ($100,000). The UGMS will provide technical assistance, technical supervision, and specialized equipment.

   The three-year effort is part of the Wasatch Front Earthquake Hazards Reduction Program and is designed to aid the counties and cities in obtaining information on geologic hazards within their jurisdictions and to provide improved access to geologic expertise on problems involving geologic hazards.

   The County Hazard Geologists will compile information on geologic hazards and pull together in a single location all the hazard-related investigations already completed for each county. An end product of the three-year program will be maps and reports describing the geologic hazards in the counties. These final products will be published by UGMS.
3. **Two Geologists will be hired to assist in an accelerated program to map geologic hazards on a statewide basis.** $150,000 - State Appropriated Funds.
4. **High hazard landslide-mudflow identification and mapping program.**

   This project, funded by a $200,000 grant from the USGS, will aid in the technical study of landslides and mudflows to better understand their dynamics and other physical characteristics. A portion of the funds will go to researchers at Utah State University.
5. **Wasatch Front Earthquake Hazard Reduction Program.** In 1983, USGS added Urban and Regional Hazards as a new element in the National Earthquake Hazards Reductions Program and identified the Wasatch Front as the highest priority area for funding under this element. The USGS invited the UGMS to participate in developing the Wasatch Front program and in carrying out this ongoing program. The Wasatch Front program consists of five components: (1) information systems, (2) hazard evaluation and synthesis, (3) ground motion modeling, (4) loss estimation models,

and (5) implementation. UGMS has worked with the USGS in developing the overall program and has a role in each component.

Division of Parks and Recreation

The Utah Division of Parks and Recreation administers a large recreational facility system which includes forty parks and recreation areas throughout the state.

Even though the majority of flood damage experienced was the result of unanticipated climatic conditions, future development and siting of park facilities will consider the 100-year flood episode. For nearly all of the parks, 1983 was the first serious flooding consequence the system has had to endure. Park location in floodplains is considered an appropriate use of land and is being encouraged all along the Provo-Jordan River Parkway and other riverways in the state as a more functional approach to flood control. The newly leveed sections of the Jordan River through Salt Lake functioned extremely well and mitigated historical losses between North Temple and 1900 North on the river.

Development concept plans and detailed development plans must have timely and professional input from the Division of Parks and Recreation Development and Engineering section to assure conformity with division, department, and legislative expectations.

Division of Water Resources

The Division of Water Resources has been directly involved with the flooding of 1983 and 1984. The division has worked closely with irrigation companies around the state to assist in the repair of flood-damaged irrigation facilities. The majority of the division's work was associated with recovery activities. The Division has been delegated the responsibility of conducting additional studies to help in developing plans for coping with the high elevation of the Great Salt Lake. Consequently, the Division conducted a variety of investigations during 1983 to address those alternatives for lake level control which appeared to have the most merit. Some studies were done under contract with private consultants and state universities, others were done by the division staff.

Division of Water Resources
Emergency Program Summary - 1984

Applicant	County	Purpose	No-Interest Loan Amount
Bear River Water Distribution Co.	Box Elder	Repair canal wash out	300,000
Kays Creek Irrigation Co.	Davis	Repair to storage reservoir	618,000
South Weber Diversion Canal Co. Diversion Dam	Davis	Repair Weber Canyon	50,000
Corn Creek Irrigation Co.	Millard spillway	Repair to dam	131,000
South Despain Distribution Co.	Salt Lake	Repair to diversion dam	120,000
Settlement Canyon Irrigation Co.	Tooele	Repair outlet valve	184,500

Division of Water Rights

The State Engineer, for and on behalf of the state of Utah, has statutory responsibility for hazard mitigation involving dam safety, alteration of natural stream channels, and some flood control mitigation activities. He also has input into dealing with hazards involving water quantity or quality through his statutory responsibilities in appropriation, distribution, and adjudication of water rights. The State Engineer's Office has also been requested to aid in emergency situations on behalf of the Department of Public Safety. These situations include such items as management of the Thistle Slide and disaster survey reports. The State Engineer is authorized to enter into agreements with any federal or state agency, subdivision or institution for cooperation in making snow surveys and investigations of both underground and surface water resources of the state. The state engineer is further authorized to cooperate with such agencies, subdivisions and institutions, for the investigation of flood and erosion control and for the adjudication of water rights.

Important emergency powers for the State Engineer were established by Utah's 1984 state legislature. Senate Bill No. 97, passed in January 1984 reads:

Whenever the State Engineer, with approval of the chairman of the disaster emergency advisory council, makes a written finding that any reservoir or stream has reached, or will reach during the current year, a level far enough above average in excess of capacity that public safety is or is likely to be endangered or that substantial property damage is occurring, or is likely to occur, he shall have emergency powers until the danger to the public and property is abated. Emergency powers shall consist of the authority to control stream flow and reservoir storage or release.

The State Engineer must protect existing water rights to the maximum extent possible when exercising emergency powers. The authority shall include right of access to private and public property and the right to seek court orders for enforcement.

Any person affected by a decision of the State Engineer made under his emergency powers shall have the right to seek injunctive relief, including temporary restraining orders and temporary injunctions in any district court of the county where that person resides.

The following is a brief discussion of his direct responsibility for hazard mitigation.

Dam Safety: Hazard mitigation is a primary activity of the Division's Dam Safety Section, which monitors the design, construction, and operation of dams within the State pursuant to Sections 73-5-5, 73-5-6, 73-5-7, and 73-5-12 of the Utah Code Annotated. Plans and specifications for all construction and major repairs of existing dams must be reviewed and approved by the State Engineer pursuant to the "Rules and Regulations Governing Dam Safety in Utah," published by the State Engineer in 1982. The dam safety section also performs field inspections of existing dams throughout the State. The inventory currently includes 172 high-hazard structures, 190 moderate hazard structures, and 422 low hazard structures. Of the structures on the inventory, 54 are owned by agencies of the Federal Govern-

1984 Funds

Facility	Spent for Mitigation & Restoration	Additional Needed
Antelope Island State Park	151,000	750,000 (Elevation)
Bear Lake State Park	30,000	0
Fort Buenaventura State Historical Mon.	364,000 (UDOT redesign and elevation)	NA
Great Salt Lake State Beach	1,660,000	3,400,000 (Elevation)
Green River State Rec. Area	71,000 (diking)	0
Jordan River Parkway	40,000	30,000
Pioneer Trail State Historical Mon.	200,000 (Flood retention pond)	Salt Lake County contributing 1/2 (100,000)
Rockport Lake State Recreation Area	105,000	7,000
Scofield Lake State Recreation Area	3,300	0
Utah Lake State Park	600,000	2,000,000 (restoration & elevation)
Yuba Lake State Recreation Area	84,000	15,000

ment. The Division completed Phase One inspection reports on 131 dams under a contract with the U.S. Army Corps of Engineers. The inspection schedule is set up to inspect all high-hazard structures on an annual basis, moderate-hazard structures every two years, and low-hazard structures every five years.

Stream Alterations: Section 73-3-29, of the Utah Code Annotated, 1953, was amended by the 1985 Legislature to give the State Engineer broader powers over alteration of natural streams. The Legislature removed the exemptions for filing a stream alteration application except in emergency situations. They also included language to the effect that the State Engineer should not approve an application if the alteration would unreasonably or unnecessarily affect the channel's ability to conduct flood flows. This language has a direct impact on hazard mitigation.

Flood Control: Section 73-2-22, of the Utah Code Annotated, 1953, enacted by the Legislature in 1984, gave the State Engineer the authority, with approval of the Chairman of the Disaster Emergency Advisory Council, to make a written finding that any reservoir or stream has reached, or will reach during the current year, a level far enough above average in excess of capacity that public safety is or is likely to be endangered or that substantial property damage is occurring, or is likely to occur, he shall have emergency powers until the danger to the public is abated. Emergency powers consist of the authority to control stream flow and reservoir storage or release.

Other: The State Engineer must protect existing water rights to the maximum extent when exercising emergency powers. The authority shall include right of access to private and public property and the right to seek court orders for enforcement.

Any person affected by a decision of the State Engineer made under his emergency powers shall have the right to seek injunctive relief, including temporary restraining orders and temporary injunctions in any district court of the county where that person resides.

The 1985 Legislature amended the act to include management of flood waters pursuant to court judgements and decrees.

The 1985 Legislature also expanded the State Engineers flood control authority by enacting Section 73-2-23, of the Utah Code Annotated, 1953. This act requires the State Engineer to assist counties in emergency mitigation on intercounty waterways.

Division of Wildlife Resources

Hazard mitigation and disaster recovery activities by the Division of Wildlife Resources have been centered on waterfowl developments, access roads, dams and waterways. Of these three areas, waterfowl developments have been the most critical and received the most attention.

The division's primary future plans and expenditures will relate to reconstruction of the impacted waterfowl management areas. Before any large expenditures are made to rebuild these areas, the division must have reasonable assurance that the Great Salt Lake has stabilized at a level permitting construction of new outer dikes and control works. It would be unwise to spend large sums on outer dike reconstruction until the lake level stabilizes.

The division focused its attention on three particular locations in 1984: Farmington Bay Water Fowl Management Area, Ogden Bay WMA, and Locomotive Springs WMA. Both Ogden Bay and Farmington Bay WMA's were inundated by the rising Great Salt Lake and required extensive diking to protect the residential and administration facilities. Ogden Bay WMA also needed access road and parking lot repairs. At the Farmington Bay WMA, most of the buildings had to be relocated to another site sixty miles away. This move may be permanent.

At the Locomotive Springs WMA, the existing dikes needed additional riprap for protection against wave action.

Stream rehabilitation work is another area where the division will plan future expenditures based upon availability of funding. It is anticipated that federal aid can be used to accomplish stream bank stabilization and habitat reconstruction on strategic stream segments that have been heavily channelized, such as the Weber River.

Division of Comprehensive Management

The Department of Public Saftey's Division of Comprehensive Emergency Management (CEM) maintains primary responsibility for coordination of hazard mitigation efforts and the disaster recovery program. The division assists county and local governments with planning, guidance, and funding for structural and nonstructural hazard mitigation activities. During an emergency period, the division coordinates disaster response operations.

The division's mission is to prepare, implement, and maintain programs to minimize injury and damage caused by emergencies which threaten property or life.

Hazard Mitigation Plans

In 1974, CEM, then the State Office of Emergency Services, produced the **Natural Disaster Hazard Analysis**, identifying all potential threats on a county-by-county basis. Used as a guide for the preparation of the emergency operations plans on the county and state levels, this document was prepared as the first phase of the natural disaster preparedness program for the state. The program consisted of seven phases including hazard analysis, legislative review, preparation of a comprehensive state emergency plan, assistance in preparation of local plans, training and testing, public information and education; and hazard mitigation actions and recommendations.

The flagship document for organizing, coordinating, and implementing the state government's response to natural disaster situations is the **State of Utah Emergency Operations Plan Volume II, Natural Disaster** issued in 1977. This document provides a detailed, comprehensive blueprint for all levels of state government to support and supplement those actions initiated by local authorities. A third set of revisions were made in 1983. Supporting this state masterplan, individual state agency plans provide specific and detailed response instructions and standard operating procedures for particular agencies' responsibilities. The **Natural Disaster Response Procedures Manual** 1980, a handbook of standard operating procedures for Division of Comprehensive Emergency Management personnel, is a companion guide to the state plan.

In December 1977, the **Long-Term Disaster Recovery Plan** established a committee for disaster recovery. The committee, when activated, would be composed of the State Planning Coordinator, State Disaster Coordinating Officer, commission chairman and mayors of the affected area, and one state representative to act as a liasion between the committee and all state agencies. Goals of the committee are to relieve suffering of survivors and victim's families; achieve positive results from disaster relief funds, assure orderly and safe redevelopment and rehabilitation; and assess similar hazardous areas and undertake efforts to reduce their vulnerability to natural hazards.

In 1980, the **Utah Hazard Evaluation and Mitigation Planning Program Guide** set forth a program concept of hazard evaluation and mitigation planning in response to the provisions of the Federal-State Agreement for major disaster or emergencies.

In 1983, the old **Council of Defense Warning Plan** of 1974 was updated. The new title is **Warning Plan, Division of Comprehensive Emergency Managment**. The plan outlines procedures to notify the state's population in an emergency situation. Communications resources and uses are discussed, as well as proper chain-of-command, direction, and control procedures.

Flood mitigation planning has taken on an enhanced importance in view of the 1983 and 1984 flooding disaster. Recent CEM planning guides include **History of Utah Floods 1847 to 1981** (1981); **Review of State and Local Flood Control and Mitigation Authority** (1981); **Utah Flood Awareness (1983); and the Utah Handbook for Local Floodplain Ordinance Administrators** (1983). The latter is a concise and relevant planning and mitigation tool for local government officials. The **Damage Assessment /Damage Survey Report Handbook for Local Governments**, published by CEM in 1983, reiterates the rationale, procedures, and responsibilities associated with the DA/DSR process. This guide will help alleviate misunderstandings and correct procedural and administrative errors encountered in 1983's flooding. Finally, this comprehensive Hazard Mitigation Plan serves as CEM's most recent planning accomplishment.

The Disaster Preparedness Improvement Grant Program (DPI) will improve state and local capabilities to cope with disaster situations through identification, vulnerability and hazard analysis, planning, and plan improvements and revisions. DPI grant activities for 1984 will concentrate on revising and updating emergency response plans in light of the lessons learned from 1983's disaster.

Training and Education

The training and education program provides continued training to state and local emergency services personnel, public officials, business and industry personnel, and the general population so they can respond quickly and accurately to emergency situations.

The statewide training of emergency services personnel includes basic and advanced seminars and workshops in specific preparedness areas. CEM periodically conducts disaster response and recovery exercises to test response capabilities and determine problem areas for public officials and emergency services personnel. Ongoing educational opportunities for the public are provided through disaster related public information programs and public service announcements.

Two recent educational seminars directly related to flood hazard mitigation were conducted. The Utah Dam and Waterway Safety Seminar, jointly sponsored by CEM and the Federal Emergency Management Agency, was held in December 1983 in Salt Lake City. The seminar was attended by 100 people, representing the federal, state, and local regulatory community, the engineering community, and private dam owners and operators. The seminar provided a forum for everyone involved in dam and waterway safety

(from siting and design through daily operations and maintenance) to meet together to share problems, ideas, and solutions for increased dam and waterway safety in Utah. It also increased awareness of existing policies, programs, technologies, equipment, and liability in this field.

The Utah Multi-Hazard Monitoring and Warning Seminar, also sponsored by CEM and FEMA, was held January 26, 1983 in Salt Lake City. Sixty participants attended representing federal and state agencies and eighteen Utah counties. The seminar instructed participants in the process of making warning effective; the role of preparedness planning in response warnings; monitoring and warning systems for dam failure; and state of the art monitoring equipment and techniques.

State 406 Hazard Mitigation Plan

Utah is the first state in the western U.S.A. to maintain a fulltime State Hazard Mitigation Officer to oversee the State 406 Hazard Mitigation Plan and Program. After the Presidential Disaster Declarations of 1983 for 22 counties in Utah and the 1984 disasters in 12 counties, CEM prepared the first State 406 Hazard Mitigation Plan for Utah pursuant to Section 406 of Public Law 93-288 and the FEMA/State Agreements of 1983 and 1984. These plans comprise the first comprehensive documentation of hazard mitigation needs for the State of Utah, and the recommendations contained in these plans are being implemented according to the requirements of the FEMA/State Agreement. The status of the recommendations contained in the first plan is recorded in this present plan.

Multi-Hazards Mitigation Project

Utah is the pilot state in a multi-hazards mitigation project being federally funded under the National Earthquake Hazards Reduction and National Dam Safety programs. The project addresses the combined hazards threatened by an earthquake, dam failure, deluging floods, or landslides. Strategies to reduce hazards and improve population safety are being developed for specific dam sites and threatened populations.

The multi-hazard approach outlined by the project formalizes a consistent method for the collection of data and analysis of individual areas. As opposed to single purpose planning, the multi-hazards approach will ensure that development and mitigation decisions address all potential threats to an area.

The Pineview Dam and Ogden City area in Weber County is the first test site. Strategies for other population-threatening dam sites in Utah will follow. This important CEM project has been included in FEMA's annual reports to the White House and Congress. Technical and policy inputs have included the Utah Geological and Mineral Survey, State Engineer's Office, Bureau of Reclamation, National Weather Service, and county and community officials.

Earthquake Preparedness Program

The State/Four County Earthquake Response Plan was developed as part of Utah's Five Year Earthquake Preparedness Program under the auspices of the Federal Emergency Management Agency. The plan concentrates on response to a major destructive earthquake affecting the Wasatch Front metropolitan areas of Weber, Davis, Salt Lake, and Utah counties, to reduce risks to populations, resources, and lifeline systems.

Goals and activities for 1985 include integration and coordination of the plan with county and state officials and agencies which have roles in disaster response; exercises designed to test the plan, response capability and expose necessary modifications; and cooperative agreements between counties and public and private agencies. As it becomes available, technical information such as microzonation studies, generated by the UGMS, USGS and others, will be integrated in the plan to help city, county and state officials in their mitigation and response planning efforts. With the cooperation and support of County Commissioners, County Emergency Directors and state agencies, Utah has the opportunity to become an innovator in the field of earthquake mitigation and response as Federal attention focuses on the Wasatch Front area. CEM is also developing a five year earthquake preparedness program for Utah in cooperation with the Utah Geological and Mineral Survey and the University of Utah Siesmograph Station.

Floodplain Management

The Division of Comprehensive Emergency Management is responsible for implementing the National Flood Insurance Program (NFIP). A professional flood mitigation planner collects and distributes information relating to flooding and floodplain management and coordinates local, state, and federal floodplain management activities.

The National Flood Insurance Program was created by Congress in 1968 to offer a nonstructural approach to reduce flood damage. The program has two major objectives; (1) it provides property owners in flood prone areas with affordable flood insurance, and (2) it discourages future development in floodplains which would be subject to flood damage.

In order to meet these objectives, the NFIP requires local governments to regulate floodplain development before flood insurance can be obtained in their community. The local regulations must meet the minimum requirements established by the federal government.

In Utah, there are 179 communities enrolled in the National Flood Insurance Program. Of these, 105 are in the

regular phase of the program which allows homeowners to purchase a maximum of $185,000 worth of flood insurance at very competitive prices. Seventy-four communities enrolled in the emergency program, have not adopted acceptable floodplain management ordinances or do not have flood insurance rate maps. Residents in these communities may buy up to $35,000 worth of coverage at a fixed rate. Finally, twenty communities have identified flood zones. The flood mitigation planner will visit each of these communities and make every effort to enroll them in the National Flood Insurance Program.

CEM increases the level of knowledge and awareness that Utah citizens have concerning flooding and floodplain management. The publication of reports and brochures about floodplain management and the development of an administrative handbook, such as this, are examples of efforts of CEM to meet this responsibility.

As the state coordinating agency for the NFIP, CEM is in a position to ensure that Federal Emergency Management Agency (FEMA) is fully aware of local needs when implementing the NFIP. For example, when FEMA begins a detailed flood insurance study in a particular area, CEM provides information on situations that are unique to that area or significant to local or statewide interests. At the same time, CEM coordinates at the local level, making sure local officials understand the flood insurance study process and their responsibilities following the study.

The Division of Comprehensive Emergency Management also works closely with other federal agencies involved in floodplain management (such as the Corps of Engineers and the Soil Conservation Service) to encourage adequate participation in the planning and/or selection of any flood control or hazard mitigation projects.

Disaster Recovery

In early June 1983, following the Thistle landslide and flooding throughout the state, the Disaster Recovery Section of Comprehensive Emergency Management was organized. A disaster recovery manager was hired to coordinate the recovery effort for the state and supervise the public and individual assistance programs. In January 1985, a full time Hazard Mitigation Officer joined the staff.

Projects have ranged from all levels of direct recovery to sophisticated hazard mitigation planning. In addition to administering available federal funding, CEM has helped communities meet disaster-related needs which are ineligible for traditional federal funding. The disaster recovery section coordinated prepartion of this hazard mitigation plan and will monitor its implementation.

Department of Transportation

The Utah Department of Transportation is involved in the design, construction, and maintenance of all state highways in Utah. Federal dollars finance about 90% of all new construction and reconstruction projects on Interstates. State dollars are used to finance 100% of the maintenance work, some minor rehabilitation projects, and to match the federal-aid monies.

The department maintains several policies and programs to mitigate damages from natural hazards. During construction and planning, normal procedures avoid adverse impact on or change of streams, floodplains, or lakes. For federally funded projects, all federal requirements are met. This includes evaluation of highway encroachments on floodplains and compliance with FEMA guidelines. UDOT utilizes a design policy for determining the frequency of floods that must be accommodated by drainage facilities for the highways.

UDOT has a hydraulics section which acts in a consulting capacity for hydraulics design, review, and recommendations for all state highway projects. All coordination and permit requirements with other state and federal agencies are also handled by this section.

Project construction is accomplished by the bidding-contracting process. A UDOT project engineer oversees construction to assure contractor compliance with the plans, specifications, and estimates. Flood control and drainage features are included with other items of contract work. Under the direction of the project engineer, it is the responsibility of the contractor to control normal flooding and repair flood damage that may occur during project construction. Unusual "acts of God" have to be given special consideration, particularly when a channel or drainage facility is only partially completed and cannot yet function as it was designed.

The Utah Department of Transportation has the following allocations and expenditures through the Federal Highway Administration's Federal Emergency Relief Fund for State Highways to repair and mitigate flood damage in 1984.

County	Allocation	Additional Planned Allocation
Cache	$ 841,000	
Juab	283,300	
Millard	341,200	30,000
Salt Lake	81,000	
Sanpete	144,300	80,000
Sevier	505,700	1.1 million (Interstate 70)
Tooele	351,200	50,000
Utah	125,700	20,000
Weber	95,000	
Total	**2,768,400**	**1,280,000**

Interstate Rehabilitation funds also administered by the Federal Highway Administration were used to build up, grade and surface Interstate-80 from Black Rock to Saltair. A total of $11,045,700.00 was allocated for this project plus an additional 7 million in anticipated funding.

In 1984, special State funds were allocated by the State Legislature to cover projects not eligible for Federal funding. The projects were not eligible for one of two reasons, 1) they were outside of State Highway right of ways; or 2) they fell outside of the declared incidence period. The figures are as follows by counties.

Rising waters of Great Salt Lake floods I-80. Both railroad and highway grades are raised. (UDOT photo)

County	Allocated Funds
Beaver	40,200
Box Elder	165,000
Cache	38,300
Carbon	65,000
Davis	38,000
Emery	68,500
Grand	82,800
Juab	199,100
Millard	306,300
Piute	11,600
Rich	10,000
Salt Lake	28,700
San Juan	42,500
Sanpete	75,500
Summit	51,000
Utah	225,700
Wasatch	3,500
Wayne	214,500
Weber	313,000
Total	**1,979,200**

In addition, carry-over work from 1983 and State Highways which were further damaged by 1984 flooding had combined 1983-84 special State Funding as follows by county.

County	Allocated Funds
Beaver	154,000
Davis	281,000
Salt Lake	108,000
San Juan	700,000
Sanpete	60,000
Weber	200,000
Total	**1,503,000**

The total of 1984 and combined 1983-84 funding by the state for flood damage is nearly $3.5 million. This compares with $5 million for the declaration in 1983.

Through the various funding programs, the State and Federal Government allocated $25,576,300 for mitigation and repair of State Highways as a result of 1984 funding.

Utah Department of Health

As a result of the high level of precipitation during the past three years, the potential for an unusually large mosquito population has posed a potential public health threat. The Utah Department of Health responded with an effective monitoring system to alleviate any potential threats.

State and local health officials and Mosquito Abatement Districts (MADs) had special concern about **Culex tarsalis**, the primary vector in the western US of Western Equine Encephalitis (WEE). Areas that may be affected include Utah County along the margins of Utah Lake, the Sevier River from near Levan to Richfield, Sanpete County, the Duchesne and Green River drainage in eastern Utah, the Jordan River, and the southeastern and eastern margins of Great Salt Lake.

Representatives from the Mosquito Abatement Districts and the Utah Department of Health continue to meet to establish contingency plans for control of a potential mosquito-borne encephalitis outbreak.

Decisions were made to purchase New Jersey light traps for mosquito population assessment and CO2 baited mosquito traps for collecting live **Culex tarsalis**. Horse blood is tested for virus at state laboratories, chicken and other bird bloods are tested at Brigham Young University, and live **Culex tarsalis** are sent on dry ice to the center for Disease Control at Fort Collins. The State Department of Health continues its surveillance efforts to counties with population centers threatened by areas of high mosquito production.

Flooding along Jordan River in June 1983. (Salt Lake Co. photo)

Utah National Guard

A unique part of the nation's military establishment, the National Guard serves a dual mission to meet both federal and state needs. At the state level the Utah National Guard provides support to the state and local communities in times of need. A resource of last resort, the guard can only be called in by the governor and only after a state or local emergency has been declared.

The Utah National Guard is traditionally only involved in short-term recovery activities encountered in the course of withdrawing from emergency response. A sensitive situation, this is based on the need of the guard to maintain readiness for its federal mission. For this reason, policy dictates that only minimum essential resources be committed and that the guard withdraw from the situation as soon as possible without compromising safety.

Communications during emergency response is supported by the Guard's high frequency single side band radio set with nearly all armories in the state and the commercial telephone system. Additional phone service during emergencies and replacement of old obsolete radios is planned to improve the efficiency of operations. Federal equipment owned by the guard is always available for use during declared emergencies.

The guard is not automatically activated in a disaster. The following guidelines are used to determine need for the guard's services; (1) all state and local civil resources are fully fully utilized if the situation is beyond their capability; (2) guard forces are to be used for preservation and protection of life and property; (3) guard support will not compete with private enterprise or the civilian labor force; and (4) the

governor declares an emergency and commits state financial support for the operation.

The office of Plans, Operations, and Military Support, within the Directorate of Plans and Training, is the point of contact for emergency response. Requests for hazard mitigation projects must be submitted in writing to the Adjutant General through the Division of Comprehensive Emergency Management and are considered on an individual basis. Generally, these projects must meet the following criteria: (1) have military training value and coincide with overall current training program; (2) be accomplished over the long-term and within the time constraints of the guard; (3) do not compete with commercial process; (4) incidental costs can be paid by the applicant; and (5) fit within the skills and capabilities of the National Guard.

Utah National Guard

Project Summary - Spring Floods 1984

County	Location	Project
Salt Lake	County Shops	Provided water trailers for county personnel and volunteers involved in sandbagging activities
Juab	Levan Canyon	Provided equipment to county for retrieving two disabled bulldozers
Millard	Kanosh	Provided rock drilling equipment and personnel for quarrying riprap material
Millard	Fillmore	Provided county with cargo carrier
Juab	Nephi	Hauled gravel for flood control
Juab	Levan	Road maintenance
Millard	Kanosh	Quarried and transported gravel
Tooele	Middle Canyon	Streambed repair and maintenance
Salt Lake	Oquirrh Range	Fly over
Salt Lake	Emigration Canyon	Fly over
Salt Lake	County Shops	Provided water trailer for county employees and volunteer sandbaggers
Davis	Centerville	Fly over
Utah, Salt Lake, Davis	Landslide areas	Fly over
Tooele	Settlement Canyon	Provided float bridge and silt pump
Tooele	Stockton	Hauled riprap
Tooele	Ophir	Stream maintenance
Sanpete	Ephraim Canyon	Airlifted city personnel into area for emergency work on water line
Salt Lake	Oquirrh Range	Fly over
Davis	County	Fly over
Tooele	Stockton	Cleared stream channel
Utah	American Fork	Recovered boat docks
Sanpete	Mayfield	Stream bed clearance

Inventory of Existing Federal Mitigation Measures

With established knowledge and experience the federal government assured a supportive role in Utah's 1983 and 1984's response and mitigation activities. Federal agencies worked in their areas of expertise to advise or supplement state and local actions. Utah's ability to tap these resources and integrate them into a coordinated response and recovery mechanism created an exemplary working situation. Without the effective cooperation of these agencies, many mitigation opportunities would have been unattended.

Key federal support came from the Federal Emergency Management Agency, the federal coordinating agency for emergency response, disaster relief funding, and hazard mitigation planning. The U. S. Army Corps of Engineers has been involved in mitigation projects for years and pro-

vided additional support in 1983 and 1984's response and recovery efforts. The Federal Highway Administration and U. S. Forest Service were actively involved in post-disaster restoration projects on federal roads and forests. The National Weather Service's forcasting, research, and reporting functions were valuable support elements in Utah's response preparation and mitigation planning. The U. S. Department of Agriculture's Soil Conservation Service provided technical and financial assistance in flood prevention, irrigation, drainage, sedimentation control in small watersheds. The small Business Administration provided low interest loans to flood victims.

Each of these agencies played a role in 1983 and 1984's response and recovery efforts but also play continuing supporting roles in Utah's statewide hazard mitigation plan. These roles are established in this section.

Federal Emergency Management Agency

In 1979, the Presidential consolidation and reorganization of several agencies involved in disaster preparedness, response, insurance and mitigation created the Federal Emergency Management Agency (FEMA).

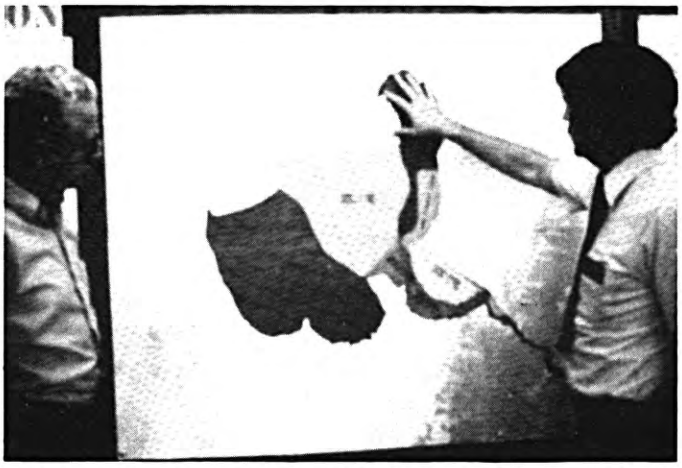
The Agency's role is to coordinate, from a federal level, all aspects of disaster planning, response, relief funding and mitigation.

At present FEMA public assistance programs provide up to 75% funding of qualified projects with a minimum of 25% coming from state, local or private sources.

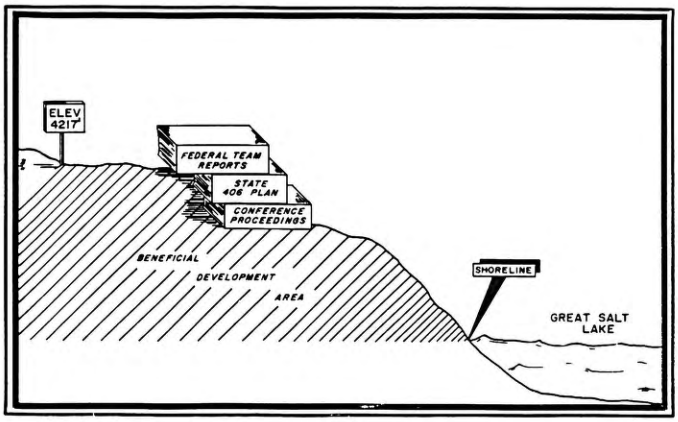
During the 1984 disaster period, 741 Disaster Survey Reports were submitted with a resulting estimate of damage of $17,502,000. FEMA's 75% contribution totaled $13,126,500. Two FEMA survey inspectors were used to help with Disaster Survey Reports. Five disaster survey experts were provided by FEMA as members of the FEMA organized Intergovernmental Interagency Hazard Mitigation Team. The team is composed of expert representatives covering a wide range of technical and administrative fields from 15 state, private and Federal agencies. The team's purpose is to assess and analyze post and predisaster aspects of natural hazards and make recommendations to mitigate imminent or probable damage.

As a result of the 1984 disaster declaration, the team developed several reports. The Interagency Hazard Mitigation Report which dealt with flooding and other natural hazards and recommended mitigation measures. The Post-Flood Recovery Progress Report which outlined the status and impact of the proposed recommendations.

FEMA will continue to monitor and recommend further mitigation activities through its various programs in the State of Utah.



FEMA representatives Bill Smith (left) Reports Officer, and Dave Grier, Federal Coordinating Officer, study the Spanish Fork flood inundation map at the Provo disaster field office. (UDOT photo)



Cover for FEMA 180 Day Report on Utah's 1984 disasters indicating the need for a Great Salt Lake Beneficial Development Area.

U.S. Army Corps of Engineers

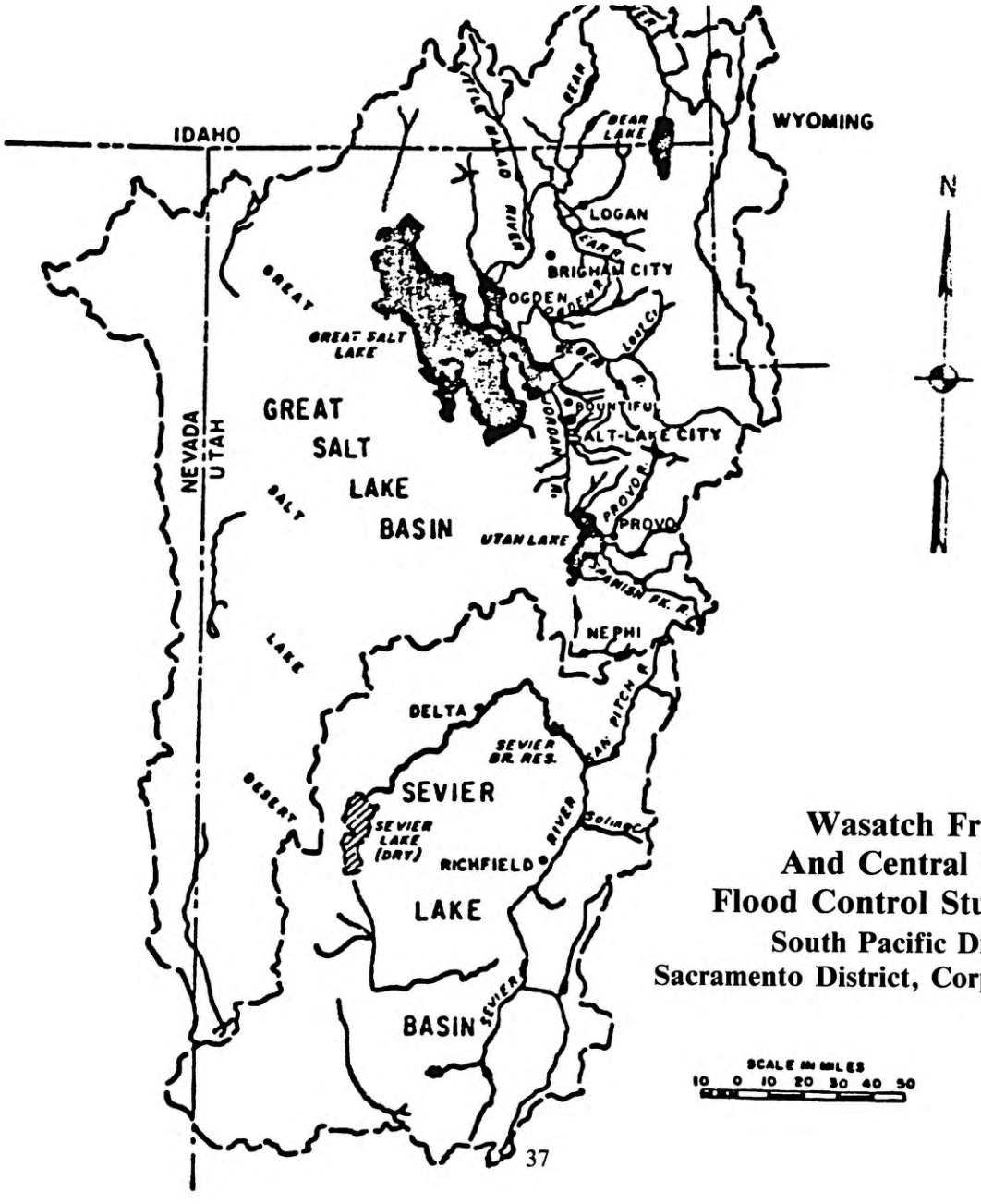
For nearly 100 years the U.S. Army Corps of Engineers has been involved in developing and implementing water projects in the State of Utah. These projects range from hydropower and recreation to flood control.

Section 14 of the 1946 Flood Control Act and Section 208 of the 1954 Flood Control Act, respectively, authorizes the Corps in providing emergency streambank protection to public facilities and removing channel debris to alleviate or prevent flooding.

Major Projects

As in the flooding of 1983, the Sacramento District Corps of Engineers continued their service to the State in 1984 by implementing flood preventive measures in two major projects; Utah Lake and the Surplus Canal.

The Utah Lake Project consisted of constructing approximately 11 miles of levees around portions of Utah Lake to protect highways, homes and the Provo City Airport from the rising lake.



Wasatch Front And Central Utah Flood Control Study, Utah

South Pacific Division
Sacramento District, Corps of Engineers

The Surplus Canal Project involved dredging the canal to remove debris built up from the flood season of 1983 and 1984. Levees were breached to reduce flows into areas where damage to property could result.

1. Utah Lake
   - A) Levees to protect Provo Airport, approximately 7 miles.
   - B) Levee on SE corner of Airport to protect homes.
   - C) Levee along south shore, approximately 4 miles.

   Total cost was about $3 million.

2. Surplus Canal Dredging

   Canal and drains with debris from 1983.
   Goggin Drain was breached and levees breached on west side of the canal.
   Total cost about 1 million dollars.

Damage Survey

Twelve (12) members of the Corps of Engineers were assigned to assist with Survey Reports and inspections during the declaration period at a cost of $87,000.

Figure 2

Study Area	Estimated Cost of Flood Control Measures	Corps Authority	
Bear River Basin	$1,950,000	**Section 205 1/**	
		Logan River	$416,000
		Blacksmith Fork	$515,000
Weber River Basin	$1,381,000	**Section 205 1/**	
		Morgan	$934,000
		Coalville	$447,000
Davis County Streams	$7,500,000	**Section 205 1/**	
		Bountiful (Mill Creek)	$1,834,000
Jordan River Basin	$17,300,000	**Section 205 1/**	
		Spanish Fork	$1,102,000
		Hobble Creek	$668,000
		Provo River	$1,224,000
		Rock Canyon	$1,968,000
		American Fork	$1,769,000
		Dry Creek	$713,000
Sevier River Basin	$5,015,000	**Section 205 1/**	
		Gunnison	$348,000
		Section 14 1/	
		Levan	$180,000

1/ Total cost, including costs of lands, easements, rights-of-way, and relocations which would be a non-Federal responsibility.

Additional Mitigation Work

As a result of disaster declarations in 1983 and 1984, 59 stream drainages from Logan to Gunnison were studied by the Corps under a Section 205 Small Projects Investigation and supplemental Section 14 work.

The studies' purpose was to assess the flood problem, carry out an analysis of possible mitigation measures, determine the availability of funds from local government and FEMA, calculate residual costs and identify prospective solutions. As a result of this study, thirteen areas were labeled as justified for additional detailed investigation.

Of the thirteen areas, six had follow-up requests by local government to the Corps of Engineers for further action on flood control. These are Logan River, Blacksmith Fork, Morgan, Hobble Creek, Provo River, and Rock Canyon.

Federal Highway Administration

The Federal Highway Administration is the regulatory agency which reviews and approves plans, specifications and funds for use by the State Department of Transportation and other agencies involved in construction of the Federal aid systems.

As a result of 1984 flooding, the FHwA approved $3 million in Emergency Relief Funds for ten counties in the State of Utah. Fifteen million dollars was approved for nonemergency Interstate Rehabilitation for Interstates 15 and 80. Rehabilitation projects were initiated around the Great Salt Lake (Black Rock to Saltair), Utah Lake and Weber Canyon.

Forest Highways

Under Title 23, Forest Development System Act, the FHwA made nearly $6 million in program approved funds available to the National Forest Service for repair and mitigation improvements to forest highways, roads, and trails in Utah in 1984.

Program approved funds are as follows:

Fish Lake National Forest	3,768,865
Manti-Lasal National Forest	1,051,973
Uintah National Forest	567,268
Wasatch-Cache National Forest	417,160
TOTAL	**5,805,276**

High water flooded Interstate 15 off-ramp in Utah Co. (UDOT photo)

Additional funds are expected to be allocated and approved in most areas around the state.

Combined with carry-over work from the flooding of 1983, the 1984 funding and efforts of the Federal Highway Administration make a very significant mitigatory contribution to the State of Utah.

National Weather Service

The National Weather Service has responsibility for monitoring, data collection, forecasting and reporting of all weather related phenomenon. Such information is critical in preparedness, response and mitigation planning within the state.

The Colorado River Basin Forecasting Center monitors incoming storms, weather patterns, precipitation, temperature, humidity, Palmer soil index (relative moisture content of soils) and collects information on hydrologic measurements of Utah Lake and Great Salt Lake. They also

make forecasts of temperature, precipitation, lake levels, snowpack, snowmelt, and stream runoff.

The Colorado Basin River Forecasting Center monitors snowpack and stream flow in the Colorado River Basin and Great Basin region and makes forecasts concerning, snowpack, snowmelt and stream runoff.

During the preflood and flooding period in 1984, the NWS played an important role in response efforts and mitigation plans. The Utah Flood Task Force, created under the auspices of the Governor and the Utah Department of Public Safety and coordinated by the Utah Division of CEM, held a series of meetings from mid-February through April 1984 to assess and monitor the flood potential in the State. National Weather Service meteorologists and hydrologists provided important information on present conditions and forecasts.

As early as July 1, 1983, the serious potential for spring 1984 flooding was identified by various agencies, including the NWS. The most obvious problem was the continual rise of Utah Lake and Great Salt Lake. By January 1, 1984, record snow packs were reported along the Wasatch Front. On April 30, Utah's flood potential was revised from very high (9.2) to extremely high (9.4).

The NWS provided continual critical weather information through the late winter and into the spring as the flooding potential increased. In mid-May, warm temperatures released mountain snowpack and caused the runoff problems which resulted in disaster declarations in six cities and four counties.

NWS representatives made almost daily presentations from mid-January through May to public officials, the press, and emergency response teams detailing and updating the flood situation.

As a result of the 1983 and 1984 flood season, the NWS proposed to add several stations to its ALERT (Automated Local Evaluation in Real Time) System network which monitors specific local weather conditions. Presently stations are located south of Great Salt Lake at Timpie, Farmington in Davis County and Little Cottonwood Canyon in Salt Lake County.

Forest Service, USDA

The U.S. Forest Service administers the conservation, public and private use, development and improvements of over eight million acres of land in the State of Utah.

In the preflood period of 1983-84, the Forest Service worked closely with the Soil Conservation Service, the Utah Geological and Mineral Survey, the National Weather Service and other agencies to monitor watershed and other potential problem areas in order to activate preflood mitigation activity and plan for post-flood activities. A monitoring program of selected drainage areas for potential floods, debris flows, and landslides was accomplished using fixed wing and helicopter aircraft.

Funded under the Section 403 Emergency Watershed Protection Program, to streambank conditions and clear channel debris were implemented by the Forest Service in Fishlake, Manti-Lasal, Uinta, and Wasatch National Forests.

Soil Conservation Service, USDA

The United States Department of Agriculture Soil Conservation Service (SCS) is the federal agency which administers repair, improvements, and development of land and water resources on USDA land. The effect of their work benefits and compliments other federal conservation projects along with state, local and private land and water interests. Other functions of SCS include cost sharing in flood prevention measures, irrigation, drainage and sedimentation control.

The 1984 efforts of SCS were concentrated in six counties; Sevier, Millard, Juab, Cache, Weber, and Morgan. Other counties received minor repair and mitigation treatment. Most work was done in direct cooperation with county authorities to reduce soil loss and damage to agricultural and watershed areas. These projects included stream bank stabilization, concrete ditch lining, channel debris clearance (Jordan Narrows) and construction of debris basins (Kanosh, Millard County). These projects were completed under Section 403, Emergency Watershed Protection funding, or directly through Forest Service Mitigation Projects.

The above projects, along with 1983 follow-up work and routine watershed management, constitute major mitigation activities and provide a valuable service to the state.

U.S. Geological Survey

The United States Geological Survey (USGS) provides important technical support to hazard mitigation activities. Ongoing mapping and technical construction projects provide the data base necessary for hazard mitigation planning. Emergency response programs provide effective response mechanisms and information needed for decision making.

Two branches of the USGS, the Water Resources Division and the Engineering Geology and Tectonics Division, both had important projects in monitoring and mitigation which were carried over from 1983 to 1984 and continue to be implemented.

The Water Resources Division is the lead agency in scientifically monitoring the level of the Great Salt Lake. Over the past four years the lake level has risen over ten feet. During this time the Water Resources Division has carefully monitored the lake and in conjunction with other agencies made predictions of future levels and how it would affect the surrounding shore area.

The Division also compiled, produced and distributed a satellite image map entitled "Great Salt Lake and Vicinity, Utah." This map is a color-infrared depiction of the Great Salt Lake at its high level of 1984. Critical facilities, highways and communities are easily identified. Elevation contours for previous lake levels as well as postulated highs are outlined. Already this map is being widely used at all levels for planning, from local lake shore communities to federal agencies to help in the mitigation process.

The Engineering Geology and Tectonics Branch of the USGS has been active since 1983 in implementing and funding programs to mitigate geologic hazards. Funding to support three County Hazards Geologists for the counties of Box Elder, Weber, Davis, Salt Lake and Utah has been provided to the Utah Geological and Mineral Survey (UGMS). These geologists will be used to carry out applied programs and consult with city and county officials on hazards along the Wasatch Front.

The unique events of 1983 and 84 have touched off a wave of interest from investigators to study the area. The continuing and proposed programs of the U.S. Geological Survey in Utah involve more than 20 projects on geologic and hydrologic hazards. Much new work in the region has begun recently as a result of the 1983 Borah Peak, Idaho earthquake and the debris flows, landslides, and floods of 1983-84. Below is a list of some of the projects.

Earthquake — Landslide

Earthquake Hazard and Prediction Research in the Wasatch Front/Southern Intermountain Seismic Belt

Tectonic-Tilt Measurements Using Lake Levels

Regional and Local Hazards Mapping in the Eastern Great Basin

Estimation of Seismic Ground Motion in Northern Utah

Development of Liquefaction Potential Maps for Salt Lake and Utah Counties, Utah

Ground Response Along the Wasatch Front

Federal Disaster Response in Utah

Earthquake Vulnerability of Urban Water Systems, Salt Lake County, Utah

Hydrologic Hazards

Effects of Water and Sediment Discharges on Channel Morphology

Rheological Properties and Initiating Mechanisms of Mudflows and Debris Flows

The USGS is also active in earthquake hazard mitigation activities in Utah. On October 1, 1983, the U. S. Geological Survey initiated a new program element, a part of the National Earthquake Hazards Reduction Program was created to develop the basic information and partnerships needed for evaluating earthquake hazards and assessing risk in broad geographic regions containing important urban areas. It will also provide a basis for loss-reduction measures that can be implemented by local governments.

In the first three years of the program the Wasatch Front will receive first priority. The goal is to provide an integrated program having comprehensive research goals and producing generic information that can be used to reduce earthquake losses in urban areas. The scientific emphasis is on developing a fundamental physical understanding of the cause, frequency, and physical effects of earthquake ground shaking, surface faulting, ground failure, and tectonic deformation in various geographic regions. A multidisciplinary task force to accomplish specific goals and close coordination with the Federal Emergency Management Agency and state coordinating agencies is required. Users of the infor-

mation produced by this program cannot find such an integrated synthesis and evaluation of earthquake hazards in the scientific literature. Loss estimates have not been updated in most urban areas for many years and the risk may be seriously underestimated due to the sharp increase in building costs and construction.

Introduction to Statewide 406 Recommendations

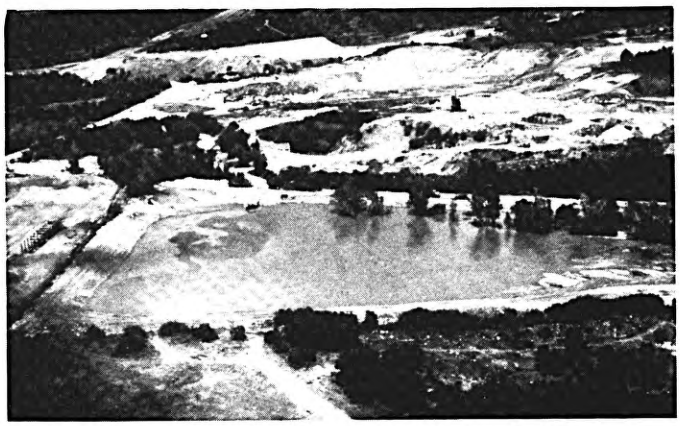
Although it was already substantial, Utah's commitment to hazard mitigation programs was greatly strengthened by successive declarations in 1983 and 1984. The scope and severity of actual damages has instigated the widespread mobilization of financial, human, and community resources toward more effective hazard mitigation programs. These include everything from broad federal and state programs to specific local actions designed to mitigate potential damages.

This document presents inventories of existing local, state, federal, regional, and private measures. Many of these measures were undertaken as direct results of 1983 and 1984's events. This summary of the implementation recommendations being used to achieve statewide hazard mitigation objectives will focus on several major areas of concern.

A status report is given on following pages for hazard mitigation recommendations contained in the 1984 State Hazard Mitigation Plan, including those from the Governor's Conference on Geologic Hazards. Many of these recommendations have been, or are being, implemented. The State Hazard Mitigation Officer will continue to pursue the implementation of these measures and will report on these periodically in an update on the State Hazard Mitigation Plan.

The first section on recommendations will consider the Great Salt Lake, emphasizing the concept and need for a Beneficial Development Area (BDA) relative to the shoreline of the lake; this is considered to be a high-priority item. The section will discuss the history of thought on the lake, especially regarding lake levels. Following this, listings of recommendations will be presented that originated from interviews and from the recent conference on predicting Great Salt Lake levels.

Following the Great Salt Lake Section, the main section of 406 plan recommendations will be presented. Recommendations were obtained by questionnaires sent to several county and city government officials. An additional set of recommendations was gathered through interviews with state officials working with all aspects of hazard mitigation, including the Great Salt Lake. From a solid base of existing measures, these new recommendations will fill gaps in existing programs and establish precedents for the future. These recommendations, in coordination with established mitigation plans and actions, create a viable hazard mitigation plan for Utah.



Big Cottonwood Debris Basin. (Salt Lake Co. photo)

Recommendation Implementation: Key to Mitigation Introduction:

The following recommendations for the 1984 State Hazard Mitigation Plan (called "The Plan") were received from local, state and federal officials through a response to a questionnaire or through an interview. The result of this process is that The Plan contains recommendations from key emergency personnel involved directly in Utah's

disasters. Thus, The Plan contains the apparent aspects of hazard mitigation currently facing the state of Utah. The importance of having such a list of recommendations can be understood best by reviewing Section 406 of Public Law 93-288 and the FEMA-State Agreement signed by Governor Scott M. Matheson. Both of these documents state that a State Hazard Mitigation Plan will be prepared and implemented following presidentially declared disasters. In keeping with this law and agreement, a State Hazard Mitigation Plan was prepared following the 1983 presidentially declared disasters. This present plan results from the 1984 presidentially declared disasters in Utah. As required, this plan will update the previous plan, taking into account the natural hazards of the entire state, and also those areas involved in the 1984 presidential declarations. Now that The Plan is prepared, the critical work of implementing the recommendations begins. As you read over these recommendations, you will see how their implementation will enhance the state's hazard mitigation capabilities considerably. In fact, some of these recommendations are basic for any state; other recommendations are innovative and will put Utah ahead of other states, which is our goal. If successfully implemented, Utah property damage can be greatly reduced, but most of all, lives will be saved.

The recommendations contained in this section of the State Hazard Mitigation Plan were obtained from a questionnaire. This questionnaire was used in the actual interviews with state officials involved with hazard mitigation; it was also mailed to all county emergency directors and city directors involved with the 1984 disasters. The questionnaire used in gathering data for this plan is included on the next few pages.

Definition of Hazard Mitigation:

Interview questions were geared to the definition of "hazard mitigation," given below. A natural hazard is considered to be a hazard as long as it is threatening people and property. This includes the time period while the hazard is simply a potential threat through the time that the hazard is actually injuring people and/or damaging property. The hazard ceases to be a hazard once no additional damage or injury results from the effects of the hazard. This basically means until the UGMS and/or State Engineer, or local government officials no longer identifies it as a natural hazard. One hazard may cause a separate, but related, hazard. For example, a landslide hazard will eventually cease to be a hazard after it has stopped sliding, but the slide may have damaged a waste water treatment plant creating a separate health hazard.

Definition: The application of structural or nonstructural methodologies to the lessening or elimination of the risk to people and/or property from natural hazards. This also involves an economic, political, and sociological process, as well as common sense.

Natural hazards can be grouped under two subcategories:

a. Passive Natural Hazards: Potentially threatening but are not presently causing injury nor damaging property.

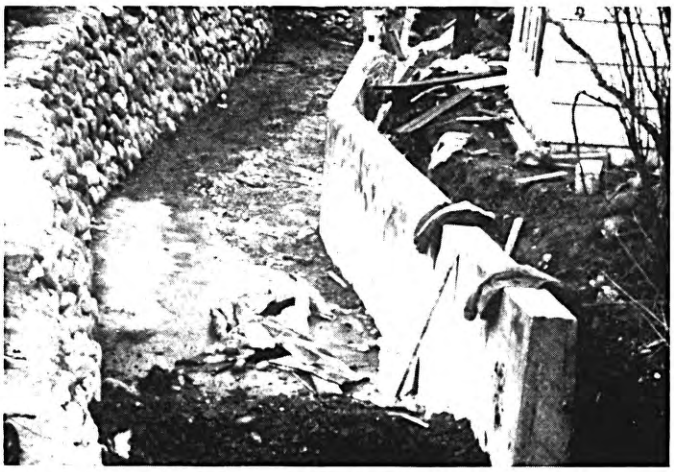
b. Active Hazards: In the process of injuring people and/or damaging property

The approaches to hazard mitigation for both active and passive hazards are:

1. Structural: Something is constructed.
2. Non-Structural: Something is studied and/or planned.

The mitigation of passive natural hazards, such as a landslide that has been identified as a threat to people and/or property but is not currently injuring people nor damaging property, requires preventive mitigation measures. Preventive mitigation measures are designed to stop the "passive hazard" from becoming an "active hazard". For example, drains placed into the subsurface of a landslide may remove water from the material that could begin to slide under the influence of gravity. This, in turn, may assure that the material will not slide and become an "active hazard."

The mitigation of an "active hazard" requires attempts at minimizing the effects of the hazard on people and/or property, but people and/or property have already suffered some impact. For example, a landslide that is moving may have injured some people and damaged some property, but it is still threatening to do more injury and damage. Mitigation in this situation may require evacuation of people, medical treatment for injured, and emergency structural measures.



Flood mitigation on Mill Creek. (Salt Lake Co. photo)

Once the hazard has ceased to be "active", the recovery process begins. The hazard that caused the injury and damage may now be reevaluated to see if it poses a potential threat to people and/or property. If it is a potential threat, then it is reclassified as a "passive hazard". This indicates that it is a repetitive hazard, and using that information, preventive mitigation measures will then be implemented in an attempt to prevent the "passive hazard" from once again becoming "active."

Hazard mitigation is defined by the federal government in the following way:

> A plan "to alleviate by softening and making less severe the effects of a major disaster or emergency and of future disasters in the affected areas, including reduction or avoidance." "Hazard mitigation can reduce the severity of the effects of flood emergency on people and property by reducing the cause or occurrence of the hazard; reducing exposure to the hazard, or reducing the effects through preparedness, response and recovery measures. Hazard mitigation is a management strategy in which current actions of potential flood disasters are balanced with potential losses from future floods." (Quote 1, Federal Register, Disaster Assistance; Hazard Mitigation (Subpart M), 44 CFR Part 205, Vol. 44, No. 218, Rules and Regulations, pp. 64809-64815, November 8, 1979; Quote 2, FEMA, Flood Hazard Mitigation Handbook of Procedures, Washington, D.C., September, 1981).

Additional definitions relating to hazard mitigation:

Floodplain Management: A comprehensive approach "to reduce the damaging effects of floods, preserve and enhance natural values and provide for optimal use of land and water resources within the floodplain. Its goal is to strike a balance between the values obtainable from the use of floodplains and the potential losses to individuals and society arising from such use (U.S. Water Resources Council, Floodplain Management Handbook, Washington, D.C., September 1981).

Dam Safety: A program to inventory, classify and inspect dams to identify hazardous conditions and insure proper maintenance through corrective orders for the purpose of protecting human life and property. A dam (including the waters impounded by such dam) constitutes a threat to human life or property if it might be endangered by overtopping, seepage, settlement, erosion, sediment, cracking, earth movement, earthquakes, failure of bulk heads, flashboards, gates on conduits, or other conditions (Department of the Army, Office of the Chief Engineers, Recommended Guidelines for Safety Inspection of Dams, Washington, D.C.).

Great Salt Lake Hazard Mitigation Introduction:

Historical Perspective:

There is some evidence of rumors of a huge salty lake in this area as early as 1710; however, it appears that no white man had set eyes on the Great Salt Lake prior to 1824-25. Indians had camped along the shores since ancient times. Archeological evidence of such encampments, dating from the 1600s, has been found along an inconspicuous lake terrace at an elevation of 4217 feet, the record highstand for near recent times. The first scientific examination of the lake wasn't until 1843 when John C. Fremont visited the island later named after him. While at the lake, Fremont determined it's elevation to be 4200 feet above sea level. In 1845, Fremont rode on horseback to the south end of Antelope Island. In 1849 Captain Howard Stansbury circled the lake on land, and during the following year named several of the islands of the lake. The historic record of lake level fluctuations begins in 1847. The level was determined indirectly by G. Karl Gilbert of the U.S. Geological Survey for the period of 1847-75 on the basis of reported observations of the depth of water over the sandbars between the mainland and Antelope and Stansbury Islands. This information was relayed to Gilbert by stockmen who rode horses across the bars to reach the islands. From 1875 to 1938, the lake level was measured periodically by staff gages at six different sites. The level has been measured continuously at the Salt Lake County boat harbor since 1939, at Saline since 1966, and at Promontory Point since 1968.

When the Mormon pioneers arrived in Utah in 1847, the surface of Great Salt Lake was at about 4200 feet above MSL. It rose almost five feet by 1855 but then declined again to 4200 feet by 1860. From 1862 to 1873 the lake level rose

almost 12 feet to reach a historic high of 4211.5 feet. This was an important moment in Great Salt Lake economic history, because the next time that the lake would rise almost that high (1983-85 to 4210 feet) the flood losses would cost close to $200 million with potential mitigation expenses of $110 million with annual maintenance of over $4 million. Had the pioneers, or others after them, considered a "Beneficial Development Strategy" for the lake at that time, developing lake shores to maximum prudent use, the federal, state, and local governments could have put such funds into other needed programs. Instead, the pioneers investigated the possibility of the water spilling naturally into the desert area to the west, but the lake peaked in 1873, ending the problem for the time being and interest in lake flooding waned. By 1905, the lake declined to 4196 feet, a historic low for the period. After periodic fluctuations, the lake declined to 4191.35 feet in 1963, an alltime historic low. Between 1873 (the historic highstand, 4211.5 feet) and 1963 (the historic lowstand, 4193.35 feet), a known lakeshore fluctuation surface had been defined; development within that area was subject to flooding. Worse yet, the now known lake terrace from the 1600s at 4217 feet suggests an even broader lakeshore fluctuation surface up to 4217 feet. The fluctuations of the lake surface generally paralleled fluctuations in precipitation as recorded in Salt Lake City where systematic record keeping of precipitation was started during 1874.

Because the lake continued to decline in the 1960s, businesses and government facilities encroached on the relict shores. Above average precipitation then caused the lake to rise, and by 1976 the lake had reached 4202 feet (11 feet of increase), flooding some roads around the lake. Studies were conducted on pumping water into the west desert. Again the lake receded, until in 1978 the lake surface was at 4200 feet, the same level it was at 131 years earlier. This 1978 elevation is somewhat deceptive because consumptive use of water reduced the lake's elevation by about 2.5 feet. It is interesting to note that a recent concept was that because of consumptive use the lake would not get above the 1873 level and that it would slowly dry up.

From 1983 to 1985 the lake rose to 4210 feet. Some forecasts predict 4215 by the year 1990.

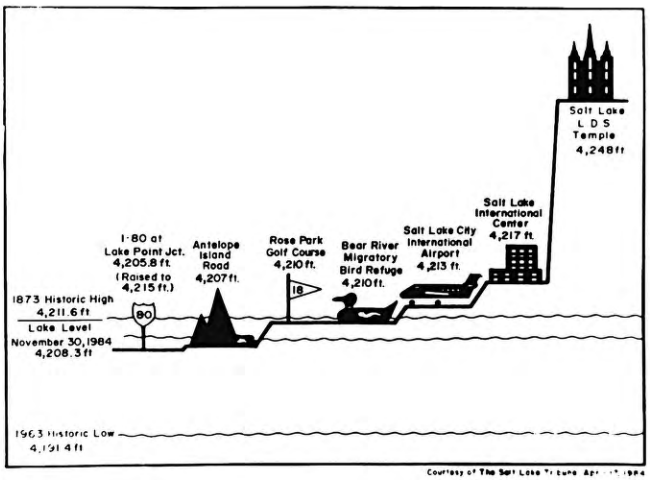
Flood Damage and Related Costs From Recent High Lake Levels

A comprehensive assessment of damages associated with lake levels ranging from 4202 to 4212 feet was reported by the Utah Division of Water Resources in January, 1984. Various water control plans were also presented. Damage of all kinds, including damage to households and tourist attractions was also calculated in terms of loss in tax revenue. Were the lake to rise to 4212 feet, estimated capital damages could equal $269 million. If the lake were to rise to 4217 feet, the highest known level reached in the past 300 years, the economic impact on the state would be tremendous, about $2 billion.

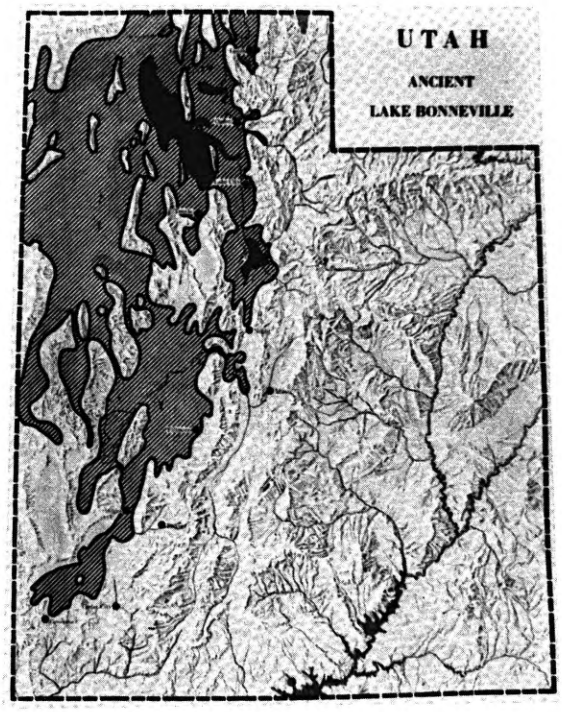
Minimizing the Impact of Future Flooding:

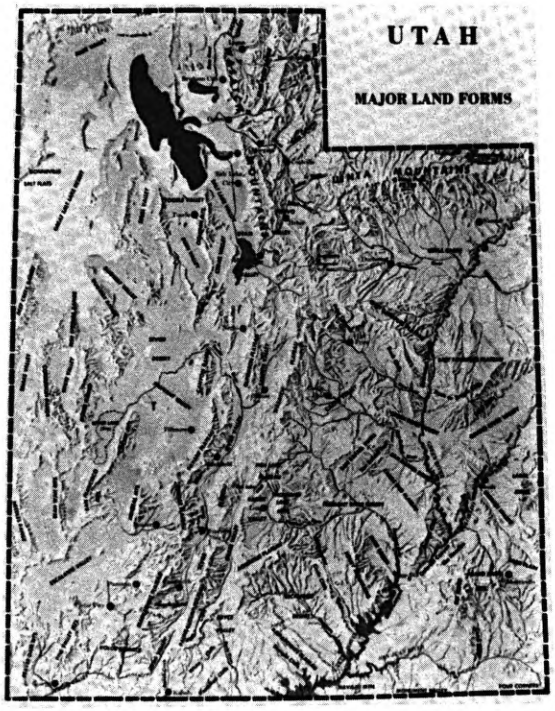
From all that has been said about mitigation activities for the rising Great Salt Lake, a vast array of costly alternatives is appearing, some of which are currently under consideration by the state legislature. These mitigation activities, such as West Desert Pumping and diking are designed to protect existing property and planned developments within potential flood elevations around the lake.

The old Southern Pacific Railroad Trestle showing low level of Great Salt Lake in 1977 with water level at about 1199 feet. (Utah Div. Water Resources, Lloyd Austin, photo)



Elevations of several major areas as they relate to Great Salt Lake shoreline elevations.





Map showing ancient Lake Bonneville; compared with map of Utah showing current Great Salt Lake shorelines.

Evaluating the Impact of Future Flooding:

With a known lake fluctuation surface up to 4211.5 feet (the 4217 foot high stand was not known yet), development proceeded in areas adjacent to the Great Salt Lake below 4211.5 feet; no "beneficial development" concepts had resulted. However, interstate highways, railroads, waste water treatment plants, refineries, airports, and other major facilities were built into these shorelines areas, and the expense of protecting this development has been unbelievably costly.

The discussion in the following paragraphs on damages and costs for flooding to elevations of 4210 and 4212 feet are taken from: *A Strategic Recommendation for the Great Salt Lake*; Department of Natural Resources, Division of State Lands and Forestry, by R. A. Miles, Division Director, and S. Elmer, Field Operations Planner. Damages and costs to elevations of 4212 feet and to 4217 feet are considerably more; in fact, costs to 4217 feet have been estimated at over $2 billion.

The Cost of Current Flooding to 4210 feet:

As the Great Salt Lake rose nine feet and covered 400,000 acres of shoreland during the last three years, it caused an estimated $200 million worth of capital damages to public facilities and private properties; this cost includes flood protection measures. Lost revenue to businesses, tourism, recreation, wildlife, and agriculture is estimated at $17.6 million for 1984.

The Southern Pacific Railroad, along with the Utah Department of Transportation, and Union Pacific Railroad have spent $74.7 million to raise and protect their road beds during the past two years.

Despite valiant efforts to raise protective dikes, AMAX Magnesium on the southwest arm of the lake lost a section of dike to the rising waters of Great Salt Lake in 1983. Thirty thousand acres of their valuable evaporation pond system were covered with fresh brines requiring the evaporation process to start over.

The lake eroded through a section of protective dike on Great Salt Lake Mineral's evaporation ponds in the northwest arm of the lake in 1984. Fresh Brine then covered most of their 17,000 acre pond complex.

At the present time all of the state and federal waterfowl management areas, with the exception of Timpie Springs and the Salt Creek Waterfowl Management areas in Tooele and Box Elder Counties respectively, have been impacted by the rising brines of the lake. Most of this valuable waterfowl habitat has been completely covered with brine, dikes have been overtopped and eroded, and vegetation essential to the life-cycle of waterfowl and shorebirds has been wiped out. Private duck clubs have been equally hard hit.

Late in the summer of 1985 it was discovered that the Ogden River was suffering from estuarine effects, and that at least one attempt at irrigating crops directly from the river resulted in flooding land with salt water, ruining the land for future planting.

The impact on recreation and tourism has been significant. The road to Antelope Island has been covered by four feet of water and eroded to a great extent. Newly constructed rest rooms on the south shore were torn apart by wave action. The South Shore Marina and access road continue to be threatened. The reconstruction of Saltair Resort has been battered by wind tides and waves of four to seven feet that can be regularly experienced on Great Salt Lake.

The Cost of Lake Flooding to 4212 Feet:

The flood elevation of 4211.5 feet was reached in 1873, but similar flooding today would be significantly more costly due to development around the lake. Studies conducted by the Department of Natural Resources, Division of Water Resources (January 1984) describe the costs involved for flooding on a foot-by-foot basis from 4200 feet up to 4212 feet. The results of this study are shown in a following table. The total cost of flooding at 4212 feet is $269 million. For comparison, flooding from the last three years has cost about $200 million. Thus, if lake flooding were to continue up to 4212 feet, the state would suffer an additional $69 million in flood damage.

When considering the expense of the lake rising to 4212 feet, the cost of mitigation activities must be taken into account. The reason that people and property require protecting is because they have been allowed to develop within a hazardous area. Thus, the cost of mitigation is part of the overall expense, as is actual damage incurred. The State Legislature is scheduled to decide the issue of spending $110 million for mitigation alternatives, including West Desert pumping and diking. If passed by the legislature, the pumping project will require a yearly $4 million to $5 million for maintenance and operation. The accomplished $3 million "breach" of the Southern Pacific Railroad causeway is another expensive mitigation measure. The lack of a "beneficial development policy" for the lake over the past several years, allowing expensive development to encroach onto the lake's fluctuation surface, has cost the state perhaps $200 million in the past three years. It may next cost the state $110 million in structural mitigation, plus $4 million to $5 million per year for maintainance. Policy makers should look to the future in implementing a "Beneficial Development Strategy" for the lake to allow for maximum prudent development of the lakeshore areas while still pro-

tecting the people of Utah from these high expenses. Discussion on such a recommendation is contained in this chapter.

The proposed West Desert Pumping and associated diking plans are geared to keep lake flooding below 4212 feet. Thus, the study, cited above, would appear to describe the maximum damage cost that could occur with these proposed mitigation measures. This is true if we have addressed all of the questions that could have an associated expense.

Some questions brought up regarding West Desert Pumping in the State Legislative Committee on Energy and Natural Resources in an April 17, 1985 meeting at the State Capitol were:

1. Is the State creating policies on the Great Salt Lake by deciding which arm should be more saline than the other?
2. What impact will occur if we change the ecology of the lake by adjusting the salinities in an unpredictable way?
3. What impact will occur on planned development of the area west of the Great Salt Lake?
4. What liability will the state incur by flooding access roads to the area west of the Great Salt Lake?
5. Are we purchasing the salt water pumps before receiving the draft copy of the Environmental Impact Statement and permission from the U.S. Air Force to do pumping in that area?

Other questions may be justified, and these are being researched. The main point is that the overall impact of flooding to 4212 feet may not yet be well understood.

The Cost of Lake Flooding to 4217 feet and higher:

Studies on the cost of flooding to 4217 feet or higher suggest flood-damage losses would be in excess of $2 billion. An examination of U.S. Geological Survey topographic maps reveals that from 4212 feet to 4217 feet North Salt Lake City would suffer tremendously. Flooding would cover the Husky and Chevron Oil Refineries, Rose Park to the State Fairgrounds, the Salt Lake International Center, most of the Salt Lake International Airport, and I-80 along the south shore of the lake. Near Centerville, Farmington, and Brigham City, stretches of I-15 would be inundated. Railroad causeways would be flooded. All waste water treatment plants located in the lake would be inundated and a sewage treatment plant near Clearfield would be in danger of flooding with wind/storm tides and waves. Farmland along the east shore would become salty. The town of Warren, including it's cemetery, would be underwater as would parts of western Plain City. Saltwater would surround the Willard Bay dikes, seeping through and polluting the bay or flooding back through the Willard Canal into the bay. Salty estuaries would back up into the Jordan, Ogden, and Bear Rivers. The town of Corinne would be surrounded by saltwater and the Brigham City Airport would be near flooding. Mineral evaporation ponds would be flooded at both ends of the lake. Ground water would be polluted with saltwater around the lake. Perhaps the climate would be adjusted slightly due to the so-called "lake effect". The lake area would be much greater, having flooded into the west desert and extending its other shores at least a few miles in several areas.

This scenario depicts an unprecedented financial disaster for the state, the cost of which can only be guessed at. Elements of a well thought out "beneficial development" strategy, allowing maximum prudent development of the lakeshore areas would help in mitigating the likelihood of future damage from lake flooding.

Capital Damages as a Function of the Level of Great Salt Lake (thousands of dollars).

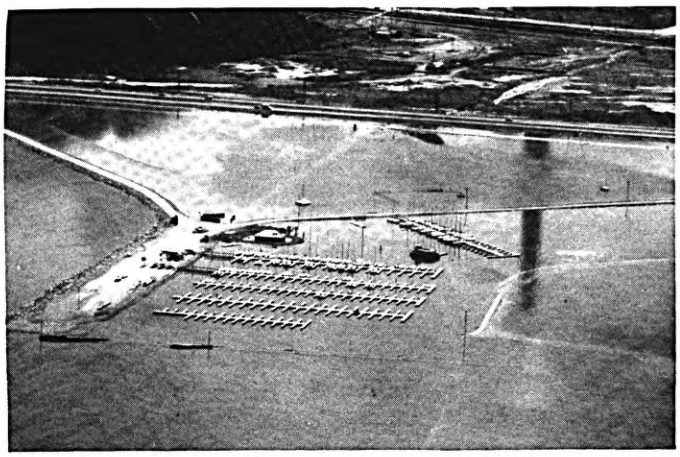
Lake Elevation	Lakeside Industries	Roads & Highways [a]	Railroads	Waterfowl Management Areas	Recreation Areas	Public Utilities	Other Public Facilities	Cumulative Total	Change Per Foot
4200		882						882	882
4201	25	882						907	25
4202	1,025	882						1,907	1,000
4203	2,861	882						3,743	1,836
4204	4,761	882						5,643	1,900
4205	19,276	14,812	23,037	2,500	657			60,282	54,639
4206	31,666	14,812	23,537	7,500	1,207	203		78,925	18,643
4207	37,206	40,562	24,037	13,700	1,207	304		117,016	38,091
4208	107,206	42,007	24,537	21,500	4,707	710	188	200,855	83,839
4209	107,206	42,377	25,037	28,500	7,707	710	198	211,735	10,880
4210	133,206	42,657	25,537	34,400	7,707	710	273	244,490	32,755
4211	134,486	42,907	42,037	37,800	7,707	710	273	265,920	21,430
4212	135,486	43,157	42,537	38,700	7,707	1,088	394	269,069 [b]	3,149

[a] These figures are based on capital investments of $13,000,000 to raise the northern causeway to Antelope Island and $25,284,000 to raise I-80 near the south tip of the lake. Alternatively, if the causeway were repaired at a cost of $1,000,000 and the highway dikes for $500,000, total damages at 4212 feet would only be $6,373,000.

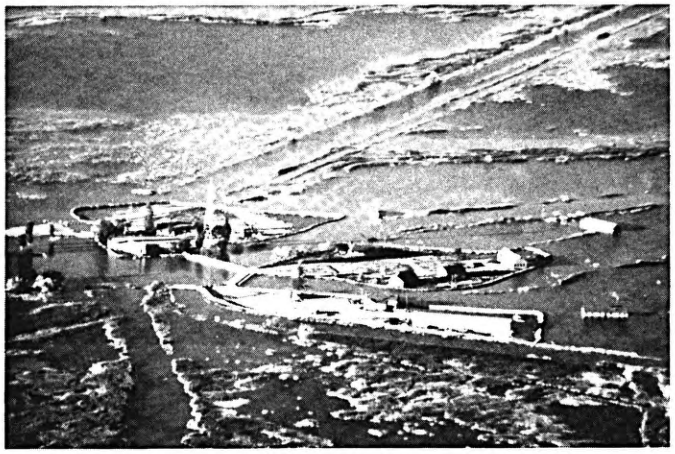
[b] If the lower road and highway cost figure of $6,373,000 at 4212 is used, then the total capital investments and losses amount to $269,069,000.

Source: Bureau of Economic and Business Research, University of Utah, November 1983.

From: Great Salt Lake, Summary of Technical Investigations, Water Level Control Alternatives, Div. of Water Res., Jan., 1985.



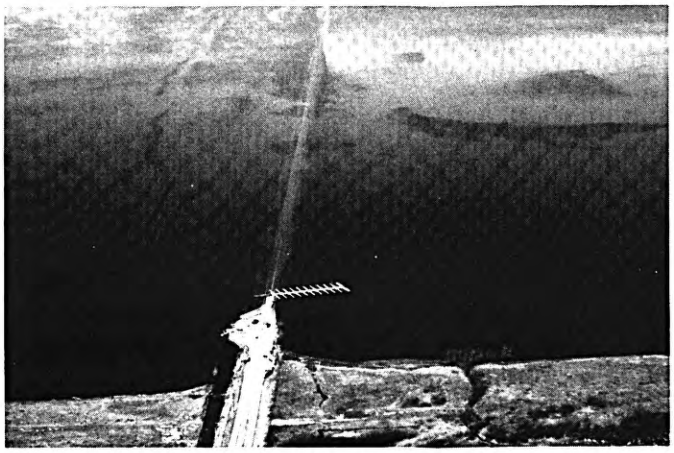
Great Salt Lake flood damage. (Utah Div. Water Resources, Lloyd Austin, photos)
Great Salt Lake Marina, April 1984.



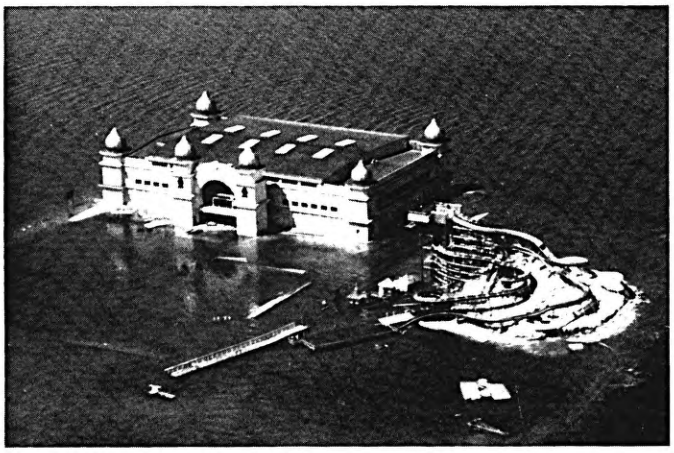
Bear River Bird Refuge, July 1984.

Flooded duck club, April 1984.

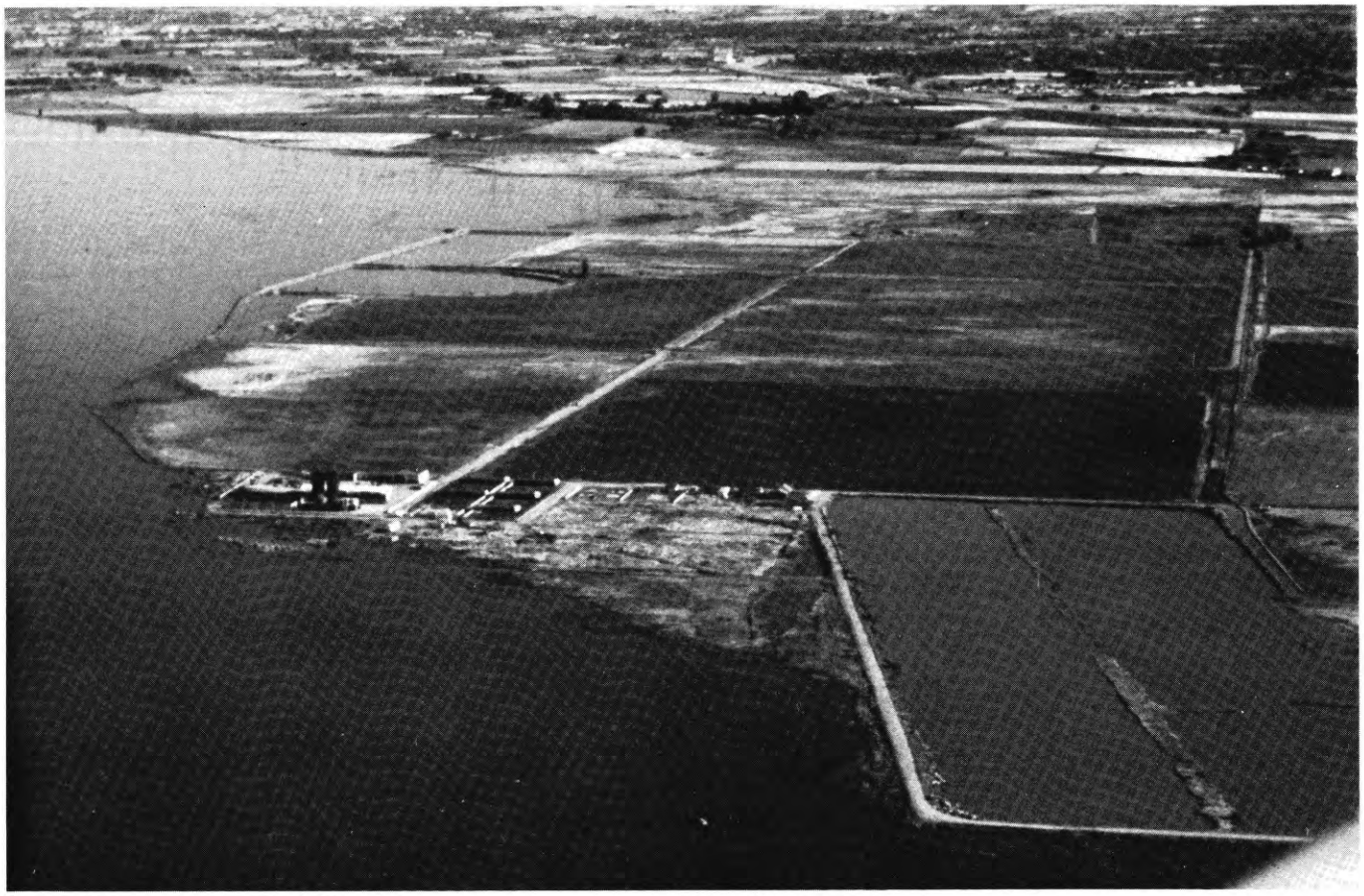
Damaged Antelope beach facilities, May 1985.



Flooded Antelope Island causeway, April 1984.



Saltair Resort, April 1984.



Flooded Wheeler Farm on Great Salt Lake shoreline in Davis County. (Utah Div. Water Resources, Lloyd Austin, photo)

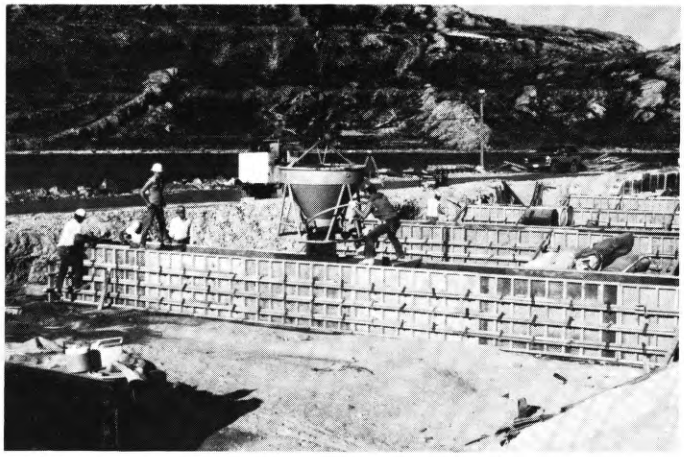
Great Salt Lake Mitigation Alternatives

Establish a Great Salt Lake "Beneficial Development Area" (BDA): Synopsis: Using the best historical and scientific data on the Great Salt Lake, a consensus is being arrived at among policymakers and other lake experts that a beneficial development strategy should exist for lake shore areas up to 4217 feet, a documented shoreline fluctuation surface. A coordinated effort between local and state agencies, with the ultimate goal of developing lake shores to the best advantage of the people of Utah, will also have the effect of minimizing what has been to date astronomical lake flood losses.

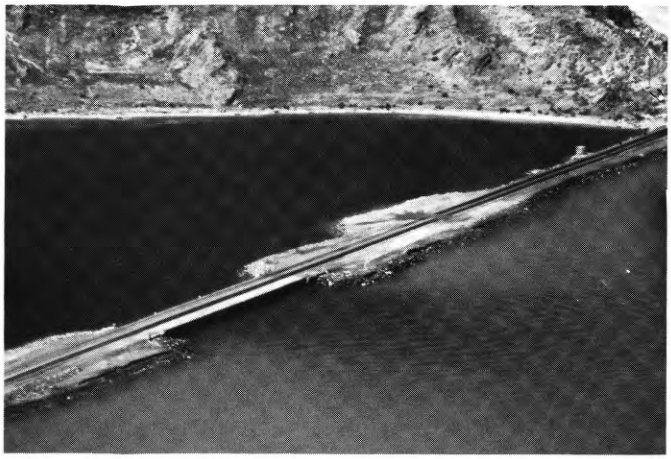
Introduction to the BDA Concept:

The Beneficial Development Area (BDA) is an attractive alternative to the various levels of government paying $200 million to a possible $2 billion during lake-flooding episodes, while at the same time funding other associated wet-cycle multihazard disasters: debris flows, riverine floods, and landslides. If the lake were to rise to levels recorded as recently as the 1600s, such costs could cripple the economy of the state, both locally and statewide. The recent lake rise of five feet per year for the past two year's wet-climate cy-

Breach of Southern Pacific Railroad causeway. (Utah Div. Water Resources, Lloyd Austin, photos)

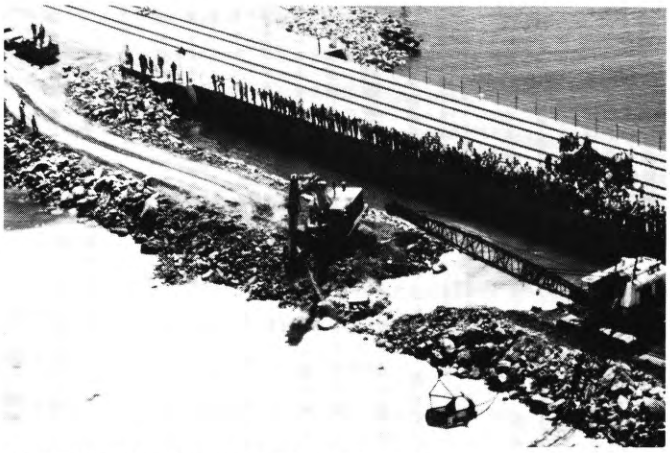


Before breach . . .

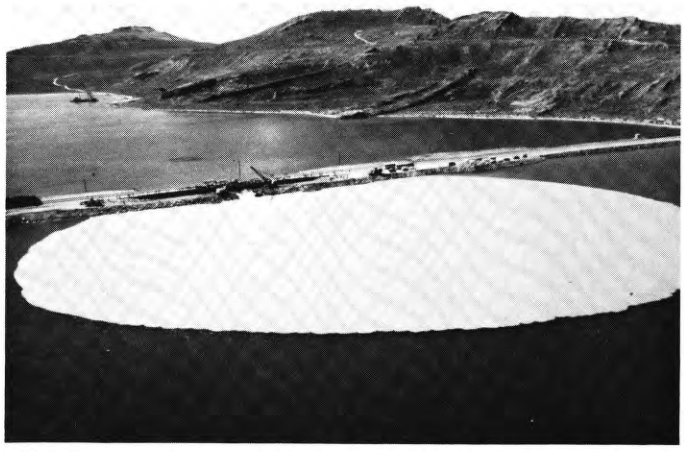


after breach . . .

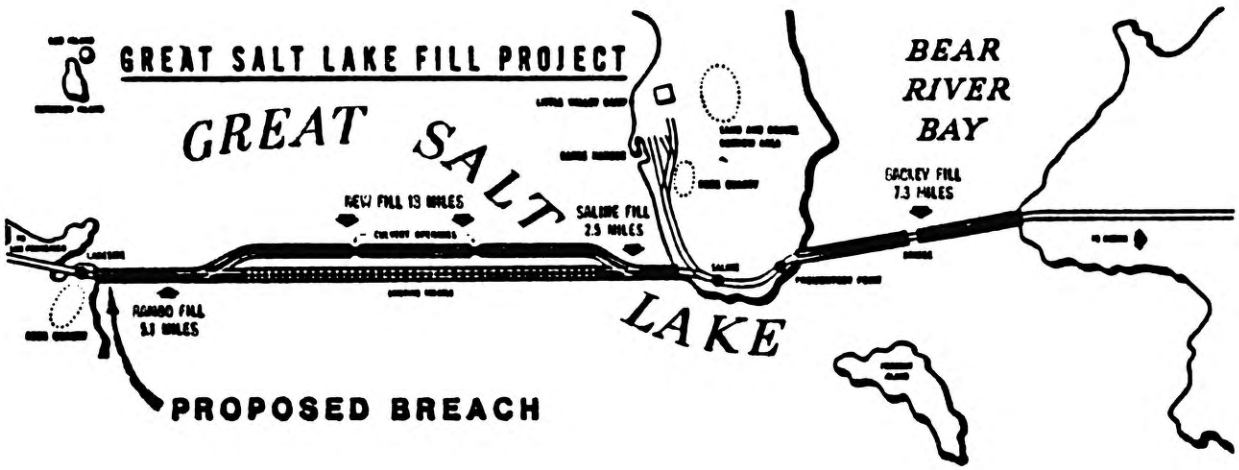
construction on causeway breach, July 1984 . . .



the first water flows through the breach . . .



a less dense silty layer built up as the breach was opened.



General map of Southern Pacific Railroad causeway across the Great Salt Lake showing breach constructed on August 1, 1984 (from Great Salt Lake, Summary of Technical Investigations, Water Level Control Alternatives, Division of Water Resources, January 1984).

cle was unusual but by no means uncharacteristic, and will almost certainly happen again, perhaps to a higher level. Oddly enough, positive aspects could prevail during wet-climate cycles in Utah. Grazing and forest lands fluorish, hydroelectric potential is enhanced, summers are cooler and winter skiing is better.

The BDA is an opportunity resulting from the past two year's astronomical flood expenses (about $200 million). The concept depends only on a joint agreement that the counties, cities, and the state wish to develop the shorelines of the Great Salt Lake in all aspects to the best advantage of the people of Utah, while avoiding nature's persistant effort to deplete local and state funds. An intercounty-city-town organization will be chosen and will meet, as needed, with representatives of state agencies to plan the beneficial development of the Great Salt Lake.

The "BDA" encompasses an area around the lake within which known key lake levels have been reached in the near past and can be documented: 4191.4 feet (historic lowstand, 1963), 4211.5 feet (historic highstand, 1873), 4214.9 feet (spillover point into West Desert), and 4217 feet (lake terrace created during 1600s, based on archeology). The upper BDA level may have been reached as many as five times during the past 500 years. Thus, the BDA is a documented lake fluctuation surface which if developed properly could save the citizens of Utah billions of dollars, while yet achieving desirable development goals.

Recommendations For Establishment of the Great Salt Lake "Beneficial Development Area":

Recommendation: Local governments should take the lead by organizing an Intergovernmental Great Salt Lake Beneficial Development Council (IBDC), including selected state officials, and coordinate efforts to determine the most advantageous development for the Beneficial Development Area (BDA) which extends landward to the elevation of 4217 feet, encompassing the documented lake-fluctuation surface (should the lake ever reach that level, wind waves will likely increase the fluctuation surface yet farther). The IBDC should define its objectives to include developing the Great Salt Lake BDA to maximum prudent use while avoiding astronomical flood losses, and to avoid unfair decisions against development already within the BDA.

The Logic of Establishing a "Beneficial Development Area" (BDA):

Although logic seems to dictate that the lake level will now go down, logic did not dictate that the lake would go up. The probabilities of the lake rising as it has over the past three years were remote at best. When the surprising rise did contradict the predictions, it caused an estimated $200 million in damage plus more for lost tax revenues. Should the lake continue to surprise us by rising to 4212 feet, the cost is estimated at $269 million. Because the concensus is that lake studies need to precede a thoughtful approach to developing lake shores, it makes sense to establish 4217 feet as a Beneficial Development Area within which we will apply what we have learned. Interviews conducted during the development of this plan continually indicate the need for basic studies. These studies should be done relative to 4217 feet. Although no official floodplain of the lake has ever been set, it seems clear that developing below 4217 feet could, at some point, mean trouble - if not from actual saltwater damage, then from high ground water problems, poor drainage and other problems.

If the Great Salt Lake again hits 4217 feet it would flow into the West Desert (4214.85 feet), expanding its water surface by 40 percent. The new shallow lake would extend west to Wendover. The larger surface area may well increase the so-called "lake effect." Eastward moving weather fronts sometimes pound the Salt Lake Valley harder than expected. Meteorologists believe the clouds pick up moisture over the Great Salt Lake. The heavy clouds move up against the Wasatch Mountains and drop the evaporated lake water. The greater the lake's surface area, the greater the "lake effect," some scientists believe.

Thus, the larger the lake, the more it may feed itself through Wasatch Front precipitation - a cycle that could keep the lake at about 4217 feet for years until a long dry spell could break the effect and drop the lake to lower elevations.

Given this scenario, we are recommending that thought be given to the potential of the lake again reaching 4217 feet (either directly or from wind/storm waves and tides), the impact if it does, and what should be done regarding the beneficial development up to this level. Ultimately, through the joint efforts of the Intergovernmental Great Salt Lake Beneficial Development Council (IBDC) a concensus will result to proceed ahead with beneficial development within the BDA.

West Desert Pumping:

The Utah State legislature will meet to decide on funding for the West Desert Pumping Project. This project is designed to pump 1.5 million acre feet of water per year from the fresher south arm of the Great Salt Lake into the West Desert, evaporating 1.0 million acre feet, and recirculating 0.5 million acre feet of concentrated brine back into the more saline north arm. Although dozens of alternative options for lake level control were analyzed, West Desert pumping evaporates the most water for the least cost. It can be in full implementation by 1987 if emergency approvals are received from the BLM and U.S. Air Force by the summer of 1985 and if construction can then begin by the fall of 1985. The estimated cost for the project is about $55 million, with a maintenance cost of $4 to $5 million per year. The goal of pumping is to keep the lake level below 4212 feet elevation.

The pumping alternative was first investigated by the Sacramento District Corps of Engineers for the Great Salt Lake Hydrologic Subcommittee in July 1976. The report by the Corps of Engineers was later published as Appendix C in the Great Salt Lake Hydrologic System Management Alternatives Report by the Division of Water Resources in May 1977.

The West Desert Pumping Alternative could affect some 350,000 to 450,000 acres in the desert area west of the Great Salt Lake. Ownership of this area includes public, State, and private land. The public land includes BLM land and land withdrawn for use by the Department of Defense (DoD). The DoD land that would be affected is part of the Hill Air Force Base Training and Testing Range commonly called the Hill Air Force Range or the Utah Test and Training Range.

The major elements of the pumping system are:

1. A causeway breach which would allow south arm brines to be delivered into an intake canal around the Southern Pacific Railroad facilities at lakeside to the pumping station on the east side of the Hogup Ridge. Isolation dikes would protect the canal from the north arm wave damage.

2. A discharge canal cut through Hogup Ridge would carry the flow from the pumping station to the west pond, which would be the higher of two ponds.

3. A primary evaporation pond, the west pond, having a surface area of about 375,000 acres and the capacity to evaporate approximately 840,000 acre-feet of water per year.

4. Railroad dikes to protect the SPRR facilities from west pond wave and water damage.

5. Bonneville dikes which would keep west pond water out of the Bonneville Salt Flats and off I-80.

6. The Newfoundland Dike, which would really be a retention dam for the west pond, with a flow control wier.

7. An overflow canal, which would deliver west pond overflow to the east pond.

8. A secondary evaporation pond, the east pond, having a surface area of nearly 88,000 acres and the capacity to evaporate about 220,000 acre-feet of water per year.

9. The east pond dike, which would lie parallel to the intake canal and would serve as a final retention dam. It would also contain a flow control structure to regulate the level of the pond and the return flow to the lake.

10. A return brine canal to deliver concentrated brines back to the lake.

The major system elements are shown in a following figure and the principal sizes, dimensions, quantities, and costs of the Earthwork Elements are summarized in a following table. The system has also been called "South Railroad Lowline Alternative."

Breaching of the Southern Pacific Railroad Causeway:

The Southern Pacific Railroad Causeway is a fill or causeway across the Great Salt Lake from the east side of Bear River Bay to Promontory Point to Lakeside as shown in a following figure. The causeway is part of Southern Pacific Transportation Company's (SPTC) line from Ogden to San Francisco. It was originally completed in 1904 with a fill from the east side of Bear River Bay to a point 2.5 miles west of Promontory Point, a trestle for the next 13 miles and a fill (Rambo Fill) for the remaining 5.1 miles. In 1959 the 13-mile trestle was replaced with a fill making the entire length of the SPTC Railroad Causeway across the Great Salt Lake a continuous fill. Two 15-foot wide culverts were placed in the new fill as shown in the figure.

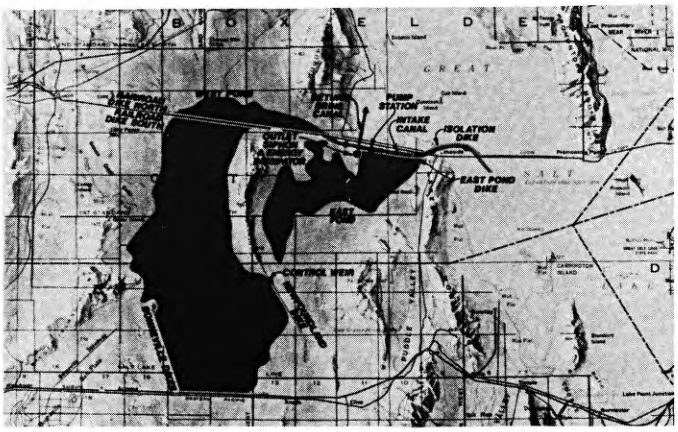
Ever since it was first observed that the construction of the new causeway was creating a water surface elevation (head) difference between the north and south arms and was concentrating the brine in the north arm there have been various efforts to add more culverts to the causeway to reduce or remove its effect on the head difference and on salinity.

In the mid 1970's when the Great Salt Lake was rising at a rate of approximately one foot per year, the issue of breaching the causeway as a flood control measure began to receive a great deal of attention. This attention continued until the 1977 drought dampened interest. The heavy rains in September 1982 and the continued high precipitation throughout the 1982-1983 water year caused the lake to rise from its September 1982 low of 4199.8 feet to 4205.0 feet in July 1983. This record rise (5.2 feet) of the lake again intensified efforts to breach the causeway and relieve flooding around the south arm of the lake as much as possible.

The causeway was breached on August 1, 1984 with an initial head difference of three feet. The initial flow rate through the causeway was 13,500 cfs which has since diminished (May, 1985) to 3,000 - 5,000 cfs, depending upon weather. Since the breach, there has been a net drop in the south arm lake elevation of 1.2 feet. Not all of the drop in lake level is attributable to the breach; about 0.2 - 0.4 foot of the drop is attributable to evaporation. Therefore, with the breach, the south arm is now about 1.0 foot lower than it would have been without the breach.

Great Salt Lake Diking:

In addition to West Desert pumping, the diking of critical facilities to an elevation of 4212 feet is of current interest to the state legislature. The Division of Water Resources contracted with Montgomery Engineers to determine what dike segments would be most beneficial in protecting public health and safety. Approximately half of the $110 million in potential Great Salt Lake mitigation funding to be considered by the State legislature would be for diking, with an additional $5 million for annual maintenance and operation of the dikes. The various diking options are still being considered.



Major elements of the Great Salt Lake west desert pumping plan. (Utah Div. Water Resources, photo)

Recommendation From The Great Salt Lake Conference On Problems Of and Prospects For Predicting Great Salt Lake Levels

Results of the Great Salt Lake Conference on Problems of and Prospects for Predicting Great Salt Lake Levels:

On March 26-28, 1985, a Great Salt Lake Conference was conducted in Salt Lake City to determine what is known about recent Great Salt Lake levels and predictability on future levels. Experts on Great Basin climatology, hydrology, and geology presented their research in the hope of arriving at conclusions regarding the future of the lake. A summary of their recommendations is contained in this section.

A special session of the Great Salt Lake Conference was set aside at the end to determine the need for future studies and, in particular, to define the "planning" level for the Great Salt Lake. Five alternatives for the planning level had been discussed in previous sessions. These levels (all given in feet) were: a level below 4212, 4212, 4217-4218 (the threshold level), 4222, and a level above 4222. A "planning level" is the level above which the participants would not expect the lake to rise during the foreseeable lifetime of Salt Lake City. The "planning level" does not imply that the lake will rise to that level, simply that the possibility that it could rise to that level is significant enough that decision-makers should factor it into their planning process. Much consideration was given to each level. Most participants believed 4217-4218 feet is a "rational number to work with." Judith McKenzie (Florida State University) indicated that her data show that during the past 500 years this level has been reached perhaps as many as five times and certainly a couple of times. Many of the specific research topics suggested that further research would directly contribute to the better understanding of the 4217-4218 foot threshold and its consequences to society.

Although concensus has been reached on the "planning level" of the Great Salt Lake, there was obvious concern about the certainty with which past lake levels had been picked. Several recommendations resulted from this conference which would greatly enhance the understanding of frequency and duration of lake levels in the recent past.

Recommendations Resulting From the Great Salt Lake Conference:

1. Conduct socio-economic studies to determine the consequences to society of different levels of the Great Salt Lake.

2. Cores should be taken in the deeper areas of the West Desert Basin and analyzed geochemically and by sedimentological means to ascertain the frequency with which the West Desert has been occupied by water. Participants felt that geochemical examination of the core could distinguish times when the West Desert Basin and Great Salt Lake Basin were united as a single lake.

3. Sediments in the boggy areas along the edge of the playa lake could be analyzed for changes in organic constituents due to flooding of the West Desert.

4. Additional core could be taken in the Great Salt Lake Basin and analyzed for its geochemistry. Some of this work has already been done and has been a successful way to note changes in water level as reflected by salinity and carbonate deposition.

5. Further delineations of shorelines, particularly the lower most shorelines, and the application of archeological findings to these shorelines has given some indication of flooded conditions in the past and appear to be a productive way to further delineate levels of the lake in the past 5000 years. Unlike geochemical analyses of cores, these studies provide information about the actual dates of flooding.

6. One of the most obviously needed pieces of information is the actual threshold level and detailed information concerning the basin morphology. The basin's geometry changes considerably at intervals between the levels of 4215 and 4225 feet and this will effect evaporation. This is an important piece of information when determining the potential for the lake to stabilize as precipitation and evaporation reach equilibrium. Most participants at the conference were surprised at the difficulty in determining the volume of the lake and correlating the volume of water with the lake level. Understanding the topography of the region would greatly assist in these volume calculations but it is also necessary to further consider rebound effects. All participants agreed that a detailed geodetic survey is a very high priority.

7. Virtually all participants agreed that tree ring research is one area for further study. No tree ring studies have been done in the Great Basin to correlate climate with the level of the Great Salt Lake. Tree ring studies done outside the Great Basin area have been more reliable in documenting dry periods than wet periods. It was suggested that trees known to be good indicators of wetter periods located in the Great Basin itself be selected for tree ring studies.

8. The short-term consequences of structural hazard mitigation that have been suggested should be further defined. The potential for catastrophic failure due to a malfunction of a dike or the probability of liquefaction from even a moderate earthquake should be considered.

9. Certain economic thresholds might be defined for policymakers as well as lake thresholds in order to better define the consequences of lake levels.

10. It was also suggested that the levels of other lakes in the Great Basin area be examined to see whether a pattern exists in the regional rise and fall of lakes. Some participants cautioned that these studies could lead to false correlations and it was urged that the physical factors controlling these levels be identified and compared, as well as the history of the levels of these lakes.

406 Plan Recommendations: For The Great Salt Lake

Utah CEM endorses those recommendations cited above from the results of the Great Salt Lake Conference. The recommendations listed below have resulted from separate lines of inquiry, but tend to support those from the conference.

1. Designate a "Beneficial Development Area" (BDA) around the lakeshore up to an elevation of 4217 feet, based on the near recent highstand of 4217 feet (based on archeology). Within this "BDA," encourage maximum prudent development of the lakeshore area while avoiding the astronomical expense from flooding. In addition to the recommendations for the "BDA" discussed earlier in this section, do the following:

2. Conduct studies on unanswered questions relating to flood hazard mitigation. Many of the Great Salt Lake Conference on Problems of and Prospects for Predicting Great Salt Lake Levels participants expressed the need for specific as well more general types of information. The State's Legislative Committee for Energy and Natural Resources also requested specific and general types of information at their April 17, 1985 meeting.

3. Investigate and stimulate the State's interests in recreational, tourism, and green belt development around the shores of the lake as part of the State's plan for developing the lakeshore areas.

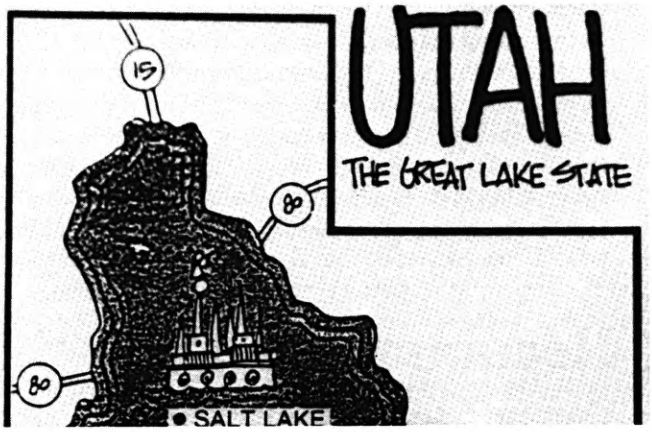
4. Examine geologic and archeologic evidence that could be collected to better understand the last 100 to 5000 years using shoreline information, geochemical information from cores, and volume calculations.

5. Obtain better information on climatic factors such as tree ring studies and continued development of models.

6. Study the impact of extreme weather, ice jams, and earthquakes on earthen dikes planned for the Great Salt Lake.

7. Investigate the possibility of utilizing portable pumps in the West Desert Pumping Plan. Such pumps would have been valuable during the Thistle Lake Disaster, and may be valuable in other situations within, and outside the State.

8. Investigate the effects on transportation routes and the impact on the associated need for transportation of the various materials passing through Utah.



Cover from FEMA Interagency Hazard Mitigation Report on 1983 disasters.

9. Investigate known climate patterns existing in the Rocky Mountain Region as they relate to lake levels.

10. Investigate what climate scenario would have to exist to cause the lake to rise to the various marker elevations, including 4217 feet. For example, how much rainfall and/or snowfall would be needed over various time intervals to cause the lake to rise to these levels.

11. Look for relict vegetation, even dead trees, that indicate wet climatic cycles that occurred prior to man's weather record keeping in the Great Basin.

12. Install real-time monitoring gages that transmit stream flow data via satellite. Real time data is valuable, once you can get it.

Recommendations: Summary (High Priority)

SYNOPSIS: The section contains a summary list of recommendations obtained through interviews and questionnaires this year. Information on background, time frames, lead agencies, activity, and cost is contained in the following section.

Recommendation: Designate a Beneficial Development Area (BDA) around the Great Salt Lake shoreline up to an elevation of 4217 feet, a level that has been reached as recently as the 1600s.

Recommendation: After state disaster declarations for counties, require those counties accepting state disaster funds to prepare and implement a hazard mitigation plan for their jurisdiction. Future state disaster funding for those counties may depend on their implementation of their hazard mitigation plan. The local governments should enter into an agreement with the Governor prior to being given disaster funds indicating that they will implement this plan.

Recommendation: A State Executive Order shall be passed indicating that each state agency shall avoid the siting of state facilities, or facilities funded in whole or in part by state monies, and the administration of any grant or loan programs, for the construction of any facility in a documented hazardous area, including a 100 year floodplain (as delineated on Federal Emergency Management Agency Maps or other "best available" data), landslide or debris flow runout area, dam failure inundation zone, or within the potential zone of deformation near an active fault. If the state has no alternative but to build in a hazardous area, then the building should be made as structurally sound as possible to minimize damage should a disaster occur.

Recommendation: Construct a hardened State Emergency Operations Center in close proximity to the Governor's Office to function as a communications and coordinating center during any disaster.

Recommendation: Develop a State Hazard Mitigation Manual that describes:

a. Natural hazards, including terminology.
b. Mitigation techniques for each kinds of hazard.
c. Typical costs for the various mitigation techniques.
d. Identification of hazards and signs of problems.
e. How to coordinate efforts in mitigating hazards. This handbook, once written, would be distributed widely in the state among persons working with hazard mitigation. It would serve as a text book for instruction of these people and ultimately establish a degree of uniformity in mitigation capabilities.

Recommendations: Summary (General Grouping)

Flood Mitigation:

Great Salt Lake: See section on Great Salt Lake Hazard Mitigation.

River Channel and Bank Maintenance:

Recommendation: Local governments need to maintain at least minimal hazard mitigation responsibilities and

provide funding for these activities: dredging, river bank and channel cleaning, and river bank maintenance.

Recommendation: Where different jurisdictions maintain different sections of a problem drainage, a close working relationship needs to be established between these jurisdictions by having preflood (late winter - early springtime) planning sessions.

Debris Basin and Outflow Works Construction and Maintenance:

Recommendation: State Hazard Mitigation Officer should coordinate between the USGS, UGMS, and county geologists and other city and county officials to keep local policy makers informed on what is being learned about debris flow potential for the many canyons. In so doing, the local governments can better plan for debris flows.

Warning Systems:

Recommendation: A selected committee from the city and/or county should meet with the State Engineer, The National Weather Service and The Bureau of Reclamation to determine what type of warning system could be established for a potential dam failure. Continue to plan for warning systems in landslides, especially ones associated with possible debris flows.

Flood Control Projects:

Recommendation: Local governments should establish committes of residents, water users, and other volunteers to walk flood-prone rivers beds and then make suggestions to county commissioners on flood control projects.

Recommendation: Consideration should be given to a flood control water retention basin in a naturally designed area along the Jordan River near 90th South.

Recommendation: An inventory of critical emergency facilities located in flood plains should be made. Flood mitigation projects should be implemented to protect these facilities. Planning and construction should be carried out at the local government level, but the state could share in the expense and/or manpower depending upon who owns the facilities.

Ground Water Mitigation:

Recommendation: Increase and strengthen laws, ordinances, and regulations prohibiting and controlling development on watersheds.

Recommendation: Cities and counties should store and maintain adequate pumping equipment to assist property owners with basement flooding during emergencies resulting from ground water.

Avalanche Hazards:

Recommendation: Local and state governments that share in such hazards should plan for increased avalanche protection through structural means and through warning systems. Research on earthquake-induced avalanche scenarios should be funded jointly by local and state government agencies.

Fire Hazards:

Recommendation: Downed timber from heavy snows can be sold by the state and federal forest services to commercial and individual firewood users. Construct roads to harvest the wood; these can be used as fire breaks.

Earthquake Mitigation

Recommendation: A structural analysis of emergency facilities buildings should be undertaken to determine which facilities are the weakest and in need of more repair/maintenance. A persistent seismic retrofit program needs to move foreward for these critical emergency services facilities.

Recommendation: The state needs to be concerned about how to keep funding for basic research after the three-year funding from the U.S. Geological Survey's Earthquake Hazards Reduction Program along the Wasatch Front is completed.

Recommendation: The State should pursue a seismic retrofit program for state-owned facilities; local governments should do the same for buildings they own.

Hazardous Weather Mitigation:

Recommendation: In dealing with populace, have contingency plans for emergency food, shelter and transportation.

Planning:

Recommendation: The State Office of Education should emphasize the development and implementation of school district emergency plans. Each school district should be contacted in writing about the Attorney General's interpretation of the law in the protection of students from a disaster. Each school district should respond to a questionnaire addressing the kinds of plans in place and how these plans are relayed on to the students under their care.

Training and Education Mitigation

Recommendation: Establish a natural hazard identification training program for state and county personnel who normally work in the field so that they can function as

hazard spotters at somewhat of a technical level. This training could be conducted as seminars or by video tapes prepared and distributed for this purpose. Provide Police Officer Standards and Training time for participants. Such training could be provided to news media helicopter pilots who are often in the air and typically become concerned with natural hazards. Other CEM training programs could get POST approval, such as earthquake impact training.

Recommendation: In areas where hazards present an apparent danger to people, those people should be made aware of evacuation procedures. These procedures should be published and distributed. These plans should include warning information and relocation points. Training of evacuation procedures needs to be carried out, either as table top exercises with these people, or as actual land exercises.

Recommendation: Develop video tapes on Utah natural hazards and provide these tapes to television stations for broadcast to viewers living in areas where these hazards exist. Each tape can cover hazards existing within a particular area, and the broadcast can be directed to those people.

Recommendation: Provide radio "public service announcements" to advise the public on whom to call should they desire information on studies on natural hazards where they live.

Recommendation: Establish Natural Hazard Information Centers in each county office. These information centers would contain information on natural hazards within the county; e.g, hazard studies and hazard maps. The county geologist could also act as an information source.

Recommendation: Train future home owners, such as high school and college students, about natural hazards in areas of the state where they are most likely to reside.

Recommendation: Train certain county employees in disaster damage assessment, to be called upon when regular county damage assessors are unable to meet reporting schedules due to work overload. Persons, such as the county assessor, some county highway department personnel, and certain others would relate well to such an assignment.

Recommendation: Develop up-to-date audio-visual presentations of aspects of hazard mitigation for state and local EOC staffs to show to interested groups as an educational medium.

Recommendation: Produce a video tape of the damage from the past two years disasters.

Recommendation: During periods of natural disasters, hold a weekly status meeting for all interested parties to

Mitigation Legislation:

Local Ordinances for Disclosure of Natural Hazards:

Recommendation: Work with cities and counties in keep all informed on current activities. An informal atmosphere will stimulate ideas for mitigation.

Recommendation: Between periods of disasters, hold periodic hazard mitigation meetings for all interested parties to continue gathering hazard mitigation ideas for the state and to report on the implementation process of previous recommendations. These meetings should consider past disasters so that we do not lose sight of our susceptibility to such disasters and the need to continue planning for them.

Recommendation: Local governments should publish information on local natural hazards and disaster preparedness in their local telephone directory.

Organization:

Recommendation: City governments and farmers should enter into agreements for the purchasing of flood easements along diversion and irrigation canals.

Recommendation: An engineering geologist should be assigned to the State Division of Facilities Construction and Management for the purpose of building site inspections for state buildings and other state financed buildings. A budget figure of about $50,000 will need to be allotted to Facilities Construction and Management or to the UGMS for this geologist.

Studies:

Disaster Documentation:

Recommendation: Because the state is becoming acquainted with the extremes of climate-related disasters (drought to wet cycles), studies should be done to document in some detail the characteristics of the disasters that have resulted from these extremes. Summaries of these studies should be furnished to state legislators for documentation of the characteristics of these extremes; this will better enable legislators to make decisions related to Utah's climate and related disasters.

Recommendation: Conduct a study on the locations of federal and state buildings located in flood plains.

Recommendation: A study should be done on the positive impact of such response in the variety of kinds of major disasters that face Utah from year to year. Because of the way the LDS Church is organized, practically on a neighborhood basis, their role in evacuation assistance and temporary relocation might also be studied.

designing and implementing natural hazard disclosure ordinances.

State Immunity From Legal Actions Resulting From Effects of Natural Disasters on People:

Recommendation: To assure that state and local government officials involved in hazard mitigation remain aware of pertinent litigation and legal philosophies on immunity from natural hazard litigation, the Utah Attorney General and Utah CEM should maintain communication with authorities monitoring such events and situations and relay important information on to appropriate agencies within the state.

Recommendation: A study should be done on the realities of the state's liability as a result of natural hazard disclosure to potential home buyers. HUD/FHA already requires developers to have studies done on natural hazards prior to approving development, and they appear to have no undue liability for doing this.

Funding:

Establishment of a Permanent Disaster Relief Fund:

Recommendation: A permanent state disaster relief fund should be established that will also fund mitigation activities at various levels of government. Preventive measures could be funded on a priority basis; mitigation of disaster damage could also be funded. State purchased bonds might be a way of obtaining the moneys. Moneys could be loaned at low interest. Repayment would keep the fund viable and increasing. Funding would be based on a prioritizing procedure.

Establish a Method for Prioritizing Hazard Mitigation Needs for Funding:

Recommendation: Establish a more effective method of prioritizing hazards for funding so that existing funds can be used more effectively.

Procedures:

Recommendation: Request that emergency/disaster coordinators in the various government agencies prepare and maintain a journal that documents a chronology of disaster/emergency involvement. Also, request that they prepare and maintain a file of photographs documenting disasters/ emergencies within their area of involvement.

Recommendation: Air and ground video tape documentation of disasters will play a key role in hazard mitigation planning. Tapes should be made demonstrating the intensity of the natural process involved and the impact of the disaster. Tapes should be made of the resulting mitigation activities.

Communications and Distribution of Information:

Recommendation: Require dam owners to supply two-way radios to dam tenders, especially those manning high hazard dams. These radios should be capable of communicating with local law enforcement and local EOC communications centers.

Recommendation: Consideration should be given to obtaining closed circuit video transmission capability from disaster scenes to the Governor's Office, Utah CEM, UDOT Headquarters, and other agencies working with hazards. Visual observation plays a key role in making decisions during disasters. Copies of such video tapes can be used in the hazard mitigation planning process, both as regarding structural and nonstructural approaches to mitigation.

Coordination Between Local Government and Private Sector:

Recommendation: State and local government agencies should coordinate with private utility companies regarding their hazard mitigation and emergency preparedness plans.

Technological Hazards

Equipment:

Recommendation: For hazardous waste materials/toxic chemical spills, response vans containing equipment necessary to deal with such emergencies should be obtained and positioned around the state to assure prompt response in mitigating the situation.

Energy Interruption Mitigation:

Recommendation: Conduct an Intermountain Energy Systems Conference through the U.S. Department of Energy and Utah CEM as an educational medium to teach state and federal officials and other interested parties in the functioning of the intermountain energy supply system.

Recommendation: Prepare an intermountain energy interruptions response plan to deal with potential energy shortages in the intermountain area due to earthquakes, sabotage, or other causes.

Hazardous Material Spills:

Recommendation: The Department of Public Safety is to determine if there is a need to lower the required wind velocity at which the freeway is closed to high profile vehicles. If so, then appropriate action should be taken.

Recommendations: Detailed (High Priority)

High Priority

Background: After a Presidentially Declared Disaster, FEMA requires the state involved to prepare a State Hazard Mitigation Plan, outlining existing hazard mitigation measures and recommendations to improve the state's hazard mitigation capabilities. Then, it becomes necessary for the state to implement the recommendations contained in the plan in order to qualify for future federal disaster funding. Such a policy could be carried out between the state and local governments, where the state would require local governments to prepare hazard mitigation plans after state, or federally declared disasters. For local governments to receive future disaster funds from the state, the local governments would have to demonstrate their intent in implementing the recommendations from their plans.

Recommendation: After state disaster declarations for counties, require those counties accepting state disaster funds to prepare and implement a hazard mitigation plan for their jurisdiction. Future state disaster funding for those counties may depend on their implementation of their hazard mitigation plan. The local governments should enter into an agreement with the Governor prior to being given disaster funds indicating that they will implement this plan.

Time Frame: Ongoing.

Lead Agency:

CEM

Activity:

Short Term: Communicate the details of this recommendation to the Governor's Office, and ask for an Executive Order specifying the new requirements for receiving State Disaster funds and the nature of State-Local Government required prior to receiving state disaster funds.

Long Term: Maintain this policy within the State, refining it as experience dictates.

Cost:

None

Background: Hazard mitigation efforts over the past few years have created a growing awareness that state government buildings sometimes are constructed in hazardous areas. Scientific studies conducted within the state over the past several years are illustrating the nature and locations of these hazards in most counties. Even though science cannot predict that natural hazards may indeed create a problem within a particular time frame of a few years, still science has documented the physical processes involved and that such hazards typically do create damage and injury when they do become active. With an abundance of scientific expertise on such hazards within, and available to, state government, it should become a matter of course that state building sites receive natural hazard investigation before construction is approved.

Recommendation: A State Executive Order shall be passed indicating that each state agency shall avoid the siting of state facilities, or facilities funded in whole or in part by state monies, and the administration of any grant or loan programs, for the construction of any facility in a 100 year floodplain as delineated on Federal Emergency Management Agency Maps or other "best available" data. If the state has no alternative but to build in a hazardous area, then the building should be made as structurally sound as possible to minimize damage should a disaster occur.

Time Frame: One year.

Lead Agency:

UGMS/CEM/Facilities Construction and Management

Activity:

Short Term: Conduct a meeting involving the heads of state agencies to discuss their interests in building their facilities in safe environments. If a consensus exists, or even a partial concensus, work from that position toward obtaining an executive order requiring that state buildings not be constructed on sites with identified natural hazards. An engineering geologist should be hired by the UGMS or Facilities Construction and Management to provide building site inspections. If state buildings must be built in hazardous areas, they should be constructed so as to minimize damage and injury that might result from the existing hazard.

Long Term: The state should have the objective of ultimately owning no buildings existing on sites with

known natural hazards that might damage the structure or injure its inhabitants.

Cost:

Primary cost would be the salary and overhead for the Engineering Geologist, estimated at $50,000 per year.

Background: Although Utah has the potential for several kinds of major disasters requiring sophisticated coordination of disaster activities, the State has not approved construction of a hardened facility located close to the Governor's Office. The Federal Emergency Management Agency approved supplemental funds to assist with constructing a hardened Utah Emergency Operations Center. Their concerns are that Utah could not adequately coordinate a response effort during a major disaster. FEMA also indicates that the Utah facility is one of the least adequate in the entire United States, even though Utah has one of the highest potentials for major disasters. Utah's current EOC, located in the basaement of the National Guard Facility on Sunnyside Avenue would not survive a major earthquake.

Hazard mitigation and disaster recovery has progressed into an era of sophistication that has little bearing on old concepts of "Civil Defense". The Utah Division of Comprehensive Emergency Management is involved with a broad spectrum of natural hazards and technological hazards, including hazardous materials spills and energy shortage scenarios involving complex energy systems. The organization has the capability of communicating with the world during disasters, while at the same time is plugged deeply into each state agency that works with hazards and disasters.

Recommendation: Construct a hardened State Emergency Operations Center in close proximity to the Governor's Office to function as a communications and coordinating center during major disasters.

Time Frame: Three years.

Lead Agency:

CEM Facilities Construction and Management

Activity:

Short Term: The initial documents requesting the State EOC facility have already passed through appropriate channels, and now require approval for funding. The directors of state agencies involved in hazard mitigation and disaster recovery should express their concern that Utah does not have a coordinating center for disasters, even though our surrounding states do. The legislature should be approached again by CEM, Facilities Construction and Management, and by the Governor to approve funds for construction of the facility.

Long Term: Utilize the State Emergency Operations Center in conjunction with all local, state, and federal agencies involved in hazard mitigation and disaster recovery, as needed. Train these staffs in the utilization of the facility.

Cost:

$4 million

Background: Although natural hazards have had much attention during the past few years in Utah, government personnel at all levels have lacked uniformity in understanding hazards and techniques in mitigating these hazards. This general lack of expertise among government employees sometimes makes communication difficult and, perhaps, causes some important figures to shy away from dealing with hazard mitigation. A basic educational hazard mitigation manual would serve as an excellent means to help government employees understand how to deal with hazards.

Recommendation: Develop a State Hazard Mitigation Manual that describes:

a. Natural hazards, including terminology.

b. Mitigation techniques for each kinds of hazard.

c. Typical costs for the various mitigation techniques.

d. Identification of hazards and signs of problems.

e. How to coordinate efforts in mitigating hazards.

f. Formation of State Hazard Mitigation Team.

This handbook, once written, would be distributed widely in the state among persons working with hazard mitigation. It would serve as a text book for instruction of these people and ultimately establish a degree of uniformity in mitigation capabilities.

Time Frame: One year.

Lead Agency:

CEM

Activities:

Short Term: Delegate responsibilities for writing the text among members of the CEM Hazard Mitigation Section. Establish an outline and a preliminary table of contents. Set approximate deadlines for chapters. Complete a first draft by September 1985. Complete final draft by June 1986.

Long Term: Set up training schedules for local and state government personnel who deal with hazard mitigation. Continue to use the handbook for training purposes. Update handbook as needed.

Cost:

Other than salary expense, the anticipated expense could be as high as $25,000.

Recommendations: Detailed (General Grouping)

Background: Because of the variety of kinds of natural hazards that have always faced the people of Utah, the year-to-year expense of repairing disaster-related damage remains persistent. In many cases, such damage is repetitive. Likely, future disaster damage will continue to mount. Much of Utah's susceptibility to disasters comes from its variety in topographic provinces and fault hazards. Because Utah contains such a variety of disaster-susceptible areas consideration needs to be given to preventing passive hazards from becoming active.

Recommendation: The counties and cities should take an active part in performing preventive hazard mitigation on high priority hazards. Each year a budget item should be passed by local governments to mitigate at least some of these hazards before they cause disasters. The UGMS should identify and prioritize these hazards for the counties, cities, and state. The UGMS should also be a lead agency in devising nonstructural approaches to preventive hazard mitigation.

Time Frame: Ongoing.

Lead Agency:

City and County EOCs
CEM
UGMS

Activity:

Short-Term: Conduct a Wasatch Front Intercounty Natural Hazards Workshop conducted by CEM and UGMS to discuss the high-priority natural hazards in the separate counties. Discuss ideas on hazard mitigation techniques and estimated costs for preventive mitigation. Write up a summary of the determinations and relay this summary to the county commissioners and city officials. Request a response on a commitment to perform preventive hazard mitigation on these items. The same can be done for other counties of the state.

Long Term: Cities and counties should gear planning and development so that preventive hazard mitigation needs diminish. Communication and activity on natural hazards within local government jurisdictions should be a routine activity. Local governments should conduct their own preventive hazard mitigation workshops, inviting UGMS and CEM; counties can utilize their county geologists to arrange the agenda.

Cost:

Preventive hazard mitigation should cost ten percent of the previous year's disaster expense for each city and county. The cost of workshops is negligible.

Flood Mitigation:

Great Salt Lake: See section on Great Salt Lake Hazard Mitigation.

River Channel and Bank Maintenance:

Background: During wet years, the same rivers typically create flood problems. Flood problems, in many cases, can be mitigated by dredging and river bank and channel cleaning. These routine activities can protect populated, industrial and agricultural areas to a great extent. Yet, difficulties sometimes arise for the local governments to adequately fund these basic mitigation needs. The repetitive nature of flooding along many of these rivers and the associated expense should be a reminder of the need to maintain river channels.

Recommendation: Local governments need to maintain at least minimal hazard mitigation responsibilities and provide funding for these activities: dredging, river bank and channel cleaning, and river bank maintenance.

Time Frame: Ongoing.

Lead Agency:

City and County Governments
Water Resources

Activities:

Short Term: The Water Resources Manager should prepare a study on a county by county basis indicating the recent history of river channel maintenance and flooding. The report should be passed on to the county commissioners requesting that ample consideration be given to basic hazard mitigation needs, such as river channel maintenance.

Long Term: The counties should establish policies on basic hazard mitigation responsibilities and how these policies should be carried out; funding basic hazard mitigation needs should be a permanent aspect of local government budgets.

Cost: Expense of river channel maintenance will depend on the county.

Background: Problem drainages are often owned by various government agencies. Thus when flooding begins, upstream controls, or considerations may involve different work staffs and different flood control philosophies or approaches. The immediate needs for coordination may be awkward if previous coordinated planning has not taken place.

Recommendation: Where different jurisdictions maintain different sections of a problem drainage, a close working relationship needs to be established between these jurisdictions by having preflood (late winter - early springtime) planning sessions.

Time Frame: Ongoing.

Lead Agency:

CEM

Activities:

Short Term: Comprehensive Emergency Management should contact appropriate officials in the various jurisdictions and encourage them to hold preflood planning meetings. If necessary, CEM may plan and conduct these meetings.

Long Term: Such planning meetings should become yearly events.

Cost: None

Debris Basin and Outflow Works Construction and Maintenance:

Background: A 1983 study by the U.S. Geological Survey (Wieczorek, *et al.*) indicates which canyons have the potential for debris flows and debris floods along the Wasatch Front from Salt Lake City to Willard, Utah. Debris basins are being built at the mouths of some of these canyons, as well as farther north and south of the study area. However, many canyons do not have debris basins implemented nor planned. The presence of alluvial fans at the mouths of many of these canyons suggests a history of flooding and debris flow activity.

Recommendation: The State Hazard Mitigation Officer should coordinate with USGS, UGMS, county geologists and other city and county officials to keep local policymakers informed on what is being learned about debris flow potential for the many canyons. In so doing, the local governments can better plan for debris flows.

Time Frame: Ongoing

Lead Agency:

CEM

Activity:

Short Term: The State Hazard Mitigation Officer should contact USGS and UGMS to see what information is available on debris flow potential. Contact county emergency directors to see what information they have and help them to upgrade their library. Make county commissioners aware of the existence of the library. Have the UGMS write a letter to each county that is prone to have debris flows informing them of their additional debris flow potential.

Long Term: Local officials will become familiar with area canyons and debris flow potential and maintain a interest in mitigating debris flows through building debris basins and funding the maintenance of these basins.

Cost:

None

Warning Systems:

Background: Although a few landslide warning systems have been installed, much still remains to be done. A general lack of knowledge on warning systems could be overcome by a concerted public education effort. A conference held at CEM in 1984 presented information on various kinds of systems. As a follow-uo to that conference, perhaps other pathways could be followed to continue some momentum. There are numerous hazardous settings in Utah where warning systems are needed. These include high-hazard dams and other landslides.

Recommendation: A selected committee from the city and/or county should meet with the State Engineer, the National Weather Service and the Bureau of Reclamation to determine what type of warning system could be established for a potential dam failure. Continue to plan for warning systems in landslides, especially ones associated with possible debris flows.

Time Frame: Ongoing

Lead Agency:

State Engineer
City and County officials

Activity:

Short Term: Conduct a second conference on warning systems where specific examples of needs and suited warning systems can be discussed.

Long Term: Follow up on results from conference, working with groups that need to find funding warning systems. Work especially to get warning systems installed in dams threatening people.

Flood Control Projects:

Background: It appears difficult for communities to get adequate information to local government policy makers regarding flood control projects, yet local inhabitants are most familiar with the needs for flood control.

Recommendation: Local governments should establish committees of residents, water users, and other volunteers to walk flood-prone rivers beds and then make suggestions to county commissioners on flood control projects.

Time Frame: Ongoing

Lead Agency:

City and county EOCs
Water Resources
CEM

Activity:

Short Term: CEM State Hazard Mitigation Officer should contact city and county EOC directors and urge them to create flood control project committees.

Long Term: State Floodplain Manager should follow up periodically to see if progress is being made. A follow up check should be made before and after runoff each spring.

Cost:

None

Background: In some cases, floodplains in Utah contain critical emergency facilities, such as hospitals, police stations, sheriffs offices, fire stations, ambulance stations, etc. Because it is unlikely that these facilities will be moved, they should be protected by appropriate flood control measures.

Recommendation: An inventory of critical emergency facilities located in floodplains should be maintained. Flood control projects should be implemented to protect these facilities. Planning and construction should be carried out at the local government level, but the state should share in the expense and/or manpower depending upon who owns the facilities.

Time Frame: Ongoing

Lead Agency:

City and County EOCs
CEM

Activity:

Short Term: The State CEM should take initial steps to contact city and county EOC Directors to discuss procedures. CEM should work jointly with local government flood control personnel in making the inventory and evaluating local/state responsibilities. Once responsibility has been established, local and state engineering offices can be contacted about proceeding to obtain government approval.

Long Term: The State CEM should proceed in evaluating the state's floodplains, until all situations of critical facilities in floodplains have been evaluated and adequate flood control measures have been implemented. At the same time, CEM should work with the State Office of Facilities Construction and Management in restricting the development of state buildings in floodplains, and encourage local governments to do the same.

Cost:

Expense will depend upon nature of the construction. Cost of studies for all counties: $50,000.

Ground Water Mitigation

Background: Some communities, even counties, are dependent on mountain springs for culinary water, but watershed developers are threatening the purity of the water. Looking to the future, Utah will likely develop considerably in mountain areas with pollution into mountain drainages increasing. Such pollution will begin to have greater effects on people living at lower altitudes.

Recommendation: Increase and strengthen laws, ordinances, and regulations prohibiting and controlling development on watersheds.

Time Frame: Two years

Lead Agency:

CEM
City and County water pollution control agencies

Activity:

Short Term: State Hazard Mitigation Officer will contact water pollution control agencies in each county to determine what laws, regulations, and ordinances exist in each county regulating the development of watersheds. Inbalances in restrictions among the counties will be evaluated. Counties that have been most successful in protecting watersheds will be studied to see what means they have used. Their approaches will be used as models. Other counties will be urged to follow suit. County commissions will be urged to implement ordinances designed to protect their water sources. Communication pathways to state and federal agencies that allow development on watersheds will be established. Attempts will be made to establish cooperative agreements with them to protect watersheds.

Long Term: Positive approaches to protecting downstream population centers will be sought across the state, especially where culinary water pollution is involved. Laws, regulations, and ordinances will be put into place to protect culinary water springs from future pollution.

Cost:

None

Background: During the past three years, abnormally high seasonal precipitation has caused groundwater tables to rise to near record heights. The array of kinds of disaster damage within the state included basement flooding. In fact, in some communities this was the main damage. Some counties acquired pumps that were loaned to homeowners, and this facilitated mitigating the problem.

Recommendation: Cities and counties should store and maintain adequate pumping equipment to assist communities with basement flooding during emergencies resulting from ground water.

Time Frame: Ongoing

Lead Agency:

City and county Engineering Offices
CEM

Activity:

Short Term: State Hazard Mitigation Officer will make initial contact with city and county engineering offices to determine their jurisdictions susceptibilty to ground water problems in homes. Jurisdictions with abnormally high susceptibility will be encouraged to obtain appropriate pumps that can be used during ground water emergencies.

Long Term: Local governments should maintain these pumps on an ongoing basis to be used whenever ground water problems reach a level where the community in general is being affected.

Cost:

Will depend on size of community.

Avalanche Hazards:

Background: More people have been killed in Utah from avalanche hazards than from any other kind of hazard. In fact, the largest single disaster in terms of life lost was caused by an avalanche in Bingham Canyon. Earthquake-induced avalanches could kill thousands during a single earthquake on a ski weekend. Basic research needs to be done to understand release mechanisms, identify areas prone to sliding (especially in areas with new housing developments, such as Salt Lake County and Park City), and to research other topics such as mountain weather patterns. Mitigation will need to include planning to eliminate construction in such hazardous sites, and perhaps structural responses to stabilize snow in starting zones (fences, reforestation, etc.). Defense structures along roads may be required if mountain use grows quickly (olympics). The Utah Department of Transportation, U.S. Forest Service, and ski resorts all have hazard warning systems, but they could use better data to be able to quantify their forecasts.

Recommendation: Local and state governments should plan for increased avalanche protection through structural means and warning systems. Research on earthquake-induced avalanche scenarios should be funded jointly by local and state government agencies.

Time Frame: Five years

Lead Agency:

Activity:

Short Term: The State Hazard Mitigation Officer will obtain a list of persons capable of carrying research that would pertain to Utah's avalanche hazards, especially such avalanches as might result from a major earthquake, and seek funding for such research. Finally, he will route research proposals to appropriate state agencies for possible funding. Proposals should deal with protecting large numbers of people from earthquake-induced avalanches.

Long Term: State-of-the-art structural defenses and warning systems will be developed and installed at critical places to protect large numbers of people from earthquake-induced avalanches.

Cost: Depends on proposal budgets.

Fire Hazards:

Background: In mountain areas the saturated, heavier snow loads, and winds combine to knock down more timber than usual. Downed timber litters the forest floor and helps spread fires faster. Wet years also cause heavier ground cover which later dries creating a heavier than usual dry ground cover. During the summer, these areas become fire hazards with a higher than normal potential for spreading fires. The heavier vegetation and downed timbers cross fire breaks, enhancing the chance of fires spreading. These areas constitute heavy fuel areas.

Recommendation: Downed timber from heavy snows can be sold by the state and federal forest services to com-

mercial and individual firewood users. Construct roads to harvest the wood; these can be used as fire breaks.

Time Frame: Should begin immediately

Lead Agency:

Division of State Lands and Forestry

Activity:

Short Term: The Division of State Lands and Forestry should work with the U.S. Forest Service in setting up an accelerated timber sale program for fallen timber from the last two winters. Access roads to harvest the timber need to be built.

Long Term: Procedures are available in the U.S. Forest Service and State Lands and Forestry whereby unusual amounts of fallen timber can be disposed of through sales.

Cost:

Clearing roads: Use the money earned from timber sales and a special budget item of $200,000.

Earthquake Mitigation:

Background: In California, earthquakes have rendered a surprisingly large number of emergency facilities useless, thereby greatly reducing the response capability. State and local governments need to decide what value they place on their response capabilities following a major earthquake. Within Utah there is a concensus among emergency/disaster workers that their emergency facility typically would not withstand the effects of a major earthquake.

Recommendation: A structural analysis of emergency facilities should be undertaken to determine which facilities are the weakest and in need of repair/maintenance. A persistent seismic retrofit program needs to be implemented for these critical emergency services facilities.

Time Frame: Ongoing

Lead Agency:

State Facilities and Construction Management

Activity:

Short Term: Cities and counties need to rank their critical emergency facilities buildings as to structural soundness during seismic events. An aggressive program needs to be designed and implemented to strengthen these facilities. Ordinances and local building codes need to require that future emergency facilities will be constructed for strength. The State's CEM Hazard Mitigation Program will contact key people in cities and counties regarding the ranking of their emergency facilities and what steps they will take to strengthen them.

Long Term: Local governments will maintain all emergency facilities to an acceptable degree of seismic soundness so that these facilities will withstand a major earthquake.

Cost:

Undetermined

Background: In recognition of the threat of catastrophic losses of life and property posed by the earthquake hazard in the United States, the Earthquake Hazards Reduction Act of 1977 (Public Law 95-124) and the 1980 amendments to that Act (Public Law 96-472) mandated that a National Earthquake Hazards Reduction Program (NEHRP) be established and maintained. In citing its reasons for enacting that legislation, Congress found and declared the following:

All 50 states are vulnerable to the hazards of earthquakes and at least 44 of them are subject to major or moderate seismic risk. . . A large portion of the population of the United States lives in areas vulnerable to earthquake hazards. Earthquakes have caused, and can cause in the future, enormous loss of life, injury, destruction of property, and economic and social disruption.

With respect to future earthquakes, such loss, destruction, and disruption can be substantially reduced through the development and implementation of earthquake hazards reduction measures, including (a) improved design and construction methods and practices, (b) landslide controls and redevelopment, (c) prediction techniques and early warning systems, (d) coordinated emergency preparedness plans, and (e) public education and involvement programs. The lead agency for the NEHRP is the Federal Emergency Management Agency. They have provided funding to Utah CEM to carry out the Utah Multi-Hazards Study currently taking place in Weber County. It is also funding a three year study on earthquake hazards along the Wasatch Front.

Recommendation: The state needs to continue funding after the three-year funding from the U.S. Geological Survey's Earthquake Hazards Reduction Program along the Wasatch Front is completed.

Time Frame: Ongoing

Lead Agency:

UGMS and CEM

Activity:

Short Term: A committee composed of CEM Hazard Mitigation Staff members, UGMS geologists, and univer-

sity geologists involved in seismic studies should meet to discuss a strategy for continued funding. Proposed projects should be discussed and future directions decided on.

Long Term: The future directions decided on should be pursued by this same committee. Meetings of this committee should take place each six months, or as needed, to maintain momentum.

Cost:

None

Background: The major cause of death in earthquakes is debris falling on people. In Salt Lake city alone, the U.S. Geological Survey estimates that a minimum of 2,000 deaths would result in an earthquake of about 7.0 richter magnitude. In some cases, as much as 90 percent of hospital beds would be destroyed. Most of the damage would result form buildings failing because they were not built to withstand major earthquakes. Utah, along the Wasatch Front, is an earthquake prone state. During a 30 month period as many as 2000 earthquakes are recorded. The major earthquake in central Idaho is a reminder to Utah of its susceptibility; Idaho's geology in the earthquake area, is much the same as the Wasatch Front geology.

Recommendation: The State should pursue a seismic retrofit program for state-owned facilities; local governments should do the same for buildings they own.

Time Frame: Ongoing.

Lead Agency:

UGMS and CEM

Activity:

Short Term: Techniques learned in the Utah Multi Hazards Project should be implemented statewide in identifying the numbers of buildings of varying seismic strength and approches to seismic retrofit programs for communities. Utah CEM and the UGMS should maintain close contact with Wasatch Front communities, conducting workshops and conferences to upgrade understanding of the problem and solutions. During 1986, a Seismic Structural Standards Conference should be held in Salt Lake City to begin this program.

Long Term: State and local governments should adopt laws and ordinances requiring new buildings to meet UBC Seismic Codes. Emergency facilities should be retrofit. The State and local government buildings should be retrofit on a continuing basis. UGMS and CEM should continue to develop the interest of state and local governments in this matter through ongoing contact and urging them to conduct their own workshops, conferences, and studies.

Cost:

Undetermined

Hazardous Weather Mitigation:

Background: Utah is subject to extreme weather, and the extremes have been felt from time to time. Should the combined effects of various aspects of extreme weather be experienced at one time a serious enough problem might result that would require moving people to a central location. For example, an extreme winter cold period with power outages and closed roads could result in food shortages and the need to move people to central facilities. Local governments are not fully capable of fealing with this problem.

Recommendation: In dealing with populace, have contingency plans for emergency food, shelter and transportation.

Time Frame: Ongoing

Lead Agencies:

Local EOCs/Utah CEM

Activity:

Short Term: Local Emergency Management Directors will be contacted by the State Hazard Mitigation Officer on their capabilities to deal with relocating people during hazardous weather. Ideas on how to deal with the problem will be accumulated and evaluated for feasibility. This information will be synthesized and distributed to the EOC Directors prior to formulating a plan. EOC Directors will be urged to obtain equipment to monitor National Weather Service broadcasts on a 24-hour basis, and have two-way communication with the NWS.

Long Term: Local government EOCs will maintain a capability to deal with such problems, as circumstances require.

Cost:

Undetermined

Planning:

Background: A survey was taken by CEM to determine which school districts have developed emergency plans. Some districts apparently still need to develop these plans and train students in their use. The Attorney General's Office has issued an opinion on the schools' responsibility to have these plans and maintain a level of preparedness in the event of a disaster. There is a strong element of

liability if this is not done. The State Board of Education has required that each school district establish policies and procedures for the care of students in emergency situations.

Recommendation: The State Office of Education should emphasize the development and implementation of school district emergency plans. Each school district should be contacted in writing about the Attorney General's interpretation of the law in the protection of students from a disaster. Each school district should respond to a questionnaire addressing the kinds of plans in place and how these plans are relayed on to the students under their care.

Time Frame: One year

Lead Agency:

Office of Education

Activity:

Short Term: The State HMO will contact the State School Board and review with them the letters from the Attorney General on the matter of school district responsibilities in disaster preparedness. A questionnaire will be developed between the HMO and the school board. This questionnaire will be mailed to the school districts. The questionnaire responses will be evaluated to see how the system might be improved. The results will be relayed back to the school districts with instructions that they should conduct at least two drills during the school year on their emergency plans, including additional suggestions from the questionnaire.

Long Term: School districts should be required to provide a report to Utah CEM and the Utah School Board on their yearly activities using their emergency plans. This procedure should be pursued each year.

Cost:

Undetermined

Training and Education Mitigation

Background: The professional staffs in both local and state government that have the responsibility to identify and mitigate natural hazards are relatively small in comparision to the areas they cover and it is difficult to cover all of the hazardous areas of the state. Yet hazards develop, somewhat unpredictably, in a wide variety of areas.

Recommendation: Establish a natural hazard identification training program for state and county personnel who normally work in the field so that they can function as hazard spotters at a somewhat technical level. This training could be conducted as seminars or by video tapes prepared and distributed for this purpose. Provide Police Officers' Standard Training (POST) time for participants. Such training could be provided to news media helicopter pilots who are often in the air and typically become concerned with natural hazards. Other CEM training programs could get POST approval, such as earthquake impact training.

Time Frame: Ongoing

Lead Agency:

USMS and CEM

Activity:

Short Term: Assemble a collection of 35mm slide presentations and video tape presentations aimed at instructing state and local government field personnel (of all kinds) in hazards identification and reporting procedures. Arrange seminars for these persons. As the Hazard Mitigation Handbook develops, instructional courses can be taught using the handbook as a text. Arrangements should be made with fish and game, highway patrol, parks and recreation, and other field groups for these seminars.

Long Term: Hazards training, identification, mitigation measures, and reporting techniques should somehow be reflected in the job descriptions of many state and local government field personnel. As a routine procedure, they woul dattend seminars to receive training in this aspect of their job. While carrying out their normal job-related duties, they can always watch for evidence of natural hazards.

Cost:

Initial budget of $10,000 to prepare visual training aids.

Background: Around the state there are numerous places where people are living in the path of a hazard. Methods to evacuate these people are typically not well developed with the result that the people are poorly informed as to warning and evacuation procedures.

Recommendation: In areas where hazards present an apparent danger to people, residents should be made aware of evacuation procedures. These procedures should be published and distributed, and include warning information and relocation points. Evacuation exercises need to be conducted.

Time Frame: Ongoing

Lead Agency:

Local governments

Activity:

Short Term: The Utah CEM Permanent Hazards Mitiga-

tion Section should contact local Emergency Management Directors and jointly identify localities where evacuation procedures might need to be implemented in the event of a natural disaster. Local EOC Directors should be urged to prepare and distribute warning and evacuation procedures. Once the publication has been distributed, the local EOC Director should follow up by having an exercise with the people affected.

Long Term: Follow-up should be repeated each year between the State Hazard Mitigation Officer and the local EOC Directors to see that yearly training is provided to people living in hazardous areas that may require evacuation.

Cost:

Undetermined

Background: Most every county in Utah faces some kind of array of natrual hazards. However, the people living in those counties are often not aware of the nature nor details of these hazards. It is difficult to reach so many people through conventional means of having seminars and meetings. To reach so many people for an education program it is important to develop the means to use mass media.

Recommendation: Develop video tapes on Utah's natural hazards and provide these tapes to television stations for broadcast to viewers living in areas where these hazards exist. Each tape can cover hazards existing within a particular area, and the broadcast can be directed to those people.

Time Frame: Ongoing

Lead Agency:

Utah CEM/UGMS
County Geologists' Offices, where established

Activity:

Short Term: A planning meeting should be held with Utah CEM, UGMS, and County Geologists to discuss the kinds of visual materials that should be developed for television. Preparation of these materials and expenses can also be discussed. Video film topics should be selected and details of what the films should show should also be decided on. Films could possibly be prepared in-house, or they could be contracted. A deadline should be set for completing the first film and showing it to a television station first.

Long Term: Several films should be prepared for the various areas of Utah, and these films should be shown on television frequently. These films could be stored at Utah CEM, UGMS, and at the County Geologists' offices where civic groups could borrow them. Television station managers should be worked with so that they understand the importance of educating their viewers on the presence of natural hazards in their area, on the potential impact of natural disasters and on how to prepare for natural disasters.

Cost:

A $20,000 budget should be set aside for the development of the first two or three films. This money should come jointly from local governments, UGMS, Utah CEM and through the County Geologists' Offices.

Background: The public is often not aware of who to contact or call in their area about information on natural hazards in their area. Utilizing public service announcements over the radio would give this information to the public on a regular basis.

Recommendation: Provide radio 'public service announcements' to advise the public on whom to call or contact should they desire natural hazards information.

Time Frame: Ongoing

Lead Agency:

Utah CEM

Activity:

Short Term: The State Hazard Mitigation Officer should contact radio stations for policies and procedures on public service announcements. These messages can be 10 or 30-second spots and may be relatively simple to prepare. These messages should become a common feature on major radio stations.

Long Term: The public service message program should be updated from year to year, and seasonal messages should also be used regarding flood potential, etc.

Cost:

Approximately $500

Background: In the past several years numerous studies, maps, and publications have been done on natural hazards in the various counties of Utah. There has been no central storage place for all this material where the public could examine it. The logical storage place for these materials is in city and county offices where it is the most accessible. Under the NEHRP, county geologists could serve as contacts for information on natural hzards.

Recommendation: Establish Natural Hazard Information Centers in each county office. These information centers would contain information on natural hazards within the

county; e.g., hazard studies and mazard maps. The county geologist could also act as an information source.

Time Frame: Ongoing

Lead Agency:

County Geologists' Offices UGMS/CEM

Activity:

Short Term: Have a meeting of county geologists (where existing) at UGMS to discuss the need for the Natural Hazards Library and a time frame for assembling these libraries. The county geologists should spend part of their work time assembling these libraries and informing the public of their presence.

Long Term: The county geologists should have a small reading room for persons using the library. The county government should consider the Natural Hazards Library as a valuable local resource in planning and development.

Cost:

A budget should be set aside by the counties each year for developing the Natural Hazards Library. Perhaps a grant could be obtained from the USGS and the UGMS to develop these libraries.

$20,000 first year $5,000 each year following

Background: Home buyers are seldom prepared to use natural hazards information when selecting a home. There are numerous examples where this caused the home buyer to make a serious mistake in selecting a home site. This has happened often enough that corrective measures need to be taken. The establishment of Natural Hazards Libraries in city and county offices will be of help. In addition, educational programs need to be arranged through continuing education programs at universities and colleges. Similar programs should be taught to high school seniors. Community sponsored courses could be taught in city community centers, much as financial planning, and other courses are.

Recommendation: Train future home owners (high school and college students) about natural hazards in areas of the state where they are most likely to reside.

Time Frame: Ongoing

Lead Agency:

County Geologists' Offices
County Engineers
UGMS/CEM

Activity:

Short Term: Conduct a State Hazards Education Workshop involving groups currently involved in providing such education. Some County EOC Directors are currently teaching seminars to schools and other groups; the Utah Museum of Natural History is doing the same; perhaps other groups are doing similar training. These groups should be brought together to plan a strategy for upgrading such teaching through a cooperative approach. The best of ideas in such teaching could be assimilated through this workshop. Further workshops could be planned. The cooperative approach to teaching should be tested out during this coming school year.

Long Term: Create a Utah Natural Hazards Educational Committee composed of persons with such teaching responsibilities and state education policy makers. Have natural hazards education implemented into to the state's educational program for high school students. Encourage colleges and universities to include such training in basic requirement courses, such as Introductory Geology.

Cost:

No cost.

Background: When natural disasters happen, county damage assessors often find themselves too busy to both assess plus write the necessary reports.

Recommendation: County employees should be trained in disaster damage assessment in case regular county damage assessors are unable to meet reporting schedules due to work overload. Persons, such as the county assessor, some county highway department personnel, and certain others would relate well to such an assignment. The same result could be obtained by having 'State Reservists' much like is done at FEMA at the federal level. In addition, mutual aid agreements between counties to share damage assessors might also solve the problem.

Time Frame: Ongoing

Lead Agency:

County Emergency Management
Director

Activity:

Short Term: County EOC Director will select appropriate county workers to participate in the training program. With approval of the County Commissioners, these people will be trained and considered to be reservists of the county. These people should be guaranteed overtime when a disaster occurs, but also be willing to commit their time to providing assistance to the EOC Director.

Long Term: County Emergency Management Directors

should meet to design a training brochure for county reservists. As flood seasons approach, review sessions should be conducted using the brochure. This brochure should evolve into a training handbook as experience is acquired in the program.

Cost:

Initially no expense. Ultimately, the cost of the brochure and handbook. Total expense should be less than $2,000.

Background: Local government Emergency Management Directors have little in the way of current audio-visual presentation materials to show to civic and government groups. These materials should be accompanied with a script or sound track. Utah CEM and other agencies that deal with disasters have accumulated numerous 35mm slides and, in some cases, video tape presentations. These materials should be sorted through to see what kinds of presentations might be produced from them.

Recommendation: Develop up-to-date audio-visual presentations of aspects of hazard mitigation for state and local EOC staffs to show to interested groups as an educational medium.

Time Frame: Ongoing

Lead Agency:

CEM

Activity:

Short Term: Have state and local EOC personnel sort through their personal collections of 35mm slides and video tapes, selecting their best illustrations of hazard mitigation. Have a meeting involving these people to discuss the kinds of audio-visual materials that they have in these slected collections. Discuss the kinds of presentations that might be produced from these materials, and decide on specific presentations that should be made from these materials. Decide on how to make the presentations and on a time frame.

Long Term: Each year, conduct an audio-visual presentation planning meeting to decide on educational programs to be developed. Set time frames and means and continue to develop a library of hazard mitigation presentations to be used for educational programs across the state.

Cost: The expense should be divided between the local governments wishing to participate and with the state. Anticipated initial expense $5000.

Background: Video documentation of the damage from the last two years disasters has not been done in a systematic way. Some news channels and government agencies have made vidio tapes on parts of the disasters, perhaps relating to some part of the disaster or some agency's involvement. However, no comprehensive video tape documentation has been produced. If not just for historical value, such a video should be produced. Such a video would also be useful for a future time when disasters of similar magnitude occur. Legislative funding might be enhanced if the effects of past disasters could be shown to decision makers.

Recommendation: Produce a video tape of the damage from the past two years disasters.

Time Frame: One year.

Lead Agency:

CEM

Activity:

Short Term: The State HMO will attempt to locate all video tapes produced by federal, state, and local government agencies and television stations on the past two years disasters, and previous. Permission will be obtained to use segments of these tapes in the comprehensive tape being created. In exchange, each agency or company contributing will obtain a free copy of the comprehensive tape. A narrative will be developed for the comprehensive tape. Likely the expertise to produce this tape will exist within the agencies and companies participating, and perhaps no expense will be involved.

Long Term: Update this comprehensive tape with each year's major disasters. Likely, several tapes will result, and these can be kept in the libraries of the various agencies and companies as a reference item.

Cost:

None, unless produced professionally.

Background: After a disaster has ended, there is a tendency to relax until the next one. This is an excellent time to conduct "Lessons Learned" work shops and to document what was learned during the disaster season and apply it in the future.

Recommendation: Between periods of disasters, hold periodic hazard mitigation meetings for all interested parties to continue gathering hazard mitigation ideas for the state and to report on the implementation process of previous recommendations. These meetings should consider past events so that we do not lose sight of our susceptibility to such disasters and the need to continue future planning.

Time Frame: Ongoing.

Lead Agency:

CEM

Activity:

Short Term: After two years of Presidentially Declared Disasters, a "Lessons Learned Conference" should be held with invited speakers from the main mitigation and recovery agencies, both state and local. The conference should be of professional quality and, perhaps, held at a local hotel. The theme would be "lessons learned" and the information from the talks should be assimilated into a publication. Recommendations that result from the conference should be included in a 406 plan update.

Long Term: Following the experiences of each year's disasters, a "Lessons Learned Conference" should be held to assimilate the information and recommendations.

Cost:

Conference expenses: $10,000.

Background: Reaching the general public regarding local hazards and disaster preparedness can be difficult. A successful method used by Davis County is to place a several-page discussion on such things in the local telephone directory.

Recommendation: Local governments should publish information on natural hazards and disaster preparedness in their local telephone directory.

Time Frame: Two years.

Lead Agency:

Local Emergency Management Directors
CEM

Activity:

Short Term: A meeting will be organized by the Hazard Mitigation Officer involving the local Emergency Management Directors to discuss the kinds of disaster-related information that should be included in a telephone directory. The directors will contact their local telephone company offices to obtain a cost estimate. Local governments should fund their own entries in the telephone directories.

Long Term: Other types of publications that reach the general public should be studied for the possibility of including such materials in them. It is likely that over the years we will find several types of publications that can be used to reach the general public.

Cost:

Davis County's expense was about $16,000.

Organization:

Background: When the flooding of a city or town is anticipated it may be decided to direct excess water through diversion canals flooding adjacent farmlands. The cost of damage would be less to farmlands than to cities. Agreements between the cities and farmers involved should be arranged whereby flood easements in these farmlands along diversion canals are purchased by the cities. When farmlands are flooded intentionally to protect the city, the farmers financial losses are covered through the cost of the flood easements.

Recommendation: City governments and farmers should enter into agreements for the purchasing of flood easements along diversion and irrigation canals.

Time Frame: Ongoing

Lead Agency:

UDA

Activity:

Short Term: The UDA Disaster Coordinator should work with the Division of Water Resources to determine the policies on flooding farmlands versus flooding cities. Examples of such repetitive flooding should be considered for the flood easement program. High priority situations (repetitive flooding) should be investigated first and contact should be made between UDA, county agriculture officials, and city officials to determine how to establish flood easements. Agreements can be put into place between the agricultural and city interests.

Long Term: Continue to establish flood easement agreements in all situations of selective repetitive flooding.

Cost:

Surveying of flood easement lines.
Cost could be substantial.

Background: Facilities Construction and Management frequently asks the UGMS for building site inspections for planned state buildings. The workload is such that a full-time engineering geologist could be employed by the state for this purpose. This geologist could have an office at either Facilities Construction and Management or at UGMS.

Recommendation: An engineering geologist should be assigned to the State Division of Facilities Construction and Management for the purpose of building site inspections for state buildings and other state financed buildings. A budget figure of about $50,000 will need to

be allotted to Facilities Construction and Management or to the UGMS for this geologist.

Time Frame: One year.

Lead Agency:

UGMS and Facilities Construction and Management jointly.

Activity:

Short Term: UGMS/Facilities Construction and Management will request a budget increase for the salary of the Building Site Geologist. Advertising should commence for an engineering geologist.

Long Term: State will require geologic building site inspections for all new state construction. An engineering geologist with the responsibility of inspecting all state building sites will be a permanent addition to the State organization.

Cost:

$50,000 per year.

Studies:

Disaster Documentation:

Background: The extreme variations in Utah weather and climate have been witnessed over the past 135 years. Disasters have been caused by extreme dry and wet cycles. Scientists have documented these extremes from numerous directions, but it appears that no comprehensive assimilation of these data have resulted for the documented extremes. If such a compendium existed, the details of Utah's extreme climate variations could serve as a reference handbook in evaluating each year's weather features. For comparative purposes, this compendium would be valuable to the government agencies that work with natural hazards and disasters.

Recommendation: Because the state is becoming acquainted with the extremes of climate-related disasters (drought to wet cycles), studies should be conducted to document in some detail the characteristics of the disasters that have resulted from these extremes. Summaries of these studies should be furnished to state legislators for documentation of the characteristics of these extremes; this will better enable legislators to make decisions related to Utah's climate and related disasters.

Time Frame: Two years.

Lead Agency:

State Climatologist

Activity:

Short Term: The State Climatologist's Office should seek funds to contract with a selected consultant for a study on the details of the extremes of Utah's climate and weather. This study should last not more than two years and be published by the state. A meeting should be organized between the following groups to determine what this study should include: State Climatologist, National Weather Service, CEM, UGMS, Water Resources, Lands and Forestry, and others.

Long Term: This study should be updated with each newly recorded extreme in Utah's climate.

Cost:

$20,000

Background: Although specific examples of critical emergency facilities sited in hazardous areas are known, an inventory of such occurrences has not been done statewide. Such an inventory would help assess the magnitude of the problem in responding to a disaster, such as a major earthquake. This inventory would help the local governments become aware of the need to avoid construction of critical facilities, and other facilities, in hazardous areas.

Recommendation: Prepare a study on the locations of existing critical emergency facilities, including hospitals, fire stations, ambulance services, police departments, etc., located in hazardous areas.

Time Frame: Two years.

Lead Agency:

Local Government EOCs, coordinated through CEM.

Activity:

Short Term: A letter should be sent to local EOC Directors requesting them to provide a list of emergency facilities located in hazardous areas. Known situations should be passed onto the EOC directors in the letter. Details of the kinds of facilities and the kinds of hazard associated with that facility should be indicated. Maps should be provided to CEM on these occurrences. The information obtained from the local EOC Directors should be synthesized into a county-by-county report that can be distributed and used as needed. Preventive hazard mitigation will be considered for each facility.

Long Term: A systematic effort should be made to reduce the numbers of critical emergency facilities located in hazardous areas. Those of high priority, as indicated by the study, will be considered first. For example, a hospital located in a flood plain would be a high priority.

Cost:

Initial inventory: no cost

Background: Over the years, the lack of understanding of natural hazards in the state has made possible the construction of federal, state, and local government buildings in hazardous areas. In recent years, numerous studies have been done to report and map these natural hazards. It is possible now to show the spatial relationship of these hazards and the locations of government buildings. An inventory of government buildings located in hazardous areas would allow for a systematic program to begin the process of minimizing such occurrences.

Recommendation: Conduct a study on the locations of State and local buildings located in floodplains.

Time Frame: Two years

Lead Agency:

Local governments coordinated by CEM.

Activity:

Short Term: This study should parallel the one described above for critical emergency facilities located in hazardous areas, the activities should be the same.

Long Term: Same as for critical emergency facilities in hazardous areas described in the previous recommendation.

Cost:

None for the inventory

Background: Although considerable emergency response and recovery volunteer effort was supplied by the LDS and other churches in 1984, the most impressive was in 1983 when as much as 1,270,000 hours of donated labor was documented. Such examples of this magnitude of volunteer work is rather rare across the country. Because this volunteer resource does exist, it forms a significant part of Utah's response capability. This capability has not been documented officially, therefore, the impact of such a response capability on a variety of kinds of major disasters would not be fully understood.

Recommendation: A study should be done on the positive impact of such response from voluntary relief agencies, such as the LDS and other churches, in the variety of kinds of major disasters that face Utah from year to year.

Time Frame: One year.

Lead Agency:

CEM

Activity:

Short Term: CEM should obtain funding to finance a grant that would be awarded to a selected hazard research consultant for study on the potential positive impact of church volunteer response to disasters in Utah. CEM should meet with state and local agencies involved in hazard mitigation to determine what the study should address and what the objectives might be. CEM would supervise the progress of the research.

Long Term: The state and local governments will be kept aware of anticipated response capabilities of such large groups of people in the various kinds of disasters that face the state.

Cost:

$10,000

Mitigation Legislation:

Local Ordinances for Disclosure of Natural Hazards:

Background: Examples of litigation in the United States suggest that home buyers need to be informed of the presence of natural hazards. Local governments have the capability to inform the public of studies and locations of natural hazards. Both the state and local governments have the responsibility to consider the well being of citizens, and the concept of "buyer beware" and "acts of god" are finding less legal acceptability. To protect local and state governments from liability, efforts need to be taken to implement disclosure laws and ordinances. Some counties and cities are considering doing this. With the hiring of county geologists, currently in progress, local capabilities of disclosure will increase. The UGMS and CEM is capable of carrying out responsible disclosure tasks. Typically these tasks would involve making the public aware of studies that have been done, and then letting home buyers decide for themselves. Many home buyers are now realizing the financial drawbacks of not having been informed.

Recommendation: Work with cities and counties in designing and implementing natural hazard disclosure ordinances.

Time Frame: Ongoing

Lead Agency:

Local Governments in coordination with UGMS and CEM.

Activity:

Short Term: County Geologists (where existing) should work with their commissioners and city officials in setting up a natural hazards library for the public. Or-

dinances should be set into place requiring that home buyers be informed of studies on natural hazards that may involve property that they are interested in purchasing. These studies will be kept in the natural hazards library in the County Geologist's Office. For each home purchase, a statement of natural hazards should be seen and signed by the potential purchaser of the property.

Long Term: Have each county develop their natural hazards disclosure ordinance, making the county geologist a key figure in making the public aware of studies available on local natural hazards.

Cost:

None

State Immunity From Legal Actions Resulting From Effects of Natural Disasters on People:

Background: Each year several examples of litigation against government agencies take place in the United States. The Federal Emergency Management Agency monitors this litigation and is becoming convinced that government immunity from litigation resulting from damage and injury caused by natural hazards may be eroding. Conferences on this liability issue are being held fairly frequently to keep government workers abreast of the developments. The state and local governments need to be kept informed on this rapidly evolving issue.

Recommendation: To assure that state and local government officials involved in hazard mitigation remain aware of pertinent litigation and legal philosophies on immunity from natural hazard litigation, Utah CEM should maintain communications with authorities monitoring such events and situations and relay important information on to appropriate agencies within the state.

Time Frame: Ongoing

Lead Agency:

CEM

Activity:

Short Term: The Hazard Mitigation Officer should maintain contact with the offices of legal authorities on natural hazard litigation. Information obtained from direct consultation or from conferences should be passed on to appropriate persons in the State Attorney General's Office and other interested parties. The Attorney General's Office should remain abreast of the events and provide authoritative analyses of the state of legalities regarding natural hazard liabilities.

Long Term: The state of Utah should take an active lead in developing laws that reflect the issue of liability and natural hazards. Sound legal judgments, based on events in other parts of the country, should be geared at protecting the people of the state of Utah from undue hardship caused by natural hazards.

Cost:

$2000 per year for CEM Hazard Mitigation Officer to attend and participate in conferences on legal issues related to natural hazards.

Background: If the concept of state immunity from litigation as it relates to natural hazards is being challenged in other states, a state study should be done to evaluate the legal realities of state immunity from such suits. Much information is available on legal activities relative to natural hazards in the United States. An evaluation of this information should form the basis for the state's study. As a matter of course, the study should include the realities of state's liability incurred from disclosure. At some point, as the legal philosophy of state's liability continues to change, it might be that disclosure is to the state's best interest for immunity.

Recommendation: A study should be done on the realities of the state's liability as a result of natural hazard disclosure to potential home buyers. HUD/FHA already requires developers to have studies done on natural hazards prior to approving development, and they appear to have no undue liability for doing this.

Time Frame: Two years

Lead Agency:

Attorney General's Office

Activity:

Short Term: The Attorney General's Office should establish an opinion of state's liability and immunity as it relates to natural hazards, based on the manner that this issue is evolving in other states.

Long Term: Because the liability/immunity issue relating to natural hazards appears to be a dynamic one, the Attorney General's Office should monitor related events in other states on an ongoing basis. Each year the AG's office should provide an update on their initial legal opinion.

Cost:

None

Funding:

Establishment of a Permanent Disaster Relief Fund:

Background: The prevention of disasters resulting from natural hazards could save Utah millions of dollars; preventive hazard mitigation is cost effective. A main problem in pursuing preventive measures is the lack of funding. While it is difficult to see the savings derived from applying preventive measures, still it is logical that such measures could only prevent damage to property and protect people. Prevention is a healthy concept and it needs to be given much thought. It is analogous to defensive driving, preventive health care, and fire prevention - much money is spent annually on these concepts.

Funds from this revolving fund could also be used for ongoing recovery from disasters. The concept of a revolving disaster relief fund was widely recommended through state and local government.

Recommendation: A permanent state disaster relief fund should be established that will also fund mitigation activities at various levels of government. Preventive measures could be funded on a priority basis; mitigation of disaster damage could also be funded. State purchased bonds might be a way of obtaining the moneys. Moneys could be loaned at low interest. Repayment would keep the fund viable and increasing. Funding would be based on a prioritizing procedure.

Time Frame: Ongoing

Lead Agency:

State Disaster Relief Board
CEM

Activity:

Short Term: The legislature should be approached on the positive aspects of a self-perpetuating, interest-bearing, permanent disaster relief fund and requested to establish such a fund as part of the state DRB. Adequate seed money should be supplied to initiate the fund. Part of the interest earned by the fund can be used for preventive measures that are not repaid. It would help if the state division heads voiced their support as part of the lobbying process.

Long Term: As the fund becomes larger over the years, the state will be able to mitigate hazards at a more rapid rate.

Cost:

Funded to estimated annual need.

Establish A Method For Prioritizing Hazard Mitigation Needs For Funding:

Background: When the hazard mitigation funds described are created, then decisions must be made as to how to use those funds. Because Utah has too many hazards to mitigate at any one time, a numerical prioritizing procedure should be established, perhaps the Integrated Emergency Management System. Those hazards threatening life would receive the highest numerical score, with other criteria following. Hazards ranked as highest priority would receive funding first.

Recommendation: Establish a more effective method of prioritizing hazards for funding so that existing funds can be used more effectively.

Time Frame: One year

Lead Agency:

CEM with DRB

Activity:

Short Term: Meet with division heads from state and local governments who deal with hazard mitigation. Discuss possible criteria for ranking of hazards and develop a ranking procedure. Consider the IEMS method as one alternative.

Long Term: Meet annually with the division heads who helped devise the ranking system to see how it should be updated.

Cost:

None

Procedures:

Background: To facilitate communication on activities in the various state and local government agencies, the agency disaster coordinator or county Emergency Management Director should maintain a written and photographic journal documenting natural hazard-related activities under his/her jurisdiction. Without this action, much information goes unrecorded that can be useful later when writing reports or developing plans. This is certainly the case in preparing a state hazard mitigation plan such as this one. These journals should contain information on dates and activities and expenses incurred by the agency in dealing with natural hazards. Photographs, preferably black and white prints, should be kept in the journal with negatives filed and retrievable.

Recommendation: Request that emergency/disaster coordinators in the various government agencies prepare and maintain a journal that documents a chronology of disaster/emergency involvement. Also, request that they prepare and maintain a file of photographs documenting disasters/emergencies within their area of involvement.

Time Frame: Ongoing

Lead Agency:

CEM

Activity:

Short Term: The CEM Director will write a letter directed to all other agency directors and local government EOC Directors requesting that adequate journals be maintained.

Long Term: Use the hazards activities journals as a resource when data from particular time periods are needed.

Cost:

Negligible

Background: The design of hazard mitigation preventive measures, especially where repetitive damage has occurred, can be facilitated through viewing video tapes of the disaster as it occurred. The nature of previous flooding at a particular site can be studied through video, as can any particular problem hazard being considered for preventive measures.

Recommendation: Air and ground video tape documentation of disasters will play a key role in hazard mitigation planning. Tapes should be made demonstrating the intensity of the natural process involved and the impact of the disaster. Tapes should be made of the resulting mitigation activities.

Time Frame: Begin immediately

Lead Agency:

Each agency (local or state) involved with mitigation should obtain and use a video camera for this purpose.

Activity:

Short Term: Each agency (local and state) involved with mitigation should obtain a video camera. Instructions on the use of a video camera in the field will be provided by Utah CEM. Each agency should have their disaster coordinator document disasters as they occur, and they should begin now by documenting old damage and examples of mitigation. A library of video tapes should be kept on file by each agency. The county geologists should use video cameras to document hazards in his/her county, and this can become part of the County Natural Hazards Library.

Long Term: A library of such tapes should be preserved. Copies of tapes should be stored separately from the originals.

Cost:

About $2000 per state and county agency involved.

Communications And Distribution of Information:

Background: Dam tenders frequently do not have access to two-way radios and must rely on land lines if a dam failure were to happen.

Recommendation: Require dam owners to supply two-way radios to dam tenders, especially those manning high hazard dams. These radios should be capable of communicating with local law enforcement and local EOC communications centers.

Time Frame: Begin immediately

Lead Agency:

Local governments

Activity:

Short Term: City and County governments should require that dam safety inspections include the examination of a functioning two-way radio in the possession of the dam tender at all high hazard dams. This radio must be capable of making contact with local EOC radios and the local law enforcement office.

Long Term: All dam tenders be required by the city and county governments to maintain such a two-way radio.

Cost:

$500 per radio

Background: Today's technology makes it possible for the state (or local) EOCs and the Governor's Office to see live closed circuit television viewing of disaster scenes. During a major disaster, such viewing could be critical to the decision-making process in responding to the disaster. Central viewing at critical emergency services facilities, such as fire stations and sheriffs' offices could make their decision making easier also, especially if television coverage were done from the air.

Recommendation: Consideration should be given to obtaining video transmission capability from disaster scenes to the Governor's Office, Utah CEM, UDOT Headquarters, and other agencies working with hazards. Visual observation plays a key role in making decisions during disasters. Copies of such video tapes can be used in the hazard mitigation planning process, both as regarding structural and nonstructural approaches to mitigation.

Time Frame: Three years

Lead Agency:

CEM

Activity:

Short Term: The Hazard Mitigation Officer should study

the feasibility of live coverage of disaster scenes through visits with local television stations. Equipment and manpower costs and training will be considered. A workshop will be conducted involving state and local government division heads and a representative from the Governor's Office to discuss the pros and cons of this capability. If a concensus arises in favor of the system, the Department of Public Safety could pursue obtaining the equipment and training.

Long Term: Use the System as needed. Have training exercises for operating the system.

Cost:

To be investigated

Background: Helicopters from television stations typically cover disaster situations; sometimes they are the first on the scene; often they may fly over potential disaster scenes while other pilots are doing the same thing.

Recommendation: A workshop will be conducted for such pilots, Utah CEM, and National Guard helicopter pilots, etc., on the radio communications capabilities in the helicopters and other aircraft involved so that all pilots understand how to communicate with each other. This may help avoid accidents.

Time Frame: One year

Lead Agency:

CEM/National Guard

Activity:

Short Term: Hazard Mitigation Officer will conduct a workshop on air to air communications capabilities of television and National Guard aircraft, including helicopters. The purpose of the workshop will be to enhance safety for aircraft flying near disaster scenes.

Long Term: Hold a yearly workshop for new pilots, or for review.

Cost:

None

Coordination Between Local Government And Private Sector:

Background: Disasters can seriously affect our way of life by damaging lifelines such as, natural gas, electrical supply, culinary water, sewage treatment, and telephone communication. It is essential that utilities be included in state and local hazard mitigation and disaster preparedness planning. The state and local governments need to understand the plans developed by utilities, and they about governments.

Recommendation: State and local government agencies should coordinate with private utility companies regarding their hazard mitigation and emergency preparedness plans.

Time Frame: Ongoing

Lead Agency:

Local Emergency Management Directors
CEM

Activity:

Short Term: Local Emergency Management Directors need to be made aware of this recommendation and be encouraged to plan meetings with utility company personnel to compare plans.

Long Term: Establish a working relationship with private utility companies in hazard mitigation and emergency planning.

Cost:
None

Technological Hazards

Equipment:

Background: County Emergency Directors frequently express concern about the potential of hazardous materials spills from trucks and freight trains. To date, Utah has not had a catastrophic hazardous material spill, but the potential exists. Having response vans positioned around the state would enhance the response capability. Vans could be developed that contain all of the equipment and materials needed to deal with such a disaster.

Recommendation: For hazardous waste materials/toxic chemical spills, response vans containing equipment necessary to deal with such emergencies should be obtained and positioned around the state to assure prompt response in mitigating the situation.

Time Frame: Three years

Lead Agency:

Department of Public Safety
Department of Health

Activity:

Short Term: CEM should conduct a workshop on response vans used in hazardous materials spills. The details of equipping these vans should be decided and cost estimates obtained. Alternative uses for these vans should

be decided so that they will serve a function much of the time. A meeting should proceed involving CEM and the Commissioner of Public Safety as to how funding might be obtained for these vans.

Long Term: Hazardous Materials Response Vans (HMRV) should be maintained in selected fire stations or highway patrol headquarters with trained staffs. Funding for maintaining these vans should be agreed upon.

Cost:

To be investigated

Energy Interruption Mitigation:

Background: Utah furnishes most all of the petroleum-related energy to both Utah and Idaho. In Utah, the refineries, which all occur together, are located in close proximity to the Wasatch Fault. Crude oil and petroleum products pipelines cross and parallel this and other faults. Main natural gas pipelines pass through Utah on their way to Idaho, Oregon, Washington, and Canada; these too cross major faults that have seismic activity. Much electrical power is generated in Utah, and some of this is dependent upon the Utah coal industry and supply routes. All of these energy sources are interdependent. Scenarios for major energy systems interruptions and resulting energy shortages are plentiful. Few people understand the potential for interruption primarily because few people understand how Utah's energy supply systems function.

Recommendation: Conduct an Intermountain Energy Systems Conference through the U.S. Department of Energy and Utah CEM as an educational medium to teach state and federal officials and other interested parties in the functioning of the intermountain energy supply system.

Time Frame: Already planned for June 27-28, Park City, Utah.

Lead Agency:

Utah CEM/U.S. Department of Energy

Activity:

Short Term: Funding has been obtained for the conference and speakers are being arranged. The conference facility has been reserved and lodging accommodations are being coordinated.

Long Term: With a knowledge of how the intermountain energy supply systems function, government and industrial personnel that would be involved in an energy shortage response will be better able to plan courses of action. Utah CEM will prepare a comprehensive energy interruption response plan.

Cost:

U.S. Department of Energy has funded CEM with over $20,000.

Background: Because few people understand how intermountain energy systems work and interrelate, the possible scenarios of major interruptions in energy flow have not been looked at until recently. With this awareness, it is now possible to develop a comprehensive energy interruption response plan. This requires an understanding of how the intermountain energy systems function, where facilities are located, what can go wrong with them, the impact, and what can be done to mitigate the problem.

Recommendation: Prepare an intermountain energy interruptions response and mitigation plan to deal with potential energy shortages in the intermountain area due to earthquakes, sabotage, or other causes.

Time Frame: Two years

Lead Agency:

Utah CEM

Activity:

Short Term: Continue to document the localities and functioning of the various energy facilities along the main energy lines. Document the kinds of vulnerabilities for these systems. Evaluate the feasible kinds of mitigation that can be done. Identify the response actions that can be taken to the various scenarios for energy interruptions, including natural disasters and man-caused disruptions.

Long Term: Train government energy offices and other pertinent agencies in the procedures for responding to a major energy interruption. Conduct exercises in energy shortage response.

Cost:

Part of the $20,000 indicated in the preceeding recommendation.

Hazardous Materials Spills:

Background: High winds along I-15 frequently cause high profile vehicles to turn over. This is especially a problem in Davis County. If a vehicle transporting hazardous materials were to turn over, the county might need to evacuate people. It appears that consideration should be given to lowering the required wind velocity at which the freeway is closed to high profile vehicles.

Recommendation: The Department of Public Safety is to determine if there is a need to lower the required wind velocity at which the freeway is closed to high profile vehicles. If so, then appropriate action should be taken.

Time Frame: One year

Lead Agency: Department of Public Safety

Activity:

Short Term: The Hazard Mitigation Officer will consult with the Highway Patrol to determine the current freeway closure policies regarding high profile vehicles and, also, regarding the frequency of turnovers of high profile vehicles in the state. The Hazard Mitigation Officer will relay this information on to the various counties that have such turnovers and obtain the counties' opinions regarding the need to lower the wind velocity required to close freeways to high profile vehicles. If there is a concensus, the Hazard Mitigation Officer will organize a meeting for the Highway Patrol and the county officials to discuss the matter formally.

Long Term: Depending upon the outcome of the "short term" activity, the Hazard Mitigation Officer will continue to work with the Highway Patrol and the counties to see that proper safety factors are in force regarding high profile vehicles, especially those carrying hazardous materials.

Cost:

None

Status On Existing Measures Governor's Conference on Geologic Hazards 1983

On August 11-12, 1983, a Governor's Conference on Geologic Hazards was sponsored by the Utah Geological and Mineral Survey in Salt Lake City. As part of this conference, experts in the area of geologic hazards and how geology relates to society outlined 171 action items that the state needed to address.

The following 50 implementation measures were generated by the working groups at the conference. Thirty-two are short term measures and eighteen will require long term implementation. Of the 171 action items recommended by the 36 working groups, these fifty measures will receive first priority. The other items remain under assessment and study for future implementation.

Action on these added measures is already underway in many cases. Although responsible organizations are identified for each implementation measure, the Utah Division of Comprehensive Emergency Management will assume a coordinating and monitoring role to ensure that all measures are fully implemented.

In consultation with Genevieve Atwood, Director of the Utah Geological and Mineral Survey, some changes in time frames and lead agencies are in order. Recommendations containing an asterisk indicate those that are of high priority.

Landslide Safety

Problem:

In the most damaging failures of 1983 were classic debris flows. We have learned a great deal about these failures in the past twenty years but many of the critical studies leading to reduction of damages have not been completed.

* Implementation Measure:

Several studies are proposed which apply to this problem. They are: model studies of flow processes; characterization of susceptible source areas, materials, and deposits; effects of microstructure on the distribution of soil

slips/debris flows; comprehensive instrumentation of a selected watershed to measure pore water pressures, precipitation, runoff, and deformations; and research to establish recurrence intervals for such events.

Lead Agency And Time:

Utah Geological and Mineral Survey (UGMS)
Universities
Five Years

Status: Ongoing

The UGMS is working with the USGS and Utah State University on a $200,000 grant to carry out the major aspects of this recommendation. A workshop is being scheduled by UGMS to decide on a strategy on how to proceed.

Problem:

During the disaster of 1983, much of the concern and damage was associated with failure of reservoirs. One reservoir failed, two others (Gunnison and Huntington) caused great concern, one (Twin Lake in Twelve-mile Canyon) was partially drained to prevent a potential disaster, and several others, including Joe's Valley and two reservoirs in American Fork, were involved in landsliding.

* Implementation Measure:

A reconnaissance investigation of reservoirs should be completed to identify those with potential problems from landslides and other defects. An evaluation of hazards should be made and owners of reservoirs that could fail during a continuation of the present weather cycle should be notified.

Lead Agency And Time:

Division of Water Rights
One Year

Status: Ongoing

This recommendation comes under the normal pattern of operation for the Division of Water Rights. During flooding periods, engineers are assigned to monitor reservoirs and hazards associated with them.

Problem:

The landslide at Thistle demonstrated how vulnerable our commerce is to disruption by landslides. The landslide at Thistle was a reactivation of a large, old landslide that has moved small amounts through much of this century. The reactivation of large, old landslides is related to rising subsurface water levels in response to abnormally high precipitation. A continuation of even normal precipitation will undoubtedly trigger more landslides of the same type.

* Implementation Measure:

In conjunction with land use planners, identify areas which are critical for maintenance of essential transport of energy and commodities. Conduct a reconnaissance of these areas to identify areas of past landsliding and visit particularly critical sites to evaluate the likelihood of reactivation of landslide movements.

Lead Agency And Time:

UGMS
Department of Transportation (DOT)
Two Years

Status: Ongoing

This work is not being done systematically; however, on an informal basis the State Hazards Geologist is monitoring reconnaissance of these areas. Much yet remains to be done.

Problem:

One of the overlooked, but important hazards in the metropolitan areas along the Wasatch Front is the failure of the "benches." These small failures are probably caused by high ground water levels and imprudent construction practices and result in large damage to property.

Implementation Measure:

A basic study of past failures is needed to determine habitat, materials, influence of construction and drainage changes, and intensity of events. From this, an evaluation of where problems are most likely to occur may lead to public acceptance of grading codes and avoidance zoning as mitigation methods.

Lead Agency And Time:

UGMS
One Year

Status: Ongoing

This work is being carried out as part of the ongoing landslide program at the UGMS.

Problem:

Inadequate assessment of debris flow hazards along the Wasatch Front south of Salt Lake City.

Implementation Measure:

Use techniques similar to those in USGS Open File Report No. 83-635 for canyons in Utah and Sanpete Counties to map hazards for 1984 water year; continue evaluation of high hazard areas identified by USGS in 1983; and investigate historical conditions of debris flow incidence in these areas.

Lead Agency And Time:

UGMS
U.S. Geological Survey (USGS)
Five Years

Status: Ongoing

The UGMS is still investigation the methodology used in USGS Open File Report No. 83-635 to see if it is applicable to other canyons.

Seismic Safety

Problem:

Potential earthquake damage to Utah Power and Light, Mountain Fuel, and Mountain Bell has been assessed in Seismic Safety Advisory Council reports. Such utilities have shown varying degrees of capability in mitigating the potential damaging effects of, and in responding to, earthquakes.

Implementation Measure:

The Public Service Commission should undertake a review of the seismic safety practices of regulated utilities and report on their progress in earthquake mitigation and response practices. Guidelines for seismic safety standards may be obtained from recent reports by the Technical Council on Lifeline Earthquake Engineering of the American Society of Civil Engineers.

Lead Agency And Time:

Public Service Commission
One to Five Years

Status: Pending

The Public Service Commission is considering such a review by implementing a proceeding on this topic. To date no action has been taken, however, it is agreed that such proceedings would be valuable.

Problem:

Selection of sites for public buildings is often made without early examination of the geoseismic advantages or disadvantages of the site.

* Implementation Measure:

Geoseismic examinations of potential sites for state buildings, hospitals, schools, or any other public facility should be made early enough in the decision-making process to be incorporated into the choice of a site.

Lead Agency And Time:

Interagency/Department of Health/Hospitals
One to Five Years

Status: Ongoing

Building site examinations is being carried out on a semi-formal basis between the UGMS the Office of Education and the Division of Facilities Construction and Management. The UGMS needs an additional geologist who could be assigned to Facilities Construction and Management for such examinations.

Problem:

Highway structures form very significant elements of our social and economic life, as emphasized by recent disasters.

* Implementation Measure:

The Department of Transportation should implement a seismic safety program for its highway bridge structures, and this program should be reviewed within one year by an advisory panel selected by the Governor.

Lead Agency And Time:

Department of Transportation
One to Five Years

Status: Pending

This program is being studied to determine the cost impact that it might have on bridge construction. Historically, there have been few fatalities caused by seismically induced bridge failures. California has discovered problems in ship-lap joints during earthquakes, however alternative construction techniques are extremely expensive.

Problem:

Public utilities often have no, or limited, seismic standards for their equipment and structures. Nevertheless, their capabilities in an earthquake are very important to effective response.

Implementation Measure:

Seismic safety standards should be legislated for municipally owned electric power utilities so that construction and reconstruction of their facilities conform with typically higher standards used by private, regulated utilities in seismically hazardous regions of the United States.

Lead Agency And Time:

Legislative Analyst
One to Five Years

Status: Pending

An inquiry to the Legislative Analyst's Office suggests that no such legislation has been implemented. The UGMS indicates the same and that the recommendation may not be achievable through legislation.

Problem:

There is need for information relevant to strong ground motion associated with earthquakes in the Utah region. Such information is essential for earthquake-resistant design and construction practices and for seismic risk assessment.

Implementation Measure:

Development within the state of the capacity to conduct research in strong motion estimation, to analyze strong motion data, and to provide information on strong ground shaking to the engineering community.

Lead Agency And Time:

UGMS
USGS
Five Years

Status: Ongoing

Although the UGMS could have monitored a network of strong-motion instruments, they and the University of Utah favored free field placement. Instruments have been placed at free field sites in the Salt Lake Valley. Major progress was made with strong motion array in Salt Lake County and in Ogden area. This has been of high priority for the UGMS.

Problem:

There is a lack of adequate strong motion instrumentation within the State of Utah which is needed for earthquake resistant engineering design.

Implementation Measure:

A state program of strong motion instrumentation should be established to carry out the recommendation of the report of the Seismic Safety Advisory Council. Implementation of such a strong motion program may be achieved, in part, by a requirement for instrumentation in major state construction projects.

Lead Agency And Time:

UGMS
USGS
Two to Five Years

Status: Ongoing

See above

Dam Safety

Problem:

Annual operation and maintenance costs for dam owners. Many owner-operators neglect performing preventive maintenance.

Implementation Measure:

Inform public of ownership of structures. Establish statewide quality criteria. Require annual operation and maintenance budget. Require owner to purchase maintenance bond.

Lead Agency And Time:

Division of Water Rights
One Year Status:

The public has not been informed of the ownership of structures; however statewide quality criteria do exist for high-hazard dams over 50 acre feet. There is some question as to whether the state has statutory authority to carry out much of this recommendation or to be directed to do it.

Problem:

All dams need to be inspected. State law provides that owners could pay for inspection, but the state has always done this for free.

Implementation Measure:

Start a program of owner-financed inspections.

Lead Agency And Time:

Division of Water Rights
One Year

Status: Pending

This concept has been examinated over the years, however, billing procedures are counter productive. Increased filing fees for water rights is one possibility for funding inspections. If a private person requests an inspection, they can be charged for the inspection. The main idea of owner-financed inspections has been disregarded.

Problem:

There is now no insurance requirement for liability incurred by the failure of privately owned dams in Utah.

Implementation Measure:

Propose legislation requiring private dam owners to obtain and maintain adequate liability insurance.

Lead Agency And Time:

Division of Water Rights
One Year

Status: Likely not to happen

Acquiring liability insurance is voluntary and is typically obtained to protect dam owners from accidental drownings and not for dam failures.

Emergency Health Care

If either the Wasatch Fault or the San Andreas Fault should slip in a major quake, 90% of southern California and 90% of Utah health care beds will likely be gone. California wants to airlift casualties to facilities in Phoenix, Salt Lake, Tucson, and Denver. Utah would have to evacuate to other locations.

* Implementation Measure:

Interstate compacts should be developed so health care can be provided and paid for. Model interstate compacts should be drafted for approval by the governor and legislature as needed and legally appropriate. A missing

persons bureau should be established in both states to coordinate notification of next of kin.

Lead Agency And Time:

Department of Health
Division of Comprehensive Emergency Management (CEM
One Year

Status: Pending

Such agreements do not yet exist, however, the State Department of Health is in favor of implementing them and will pursue the matter.

Problem:

We have no central authority to bring scattered portable hospital units together. In a geologic disaster, we have not enough bedding, blankets, and clothing to give out to the people.

* Implementation Measure:

Have one or two central places and one agency to take care of these units. State administration should handle a central unit to warehouse clothing, bedding, generators, etc. The Health Department should take care of taking apart the units and determining what is useful.

Lead Agency And Time:

CEM Department of Health
One Year

Status: Pending

This recommendation is now contained in the Department of Health's Disaster Plan. Currently no such facility exists. Much of the equipment contained in the portable hospital kits is outdated and in poor condition. Repackaging is necessary for some of the kits as some have been cannibalized.

Problem:

Most health care facilities do not have emergency plans if evacuation is required. In 1983 some facilities barricaded the water, but found they couldn't get over sand bags when patients had to be evacuated.

Implementation Measure:

The Department of Health should work with each health facility to prepare emergency plans. How will evacuation occur? Where will patients be moved? How will they be moved? Triage or classification of condition, appropriate response for each condition, contingency plans, remote rescue power, reserve water, food supplies, etc. Work with professional organizations to develop refine, and implement plans. Develop model agreement on payment transfer.

Lead Agency And Time:

CEM
Department of Health
One Year

Status: Pending

The State Department of Health has recommended that this recommendation be followed up on as part of the State 406 Plan. While they have had ongoing discussions with health facilities on this matter, more progress is necessary.

Hazard Mapping

Problem:

Maps identifying mud and debris flow hazards within Utah communities do not currently exist. FEMA, through the National Flood Insurance Program, has identified clear water flood hazard areas for all communities at risk in the state and is beginning an effort to map the hazards associated with mud and debris flow areas. Without this data and the federal requirement to adopt it as a part of a local flood plain management ordinance to maintain eligibility in the NFIP, few Utah communities would adopt mud and debris flow management programs independently. The NFIP is beginning a limited mud and debris flow mapping program. However, it could be several years before a detailed mapping program is complete for the entire Wasatch Front, considering the current program.

* Implementation Measure:

The boundaries of mud and debris flow areas from recent events were well documented and should be adopted by local governments as the basis for mud and debris flow management programs until detailed studies of these areas can be accomplished. Local governments should adopt mud and debris flow ordinances (available from FEMA) for these areas. An added incentive would be to link state funds for recovery to the adoption of these ordinances. The limited FEMA program to add mud and debris flow hazards to flood insurance maps could be accelerated by cost sharing from state and local governments. It is also important to assure that the FEMA effort to map debris flows is continued at the current level. This can be accomplished by advising the FEMA national office and the Utah congressional delegation of its importance and backing it up with state and local funds.

Lead Agency And Time:

UGMS
USGS
Five Years

Status: Ongoing

To date no communities have adopted mud and debris flow ordinances, however, communities in Davis County are obtaining a legal opinion on a model ordinance that could be implemented. No link has been established between requiring such ordinances and the obtaining of state funds. There exists the possibility that this can happen as the legal aspects of this model ordinance are determined.

Problem:

There is a need for detailed mapping and studies of: (1) the Wasatch Fault; (2) other active faults throughout the state; (3) liquefaction potential; (4) engineering properties and 3-D distribution of foundation materials; and (5) site response.

* Implementation Measure:

Establish a state seismic risk assessment program to compile existing studies and systematically obtain additional data to provide seismic risk information at scales and in formats usable by county and local officials. Such a program should focus on items listed above.

Lead Agency And Time:

UGMS
USGS
Three Years

Status: Ongoing

The current Wasatch Front Earthquake Hazards Reduction Program considers this recommendation, and the UGMS is actively involved in carrying out these tasks. By the end of this coming field season the entire Wasatch Fault Zone should be mapped. Ground motion instrumentation and studies are proceeding ahead in the Salt Lake Valley.

Problem:

Accompanying all the data being generated are maps identifying different threats, hazard zones, insurance rates, drainage patterns, lake levels, etc.

* Implementation Measure:

This information should be systematically compiled with consideration given to: (1) adopting a uniform scale creating digitized overlays; (2) compiling a statewide multi-hazard map; (3) encouraging processing of 1981-83 USGS Landsat photo imagery data for producing photo maps of the Wasatch Front; (4) incorporating information generated from authorized NFIP restudies that use methodologies for alluvial fan flooding rather than the more common clear back-water analysis.

Lead Agency And Time:

UGMS
USGS
FEMA
U.S. Forest Service
Five Years

Status: Ongoing

New legislation obtained funding for a three-year program, beginning July 1, 1985, for the UGMS to compile geologic hazards information and a statewide hazards map. This is being actively pursued.

Problem:

When sufficient data and information are available, hazard maps should be developed to identify areas according to low, moderate, or high risks, or some other appropriate basis.

* Implementation Measure:

Statewide hazard maps should be developed for debris

flows and debris floods. This mapping is needed before hazard zoning and disclosure laws can be effectively implemented. As more data becomes available, any such maps would need to be revised and updated.

Lead Agency And Time:

UGMS
Five Years

Status:

Several communities are continuing on their own to obtain local hazards maps; likely, ordinances will be developed in a subsequent stage. As the UGMS obtains additional hazards information, these local maps may require updating.

Problem:

Local planners and building officials need risk maps for hillside ordinances, etc. Yet, Utah Geological and Mineral Survey personnel qualified to do such work are often overburdened with other critical issues.

* Implementation Measure:

The Utah Geological and Mineral Survey should prepare and let contract bids to complete seismic risk mapping within a fixed budget and time.

Lead Agency And Time:

UGMS
USGS
Three Years

Status: Pending

Seismic risk mapping is better done by the communities involved, as is the letting of contract bids. The UGMS will assist communities in hazards evaluations, as needed, and as their resources permit.

Facility Siting and Inspection

Problem:

Many public facilities are not required to obtain a comprehensive geologic hazard review before approval for site and construction. State and local agencies, as well as private hospitals and critical care facilities, need guidance on geologic hazards.

* Implementation Measure:

Require review of all state and critical care facilities by the state geologist prior to funding approval.

Lead Agency And Time:

UGMS
Division of Facilities and Construction and Management
One Year to set up; ongoing program.

Status: Ongoing

Private critical facilities are not required to have hazards evaluations prior to construction. The UGMS works closely with the State Division of Facilities Construction and Management in supplying such evaluations for state buildings. State hospitals and other state critical facilities, therefore, do typically require such inspections on a semi-formal basis. The UGMS has discussed the matter with the Department of Health, and progress is anticipated.

Problem:

Many critical public facilities were built without standards in areas of geologic hazards and are therefore dangerous to the occupants during hazardous events.

Implementation Measure:

Critical public facilities should be inspected and brought up to code, or in some cases condemned or moved.

Lead Agency And Time:

UGMS
Local Authorities
Five Years

Status: Ongoing

While this is an idealistic objective, it is unlikely that legislation could be obtained requiring condemning or moving critical public facilities, except in extreme cases.

Critical facilities such as nursing homes typically operate on a low budget. Therefore, the land they purchase is sometimes of lower value and it may be located in hazardous areas.

Problem:

In some instances geologic data are not being used in school site selection.

Implementation Measure:

The State Office of Education should secure the approval of the USGS before giving final approval to local school districts for construction of school facilities.

Lead Agency And Time:

State Board of Education
One Year

Status: Ongoing

On a semi-formal basis, the State Office of Education has a strong commitment to ask the UGMS to provide school building site inspections for natural hazards.

Problem:

Drinking water facilities are essential to a community but are often located in areas of geologic risk. The Bureau of Public Water Supplies is empowered to review and approve plans for all new drinking water system projects, but evaluation of geologic hazards in not emphasized.

Implementation Measure:

As part of its normal review process for all new spring sources, wells, treatment plants, transmission lines, and finished water storage reservoirs, the Bureau of Public Water Supplies should require an engineering geologist's report to be submitted for review prior to the design of the project. The report would address the geologic hazards of the project site and make recommendations in this regard. Utah's Public Drinking Water Regulations should be appropriately amended.

Lead Agency And Time:

Bureau of Public Water Supplies
Department of Health
One Year

Status: Pending

The State Bureau of Public Water Supplies anticipates making changes in their regulations in late fall and they are considering the implementation of this recommendation.

Problem:

The Bureau of Public Water Supplies reviews and approves all new drinking water system construction. However, they do not review the structural adequacy of design. In the case of reservoirs, which are large and often built in earthquake zones, a structural review would be prudent to minimize risk of failure during an earthquake.

Implementation Measure:

Revise Utah's Public Drinking Water Regulations to require proper structural design of reservoirs. Bring an engineer on staff of Bureau of Public Water Supplies to do structural review.

* Change sections 6.2.3.1c, 6.2.4.1f, 6.2.6.4a2, and 6.2.7d to require that well casings extend at least eighteen inches above maximum probable flood elevation.
* Change sections 6.3.5g to require that a spring be protected by a berm rather than a diversion ditch. Require riprap and gabion where spring area is adjacent to creek bed.
* Revise section 8.1 to require that attention be paid to landslide and other geologic hazards in the siting of treatment plants.
* Revise section 10.1.1 change "25-year frequency" to "maximum probable flood level" when considering level of protection for pumping stations.
* Revise section 11.2, 12.0.5 to require that geologic hazards be considered in placement of reservoirs and distribution piping (currently only advised).
* Add a section to the regulations dealing specifically with transmission lines (i.e. to minimize geologic risk).
* Define section 12.4.6.2 to require a case-by-case evaluation of underwater crossings and recommended suitable protection against flooding.

Lead Agency And Time:

Bureau of Public Water Supplies
One Year

Status: Pending

No action has been taken, however, discussions are anticipated prior to making changes in regulations by late fall.

Problem:

Only a few cities and counties have regulated development in hazardous geologic areas.

Implementation Measure:

The state legislature should require every city and county to adopt a grading, building, subdivision, or other development ordinance that regulates development in hazardous geologic areas.

Lead Agency And Time:

State Legislature Local authorities
One Year

Status: Pending

No known action taken.

Problem:

Some of the state's sewage treatment facilities are being located in areas which are subject to geologic hazards. Several sewage treatment plants (Fillmore City, Murray, Provo, etc.) are located where they have been adversely affected by flooding. the outfall lines of some facilities were located below the rising level of lakes and rivers this spring.

* Implementation Measure:

A geologic hazards evaluation of all public sewage treatment facilities should be required.

Lead Agency And Time:

Department of Health
Two Years

Status: Ongoing

The flood potential for public sewage treatment sites is always considered, however, inspection for other kinds of natural hazards is still being considered. The State Bureau of Water Pollution Control is concerned about the need for such inspections and action is likely to follow.

Problem:

Failure of many septic tank soil absorption fields, chiefly due to high ground water, during this wet year has posed serious health hazards to the people of the state. The present health code, in terms of regulations and enforcement, is inadequate as it relates to siting of septic tanks. Revisions are needed which would include more strict regulation of septic tank placement in areas of high ground water, shallow bedrock, and flood hazard. Chief among these is the need for a greater separation distance between drainfield lines and the water table.

* Implementation Measure:

Adoption of revisions to Part IV of the State Health Code as proposed by the Bureau of Sanitation, requiring a minimum 4-foot separation between drainlines and the water table.

Lead Agency And Time:

Department of Health
One Year

Status: Ongoing

Progress is being made. Originally a one-foot separation was required, however, the State Legislature has now approved a two-foot separation even though a four-foot separation had been requested. There appear to be good reasons for going to the four-foot separation and this may happen in the future.

Education and Information

Problem:

Bankers and other lenders need to be made aware of the importance of considering the presence of geologic hazards as part of their lending policy. They also need to be made aware of the engineering and planning options which can be used to work around a potential hazard situation.

Implementation Measure:

Organize a conference to address these topics.

Lead Agency And Time:

CEM
UGMS
Six Months

Status: Completed

Utah CEM conducted a Business and Industry Conference that covered most of these topics, and a future such conference is being considered. In addition, CEM provided flood and hazard brochures to local banks for public distribution.

Problem:

Public officials, practicing engineers, and emergency preparedness directors need to be made aware of the damages caused by floods and debris flows.

Implementation Measure:

Organize training, to include awareness of the hazards, protective measures, and appropriate response actions.

Lead Agency And Time:

CEM
UGMS
April 12-13, 1984

Status: Ongoing

Utah CEM has conducted two Public Officials Conferences which were open to all agencies.

Problem:

Many industry and business disaster response plans are out of date.

Implementation Measure:

Hold a seminar to address damage assessment, lifelines, and response planning.

Lead Agency And Time:

CEM
UGMS
March 13, 1985

Status: Ongoing

Utah CEM has conducted Business and Industry Seminars covering these kinds of topics. In addition, the CEM Plans and Preparedness Section provides assistance to business and industry in preparing and updating their emergency plans.

Problem:

Local officials need to be informed of how to use schools in an emergency situation.

Implementation Measure:

Reinstate a shelter management training program and make it mandatory for school officials and maintenance workers.

Lead Agency And Time:

CEM
Two Years

Status: Ongoing

It would require legislation to make a shelter management training program mandatory, and this has not been done. The State Division of Social Services has one person to do such training, and this has restricted training primarily to northern Utah. School District Superintendents stress the importance of having some people trained in each school.

Problem:

Many critical facilities would not be able to withstand a disaster and patients would need to be evacuated.

Implementation Measure:

Train staff of medical facilities in the evacuation and care of patients in a disaster.

Lead Agency And Time:

CEM
Department of Health
Two Years

Status: Ongoing

In the licensing of health care facilities, rules and regulations must be followed in this regard. Each facility must have a disaster plan indicating who is in authority to move the injured. Disaster drills occur approximately each six months.

Problem:

Local flood plain managers need more training in NFIP, flood mitigation, and post-recovery activities.

Implementation Measure:

Train local flood plain managers in the goals and objectives of NFIP, flood mitigation, and post-flood recovery.

Lead Agency And Time:

CEM
Six Months

Status: Ongoing

Utah CEM will conduct two seminars in August on flood plain management, one in Saint George and one in Salt Lake City. During the past five years three such conferences have been held.

Problem:

Local planning and zoning commissions do not always consider hazards.

* Implementation Measure:

Hazards should be a normal part of staff reports to planning and zoning commissions. If local staff does not have expertise, UGMS should be consulted.

Lead Agency And Time:

CEM
UGMS
Two Years

Status: Ongoing

This is being done selectively. For example, in Weber County, such reporting occurs as part of the Utah Multihazards Identification Program. Through the Flood Plain Management Program, zoning and planning commissions are also contacted and kept abreast of flood hazards associated with flood plains.

Problem:

Many of Utah's children, youth, and educators are not adequately informed and prepared to cope with various hazardous situations and events which may occur in public facilities, especially schools.

Implementation Measure:

The Board of Education should assume a leadership role in providing emergency preparedness training for Utah's children, youth, and educators. Comprehensive procedures need to be established to cope with each potentially hazardous situation existing in individual schools.

Lead Agency And Time:

CEM
Educational Organizations
One Year

Status: Ongoing

Such training is done on an ad hoc basis. Such programs could be implemented. Other organizations, such as the Utah Museum of Natural History conduct natural hazard educational programs. County Emergency Management Directors often carry out such programs in schools as well. However, the schools themselves currently do not have any uniform training in the area of natural hazards.

Problem:

Some mechanism is needed to facilitate transfer of information from earthquake-hazards researchers to individuals responsible for public education and public policy.

Implementation Measure:

Periodic workshops should be organized.

Lead Agency And Time:

CEM
UGMS
One Year

Status: Pending

Currently no such program has been implemented, however, a goal of the Utah CEM Permanent Hazard Mitigation Section is to maintain contact with these individuals to assist them in educating the public.

Problem:

Some mechanism is needed to provide a centralized source of information relating to earthquake hazards in Utah and to facilitate the dissemination of results of on-going earthquake hazard research. The general public needs a readily identifiable source of information and assistance. Further, a host of technical users need the assistance of a modern information/resource office—particularly for access to up-to-date information not readily available in standard libraries.

Implementation Measure:

An information/resource office (distinct from a publication sales office) should be established within state government and operated by an information specialist. Functions should include: (1) aggressive acquisition and library maintenance of at least one file copy of publica-

tions, reports, newsclippings, newsletters, etc. relevant to earthquake hazards in Utah and bordering regions; (2) on-site availability of library materials and photo-copying service to meet needs of out-of-town users; (3) provision of reference services to meet telephone and on-site requests; (4) establishment of computerized data base to facilitate information retrieval of holdings; (5) interaction with diverse researchers and officials to provide informed assistance, in their stead, to general public.

Lead Agency And Time:

CEM
UGMS
One Year

Status: Beginning

Central Hazards Information Centers are best handled on a local basis, likely through city/county engineers or geologists' offices. Currently, some counties are hiring county geologists through a program sponsored by the UGMS and USGS.

Problem:

Planners at the local level do not have all published and unpublished natural hazard data in their offices.

* Implementation Measure:

Utah Geological and Mineral Survey should send area-specific bibliographies of all geologic publications and data sources and a selection of pertinent maps free of charge to all cities, counties, and regional planning commissions. The state should continue to develop and utilize centralized computer data bases, such as AGR, to disseminate geologic hazards data to all levels of government. Local governments should budget funds for acquiring hard copies of most geologic hazard maps, once the Utah Geological and Mineral Survey bibliography has identified them.

Lead Agency And Time:

UGMS
Five Years

Status: Beginning

This action is likely part of the Central Hazards Information Centers discussed above. As more county geologists are hired, these reference systems and data bases will develop within the county jurisdictions. The UGMS is working on this recommendation.

Problem:

There is a lack of awareness of the cost of geologic hazards, particularly landslides, to the state. Hidden costs, such as lost revenues from decreased tourism, are rarely identified. Even direct costs such as road repair are incorporated into maintenance budgets and difficult to identify. As a result, it is difficult for the planning and budget office to assign priorities or present actual costs to the legislature.

Implementation Measure:

The costs of geologic hazards should be identified each year. Specific actions that can be taken by the budget and planning office include: identify the reduction of geologic hazards as one of the governor's budget policy themes; require agencies to identify geologic hazard costs in their budget preparation; require a one-page report from each agency identifying long term hazard mitigation and short term response; require DOT to document costs of hazards each year; request such information from counties; have a one-time review of costs of the events of 1983; require reconnaissance and statewide mapping of geologic hazards and multi-hazard maps of critical areas; require the Division of Water Resources to include geologic hazard analyses for all new construction projects; require DCED to require geologic hazard analyses as criteria for new projects and redesign of old ones; exhort the Utah congressional delegation to fund landslide identification maps; apply for (and have it retroactive) the 2.5% of public assistance FEMA money that can be used for mitigation (approximately $1.5 million); apply for emergency block grant funding from FEMA; increase governor's contingency fund for emergencies and set up an account so FEMA match can be accepted; require county hazard identification as part of county hazard mitigation plans and as condition of receiving state aid; use the coordinating committee to identify priorities of the state plan for mitigation; update vulnerability analysis; establish hazards information library; and use coordination committee and budget documents to document the effectiveness of these actions.

Lead Agency And Time:

CEM
UGMS
Office of Planning and Budget
Two Years

Status: Beginning

While some of these kinds of information are gathered together in the State 406 Plan, much of the responsibil-

ity for maintaining records and reporting on this information should lie with the agency's disaster/emergency coordinators as they are the ones who relate to all of this information. A new recommendation in this 406 Plan is that such coordinators should maintain a journal for records and photographs.

Problem:

Funding for hazards needs to be addressed. Most local governments do not possess adequate money for study, mitigation, or clean up. They may not have adequate authority or a mechanism to implement hazards work. They require technical assistance for new work, including structures, rehabilitation, and monitoring inplace structures for hazard work.

Implementation Measure:

Recommend changes to improve the adequacy of federal and state emergency funds in amount and authority for use. State and federal authorities should assist local entities with dam safety, new structures, and budgeting for all hazard work, including maintenance.

Lead Agency And Time:

CEM
DCED
Division of Water Rights
One Year

Status:

Ongoing State hazard mitigation and recovery assistance is well exemplified in the formation of the State Disaster Relief Board and the plans for breaching the Southern Pacific Causeway, West Desert pumping and, also, diking plans for the Great Salt Lake. Other examples include assistance in constructing debris basins, UGMS landslide monitoring instruments, and visual monitoring of hazards, especially from aircraft.

Miscellaneous

Problem:

Lack of policy advisory group at the state level on geological hazards.

Implementation Measure:

An advisory policy group should be formed with representatives from the following groups: (1) earth scientists; (2) engineers; (3) public officials; (4) business and industry; (5) general public.

Lead Agency And Time:

CEM
One Year

Status: Pending

To date nothing specific has been done.

Problem:

The statute which mandates a strategy to maintain the lake level at 4202 also mandated that the Department of Natural Resources define and manage the lake flood plain as a hazard zone. The statute did not provide a mechanism for definition and management of the flood plain.

Implementation Measure:

Send this back to the legislature for further definition and a mechanism to achieve its definition and management. It would be more efficient for the legislature to pronounce its long-range policy on the Great Salt Lake and then ask the Department of Natural Resources to confirm its programs accordingly, rather than the state agencies constantly trying to sell their own policies to the legislature.

Lead Agency And Time:

State Legislature
One Year

Status: Ongoing

While no new legislation has resulted regarding definition and management of a Great Salt Lake flood plain, this current 406 Plan is recommending the establishment of a "Beneficial Development Area" (BDA) which includes the lake's fluctuation surface up to an elevation of 4217 feet. A detailed discussion of this topic is contained in the section of this plan on the Great Salt Lake.

Problem:

There are no stream gauging stations in current operation in Davis County. (There were many in the 40's, 50's and 60's.) Lack of stream gauging stations adversely affects the ability of technical expertise in assessment of geological hazards as related to predicting effects/impacts on downstream improvements caused by high stream flows, landslides, mud flows, etc.

* Implementation Measure:

Reactivate selected stream gauging stations in Davis County. consider reactivation or new gauge stations where critically needed, and elsewhere where identified geologic hazards and downstream impacts dictate such investments for public safety. Implement company agreements or memoranda of understanding to get cooperative effort and commitment.

Lead Agency And Time:

USGS
U.S. Forest Service
Division of Water Rights
Two Years

Status: Pending

The USGS requires a 50:50 match from state or local governments to install or maintain stream gauging stations. To date, the funding for the needed Davis County stations has not been available. The USGS recommends that the State Hazard Mitigation Officer attempt to generate interest within the state or local governments to obtain the matching funds.

Problem:

Section 2.8 of Utah's Public Drinking Water Regulations advises all public water suppliers to develop contingency plans to cope with emergency situations.

Implementation Measure:

Make preparation of an emergency response plan mandatory for all water supplies serving more than 800 people. Section 2.8 should address hazards identified by a private sector engineering geologist or a representative of the UGMS.

Lead Agency And Time:

Bureau of Public Water Supplies
One Year

Status: Completed

Section 2.8 is now section 2.9. The updated version of Utah's Public Drinking Water Regulations has had a public hearing and has now gone to the State Archivist. This new regulation should be finalized by May 27, 1985.

Problem:

Inadequate attention and resources have been devoted by the state over the years to the protection of shallow ground water resources. Virtually no standards exist for the protection of shallow ground water. In some areas shallow ground water is in direct contact with aquifers which are used for culinary purposes. In other areas shallow ground water is the only usable source for culinary purposes.

Implementation Measure:

Develop a state policy which addresses the quality and use of shallow ground water. Standards need to be developed which prevent the degradation of the quality of shallow ground water.

Lead Agency And Time:

Department of Health

Status: Completed

Approximately one year ago a state policy on ground water was established.

Conclusion

Hazard mitigation is a management strategy in which current actions and expenditures to reduce the occurrence or severity of potential disasters are balanced with potential losses from future disasters. Utah is committed to this philosophy and presents this hazard mitigation plan as evidence of a commitment to implement this strategy.

Utah's 1983 and 1984 disasters were widespread and severe enough to mobilize serious response, recovery, and mitigation actions. In reviewing and reporting these actions, we are seeing their integrated scope for the first time. This document will now serve as a guide for reviewing the existing measures and implementing the newly-proposed measures. An attention to detail without losing sight of the comprehensive plan will guide Utah toward effectively mitigating damages from potential future disasters.

Highlights of the plan include the proposed Great Salt Lake Beneficial Development Area, a concept of prudent beneficial development of the shores of the Great Salt Lake to the best advantage of the people of Utah. Through numerous interviews with personnel in state and local government agencies, recommendations were gathered which can only represent the mitigation needs of the state of Utah. The array of kinds of recommendations is much broader than originally envisioned, suggesting that Utah is in a pioneering phase of developing its hazard mitigation program. This plan could not have resulted without the help of numerous people in local and state government.

Now begins the task of implementation.

Appendices

Appendix One
Damage Incidents in Delared Counties

The magnitude of Utah's disaster is well illustrated by the overall financial impact to the state, but is also apparent in each affected county's story. The following section outlines the main problems, actions, and expense from 1984. It includes information from approximately 900 damage survey reports.

While the disasters of 1984 did not equal in magnitude those of 1983, still 12 counties were included in the presidential declaration. On July 27, 1984, when Governor Scott M. Matheson asked for a Presidential Declaration, he estimated the statewide damage to be approximately $41 million for private and public lands and facilities. This included $500,000 in private non-agricultural losses, $8,680,029 in agricultural losses and $32,233,450 in public (state and local) losses. The Governor expected that $6.9 million in losses would not be eligible for federal reimbursement. Between August and December, 12 Utah counties were given presidential declarations. The federal share for this $41 million in damage totaled $13, 126,500. In 1983 the federal share was $46,448,945.

An individually declared disaster, the Great Salt Lake is presented in a separate section of this report to emphasize the magnitude of existing and potential damage at this site. Mitigation planning and actions concerning the lake have also taken precedence in the state's hazard mitigation program.

Utah relies heavily on local governments for implementation of mitigation actions. Supported by a strong state and federal network, these local authorities responded effectively in 1983 and 1984 with personnel, equipment, action, and funds to provide disaster response and recovery. Each affected political entity was queried at the end of 1983 and 1984 regarding damages sustained and the status of recovery actions. Response questionnaires were generated for each year and distributed to the counties receiving federal public assistance. In addition, in 1984 numerous interviews were held with key people in State and Local agencies to gather in information.

The high level of response to this questionnaire and interview approach reflects the concern and commitment of Utah's local authorities to recovery and mitigation. The following county-by-county inventory of damages in 1984 includes a general overview of major damage items, the extent of damage, and the expenses involved. Utah County was the most severely impacted with over $4 million in Federal assistance; Summit County was the least severely impacted with over $99 thousand in Federal assistance.

This county-by-county inventory has served to identify individual problems and damages and associated recovery and mitigation activities. This examination is imperitive for comprehensive statewide planning that meets local needs, state goals, and federal requirements.

Utah County

The preliminary study by State and Local authorities placed damage figures at $5,467,000, for property that was located within the boundaries of Utah County. Estimates for damage to property controlled by Utah County, prior to the Presidential Declaration of 1984, were $1,955,626.

After the FEMA/State/Local damage assessment, Damage Survey Reports were written up in the amount of $5,448,281. This figure involved 17 individual applicants throughout the County for Federal Disaster Assistance after the 1984 flood damage. For Utah County, FEMA has estimated that $3,214,305 will be needed to restore service and clean up the flood of 1984. Of this portion, the State Disaster Relief Board has contributed $656,625 as a match for FEMA projects.

High water flows from the mountains that surround the heavily populated area of the county caused a great deal of emergency and restoration works before, during and after the major flooding of 1984. The majority of the work pro-

jects in this area involved emergency works, along with restoration works of numerous bridge, culverts, and roadways along the water-ways. Mitigation efforts on the part of the State of Utah and eight entities in Utah County have totaled over $2,427,100, with matching shares coming from both the State and the entity involved. Mitigation efforts, after the 1983 flood, by the County and the Corps of Engineers have substantially lessened the loss of agricultural crops and homes near Utah Lake and the tributaries that feed the lake.

Agricultural losses are estimated to be near $398,800.

Utah County suffered the most disaster loss of any Utah county in 1984. The Utah County Engineer's Office is now printing a report entitled "Utah County, Stream and River Flooding, 1983-1984." In this report, each drainage system in Utah County is examined topographically, historically, and in terms of the past two years flooding. The report is well illustrated, demonstrating the results of the past two year's flooding.

Provo City

Estimates by State and Local teams prior to the 1984 Federal Disaster Declaration were $1,069,000 for the damage that occurred to Provo City.

Major damage to the City included mainly clean-up and protective measures before, during, and after the flooding of 1984. The majority of projects involved the unusually high water from the three main water sources of Provo; Slate Canyon, Provo Canyon and Rock Canyon, and from the continually rising waters of Utah Lake. Damage was also caused to major culverts, bridges, and roadways that are adjacent to these waterways.

Mitigation efforts and experience from the previous years' flooding helped alleviate many of the problems that plagued the city during the 1983 flooding. Experience and prior planning proved to be of great benefit for this central Utah city.

FEMA estimated damages to be near $952,196, with the DRB supplying $119,025 on a match basis.

Disaster Relief Board monies were also used to mitigate non-FEMA projects in the Provo area in the amount of $1,264,465, with Provo City sharing the cost at $632,232.

Juab County

A preliminary study by State and Local officials prior to the Presidential Declaration determined that damage to public properties of Juab County were approximately $760,268. Damages throughout the County were estimated to be near $1,319,368.

Federal Emergency Management teams and their counterparts in other Federal/State agencies estimated that there was $606,501 worth of eligible repairable damage to the County owned areas. Damage was written up at 33 sites around the area. Damage Assessment teams wrote up Damage Survey Reports totalling $1,747,421, representing the County and two cities involved with flooding for 1984.

Juab County, in 1984, experienced very similar flooding to that of 1983. Damaged during the flooding period were culverts, river embankments, and bridges. A great deal of their time and efforts were spent on Emergency Work; i.e. debris clearance during and after the flooding, and in protective measures, i.e. sandbagging and river channeling. Because of the nature of the streams in Juab County large amounts of sand and gravel deposits in the stream channels caused continual problems for residents of the area.

The State Disaster Relief Board contributed $78,369 in matching funds for FEMA related projects for the County, with a total donation of $315,900 to Juab County, Nephi, and Levan. Their contribution to Non-FEMA projects has been $135,087, with the County supplying a similar amount on a 50/50 basis. Efforts are presently under way to help mitigate the continuing problem of high amounts of sand/gravel/debris that flow from their high mountain sources and have caused a major problem.

Millard County

Preliminary estimations of damage in Millard County were $948,466. These figures were arrived at by teams from the state and local entities. Damage estimates for the county proper were estimated to be $628,566.

FEMA estimates for eligible damage for this county were $656,272, which includes two cities that sustained damage, as well as a number of smaller locations which the County elected to act as representative for. The estimate for damage to the County proper were $468,658.

The majority of 1984 flood damage to Millard County involved roadways, bridges and culverts, and the river embankments. Major damage occurred in two of their canyon areas, washing out vital links to the forest areas, as well as mountain springs that were a main source to the city water supply.

Due to the number of small towns, basically without equipment resources, the County elected to restore many of the flood damage facilities that would normally be assigned to individual entities. This showing of cooperation was evident not only in Millard County, but throughout the State as entities worked together to help during the flood fights. The Disaster Relief Board has shared in non-FEMA projects for Millard County in the amount of $3,527, with an equal matching portion from the County. The DRB share of the FEMA Match projects has been $39,568, for the County, to date. Approximately $75,864 has been allocated to the County and cities involved in FEMA flood fight work. (This figure does not include major funding for the Town of Kanosh, which will be handled as a seperate entry.)

Juab County residents have made applications to the Farmers Home Administration for agricultural assistance in the amount of $600,720.

Town of Kanosh

Preliminary surveys involving this entity showed $202,900 for the damage estimates. This figure was very low as compared to the actual damage costs.

FEMA participation, at this time, amounts to $141,275. A number of projects in the Corn Creek area are still under consideration, with a decision expected soon. Much of the restoration of the area above the Town, involving Corn Creek Dam, will have to be restored at non-FEMA expense.

Extremely high water flows out of Corn Creek, and the eventual failure of the Corn Creek Dam, washed out major portions of State Highways, City roads, and the City water system. The Town was almost isolated because of the flood conditions. Emergency work with sandbagging and channelization was great, but the efforts were not enough to withstand the tremendous amount of water coming from the mountain areas near the town.

The DRB did approve restoration and mitigation efforts in the amount of $557,000. Because of the financial situation of the Town, the importance of the dam that services this area, and the lack in income, the DRB elected to finance this project 100%. Disaster Relief Board participation on FEMA eligible projects amounts to $33,521, at this time.

Juab County residents have made application to the Farmers Home Administration for agricultural assistance in the amount of $600,720.

Sanpete County

Preliminary estimates for damage for 1984 in Sanpete County and eleven other entities reached $1,088,687. These estimates proved to be higher than the actual FEMA allowed restoration costs. Estimates for the County only were approximately $219,000.

FEMA has made authorization for Sanpete County of $315,694 for restoration of damages and for the general clean-up and emergency work associated with the 1984 flooding for the County proper. They have written up Damage Survey Reports in the amount of $1,842,847 for the eleven separate entities and the County.

Damage to Sanpete County was mainly confined to the stream and river banks and the associated bridges and culverts. The majority of damage was limited to these structures, as well as the roadways adjoining them.

A large number of private property owners were especially hit hard by the continued high flows of water and the debris that was deposited on their lands. 1984 was the second year in a row that agricultural interests have had to shoulder the burden of damage to their lands and bear the expense of income loss.

The Disaster Relief Board will authorize $51,400 as the State's portion of the FEMA projects to the County. As individual entities, $227,408 has been requested from the Board for mitigation of non-FEMA projects in the County. They have come up with 50% of the fundings for these projects.

Agriculture interests in the County have requested over $2,241,700 of funding from the Farmers Home Administration. A large portion of these funds are requested due to the lack of land adequately drained to continue farming and other agricultural interests.

Ephraim City

Preliminary damage estimates for Ephraim ran to $344,891. These figures held up in comparison to actual damage survey FEMA estimates made at a later date.

Major damage in Ephraim was to their culinary water supply and the transmission lines into Ephraim City. Damage to these systems was due largely to the slide up Ephraim Canyon which destroyed, to a large part, the transmission system and collection system from their water sources.

Much work was needed to help continue uninterrupted service to the Town, but these efforts became fruitless as the slide continued to grow and cause more damage. Eventually all water from the springs above the city was shut off. They were forced to shut down the water system, leaving limited emergency use for fire purposes only.

The FEMA estimate of damage to Ephraim was $388,497, with the majority of it used in the water line restoration. The State DRB has contributed $85,984 in matching FEMA funds.

The State has also contributed over $40,000 towards $59,535 worth of non-FEMA projects. Again, the financial conditions of the City were considered in granting this unusual request for a non 50/50 split.

Manti City

The preliminary study by State and Local officials estimated that $313,850 would be necessary to restore function and service to the City of Manti.

The majority of the damage that occurred to this area was due, in part, to the large volume of water that came down from the high mountains around the City. The largest portion of FEMA eligible projects involved the emergency protective and debris removal measures, i.e., sandbagging of area, prior to the flooding and cleaning of debris. Damage also occurred to their spring water supply and system.

FEMA estimates, at this date, indicate that $329,903 will be needed to restore function and services to the original conditions. The State DRB has allocated $72,899 in matching funds.

The State DRB has also allocated $134,678 for mitigation efforts by the City, with a match of $134,678 by Manti City.

Springville City

Estimates of damage prior to the Declaration for Springville City was $1,094,000.

Major damage for Springville was mainly confined to emergency work and debris clearance due to the unusually high water run-off from both Hobble Creek and Spring Creek. Damage also occurred to culverts, some bridges, and stream embankments, but to a lesser extent than the 1983 flood. Mitigation efforts after the 1983 flooding helped lessen the damages that could have occurred during the 1984 flooding.

FEMA estimated damage for Springville City was $558,116, much less than originally thought by the State/Local teams. Of this amount, $72,835 has been applied for through the DRB.

Mitigation efforts for Springville City are at $54,000, with $27,000 coming equally from the Disaster Relief Board and Springville City. They are presently working on plans to construct further mitigation efforts which will greatly reduce the threat of flooding downstream from both Spring and Hobble Creeks. These projects will be done on a 50/50 basis.

Sevier County

Preliminary estimates for Sevier County placed damage at approximately $286,000. This estimation was based on one town's water supply being damaged, however, upon more complete examination, the figure was revised.

Total damages to the County and the five entities that eventually applied for diaster relief from FEMA are $247,394. The County proper has claimed and been approved for damage restoration in the amount of $75,958.

The main damage to areas in Sevier County were along the waterways of the county, and involved culverts, bridge abutments, and waterway embankments. There were a number of locations where damage throughout the county was considerably less than that experienced during the 1983 flooding.

The State of Utah Disaster Relief Board has participated to the extent of $9,495 on a match for County/FEMA eligible projects. They have participated for a total of $38,726 for all County and City projects. Only one entity has, at this time, requested further assistance to mitigate future flooding. This project was approved for $14,221.

Agricultural losses are estimated to be near $137,705.

Wasatch County

Preliminary estimates of damage to areas of Wasatch County and one city reporting damage were believed to be near $523,000. This preliminary estimate was remarkably close to that of the actual damage assessed by FEMA.

FEMA estimates for eligible damage for Wasatch County have reached $511,624. Damage for the entire County has been estimated to be $646,526.

Major damage to areas in Wasatch County involved stream banks, culverts, bridge structures, and roadways near streams and creeks which run from the mountains surrounding the Wasatch Valley into Deer Creek and the Provo River.

A large portion of the eligible damage in Wasatch County was involved in emergency work. The sandbagging and cleaning process for this area was a major part of funds expended. Of this portion the State has funded $63,953 as their portion of the flood fight match.

Non-FEMA projects for Wasatch County, to date, have reached $118,420, with the county and State participating on a 50/50 basis in the amount of $59,210. Other mitigation efforts are presently under consideration for funding.

Because of a great deal of mitigation efforts during the 1983/1984 season large flows of water and debris were able to be handled more efficiently than during previous flooding periods. Experience gained from the 1983 flooding helped in managing the large amount of water that Wasatch County experienced during 1984.

Agricultural losses are estimated to be near $25,800.

Box Elder County

In July, 1984, prior to the 1984 Federal Presidential Disaster Declaration, the damage assessment for facilities located within Box Elder County was estimated at $331,442.00. The county alone reported damage assessments of $234,434.

Overland flows carried debris onto private lands, and filled Willard, Facer, and Barker Debris Basins. Flood flows across roadways eroded pavement, washed out road shoulders, and culverts. FEMA made authorization of $290,063 to repair facilities within the county to their original condition. The Federal participation was $217,547 and the State's participation was $36,258. Damage Survey estimates for Box Elder County entity amounted to $109,036, the FEMA obligation was $81,777, and the State obligation $13,629.50.

The Disaster Relief Board approved mitigation to cover the building of new debris basins in problem areas, constructing waterways and lining them to control the conveyance of waters from mountains to Willard Bay. This included installing pipeline through the Union Pacific Railroad tracks and under Federal, State and County roads. Also included in mitigation was the replacement of Honeyville City Corporation's main culinary spring collection box that was damaged by flood waters. These mitigation projects totalled $705,700 with the DRB sponsoring $352,850.

In addition to the FEMA funding for flood fight costs, Box Elder County residents made application to Farmers Home for loans, in the amount of $1,382,000 for damages that occurred to agricultural lands.

Davis County

In July, 1984, prior to the 1984 Federal Presidential Disaster Declaration, the damage assessment for facilities located within Davis County was estimated at $1,986,532. The county alone reported damage assessments for $1,106,044.

Debris and sediment clearance on Mill, Stone, Barton, Duel, Parrish, Barnard, Ricks, Davis, Steed, Rudd, Farmington, Shephard, and Baer Creeks due to flood flows. Blow out of corrugated metal pipe and destruction of chain link fence from intense water pressure caused by debris build up. FEMA made authorization of $1,118,189 to restore facilities within the county to their original condition. The Federal participation was $838,642 and the State's participation was $139,774. Damage Survey estimates for Davis County entity amounted to $636,587, the FEMA obligation was $477,440, and the State obligation was $79,573.50.

The Disaster Relief Board approved mitigation that includes the reshaping and grading of streets and installing storm drainage, curbs and gutters, and replacing culverts to better control flooding if disaster strikes again. These mitigation projects total $1,062,827 with the DRB sponsoring $531,414.

In addition to the FEMA funding for flood fight costs, Davis County Residents made application to Farmers Home for loans, in the amount of $492,000 for damages that occurred to agricultural lands.

Summit County

In July, 1984, prior to the 1984 Federal Presidential Disaster Declaration, the damage assessment for Summit County entity was estimated at $368,850. There were no individual claims requested.

Restoration of Wooden Shoe Road that was washed out when the debris filled the creek channel and water flow was over the road. Debris removal incidental to the road repairs was also completed. The hillside gave way in Coalville Park, putting debris on the road and in the parking lot. Overbank flooding damaged sections of Chalk Creek Road, including culverts, arch pipe bridges, erosion of roadway and slumping of roadway. Also diking and dredging of Chalk Creek was necessary to protect roads, city park, and residents. FEMA made authorization of $132,377 to restore facilities within the county to their original condition. The Federal participation was $99,283 and the State's participation was $16,547. Damage Survey estimates for Summit County entity amounted to $106,201, the FEMA obligation was $79,651, and the State obligation $13,275. The Disaster Relief Board aided in mitigation projects to increase the capacity of the Swede Alley Storm Drain System in Park City that will tie on to the end of the Daly Avenue storm sewer. The construction of a detention pond and repair of an asphalt road were necessary. Park City's Daly Avenue Construction Project consisted of designing and constructing of a storm sewer, a debris basin, and of road repair and clean up of debris from reisdent's yards caused by the flooding. Park City's Prospector Stream Channel Stabilization project is to stabilize the Silver Creek embankment to protect downstream users from mine tailings contamination into the stream. The stream is also close to many buildings; this project would protect these buildings during high water runoff periods. These mitigation projects totalled $1,303,191 with the DRB sponsoring $651,596.

In addition to the FEMA funding for flood fight costs, Summit County residents made application to Farmers Home for loans, in the amount of $30,700 for damages that occurred to agricultural lands.

Weber County

In July, 1984, prior to the 1984 Federal Presidential Disaster Declaration, the damage assessment for facilities within Weber County excluding Ogden City was estimated at $616,535. The county alone reported Damage assessments of $600,500.

The flood damages incurred by Weber County include landslides on county roads, erosion of pavement on flooding streets, erosion and sliding of road shoulders, and silted up drainage channel. The Weber River experienced bank erosion where the river crosses 3lst Street. High water washed out bridge abutment on downstream side of bridge and the bridge washed out due to the abutment washout. Flood water erosion from an uphill ravine on gravel road and at a culvert. In Wolfe Creek, a corrugated metal pipe washed out due to high flows through the creek. FEMA made authorization of $203,360 to repair facilities within the county to their original condition. The Federal participation was $152,520 and the State's participation was $25,420. Damage Survey estimates for Weber county entity amounted to $182,492, the FEMA obligation was $136,869, and the State obligation was $22,8ll.50.

The Disaster Relief Board approved several mitigation projects within Weber County. The North Ogden Substation and Storm Drain Project for the installation of piping to control ground water from surfacing in public street R.O.W.'s and installation of piping to collect surface flow of water and transport underground to detention basins for release by controlled flow. The Mountain Water Channel Improvement Project for installation of rip-rap in open channels to stabilize slopes and control erosion of the stream bed. The Burch Creek storm drainage pipe was severely damaged by the flood, and consequently replaced. The 4400 South Storm Drain flooded yards and basements in the residential area. Therefore a concrete storm drain pipe was installed parallel to the existing storm drain system. The Madison Avenue Detention Basin Park was built to protect all homes down stream. These mitigation projects total $1,154,330 with the DRB sponsoring $577,165.

In addition to the FEMA funding for flood fight costs, Weber County residents made application to Farmers Home for loans, in the amount of $196,000 for damages that occurred to agricultural lands.

Ogden City

In July, 1984, prior to the 1984 Federal Presidential Disaster Declaration, the damage assessment for Ogden City was estimated at $213,000. Debris removal, sand bagging, and cleaning storm drain inlets from several locations in Ogden City caused by flood flows was completed by the city. A sewer line along Burch Creek was damaged due to a slide. Street flooding eroded away the asphalt and base material. A landslide occurred on Valley Drive, and another slide broke a sewer line. High flood waters in the Weber River caused the river bed to down grade and break the culinary water line. The Ogden City Golf Course incurred damages of 2' to 8' deep erosion through to greens and fairways requiring replacement of fill and resodding. FEMA made authorization of $89,894 to restore these projects to their original condition. The Federal participation was $67,420 and the State's participation was $11,237.

The Disaster Relief Board approved mitigation to cover several projects in the Ogden City area. These flood related projects included sewer line replacement, flood damage repair to roads and to the golf course, mud slide clean up, and replacement of damaged curb, gutter, asphalt, and filling. These mitigation projects total $1,218,818 with the DRB sponsoring $609,409.

Salt Lake County

Damage assessments were conducted in July, 1984 and amounted to $4,963,644 including all cities within the County. Estimates for damage to property in Salt Lake County were $4,199,000. These damage estimates were primarily for emergency protective measures, debris removal and water control facilities.

Although extensive flooding at least equal to 1983 occurred in Salt Lake County during the 1984 flooding incident, the extent of damage was substantially less. Over $20 million dollars in restorative and mitigation construction was accomplished during the nine month period between the 1983 and 1984 floods. Consequently, the damage was reduced from some 1,400 locations in 1983 to about 100 locations in 1984. Principal and significant damages resulting from the 1984 flooding were along the Jordan River where peak flows were some 30% greater than in the previous year. Also, high flow occurred over a longer period during the summer and fall of 1984. The longer term flows had a weakening effect on levees and major bank erosion along the Surplus Canal. Levees had to be raised one to two feet at various locations along the Surplus Canal over a 2,000-foot distance.

The damage survey FEMA-approved costs for the entire county amounted to $2,563,515. FEMA's obligation amounts to $1,900,224. The cities within the county had FEMA approved costs amounting to $868,357.

The State Disaster Relief Board has participated in funding $316,704 with an equal amount by the County and other entities for restoration and recovery of damaged works. Further, the State Disaster Relief Board has participated in construction of non-FEMA projects on a matching fund basis in the amount of $661,231 with Salt Lake County participating in the amount of $161,232.

A $33 million dollar bond issue approved by voters in late 1983 for flood mitigation measures provided $13 million dollars toward the restorative and mitigation efforts of 1984 (the balance being reserved for other projects over the next two years). Private financial participation amounted to $400,000 in the County's bank stabilization program, wherein the County installed gabions and other protective facilities along Big Cottonwood, Millcreek, and Little Cottonwood Canyons.

In February, 1985 the Utah State legislature authorized expenditure of $12,300,000 to cover costs of dredging the Jordan River in Utah and Salt Lake Counties.

There were some damages to previously constructed facilities, but the restorative and mitigation measures previously made were instrumental in reducing major damage to property from all flooding in 1984.

Salt Lake City

Damage assessments for Salt Lake City made in July, 1984 amounted to $659,917. These damages are principally related to emergency protective works.

Damage survey reports developed by FEMA teams totaled $752,031 of which FEMA's obligation was $564,024. Of this amount $94,004 was paid by the Utah Disaster Relief Board with local interests contributing a like amount. These costs were to cover emergency protective works, water supply measures and debris removal.

Murray City

Damage assessments for Murray City made in July, 1984 amounted to $60,977 related to emergency protective works.

The FEMA damage survey teams authorized works for $116,325 of which FEMA's obligation was $87,244. The Utah Disaster Relief Board participated financially in the amount of $14,541 and the local entity provided a like amount. These funds were utilized for emergency debris removal and protective works, spring restoration and park repairs.

Tooele County

Damage assessments for all of Tooele County done in July, 1984 amounted to $4,426,764. The cities within the county had damage assessments estimated at $2,556,934. These damages were associated primarily with debris removal, emergency protective works, streets, roads, bridges, and water collection and treatment facilities.

The FEMA damage survey teams authorized expenditures totaling $1,084,901 of which FEMA has obligated $813,676. The cities had FEMA approved costs amounting to $634,927 of which FEMA's obligation amounts to $476,195. Utah Disaster Relief Board participated in the approved FEMA projects in the amount of $135,613 with the County participating in a like amount.

The Utah Disaster Relief Board provided $453,647 which was matched by a similar amount from the County for non-FEMA mitigation projects.

As in 1983, there were higher than normal accumulations of snow in the Oquirrh and Stansbury Mountains with a rapid melt in late May. Settlement and Middle Canyons sustained the brunt of damages in the form of high creek stream flows resulting in major erosion of stream banks, destruction of canyon roads, water and gas lines, loss of trees

and natural cover and damage to park and recreational facilities in the canyons. Damage to bridges, culverts and streets were in evidence which includes all governmental entities within the County.

Tooele City

Damage assessments for Tooele City done in July, 1984 totaled $2,406,934. These damages were primarily for debris removal, emergency protective works, streets, roads, bridges and water collection facilities.

The FEMA damage survey teams developed damage reports totaling $426,710 from which FEMA has obligated $320,033.

The Utah Disaster Relief Board participated in non-FEMA projects in the amount of $726,550 with the City of Tooele committing a like amount.

State Agencies

The state agencies including Utah Department of Transportation, Utah National Guard, Department of Natural Resources and the Health Department reported flood damages for the 1984 flood totaling $9,308,230. Of this total $137,952 was categorized as emergency protective work, $4,564,768 was related to roads and bridges and $4,605,510 was damage to parks, recreation, and wildlife resources. Restoration for these works are under way except for parks, recreation, and wildlife that are inundated by the Great Salt Lake.

It is not anticipated that these facilities will be restored until the waters of the lake have receded.

Appendix Two
Chronology of Events in Utah Counties - 1984

Chronology of Events in Utah counties, 1984:

Utah County:

3/6 Dredging begins along Jordan River.

3/8 County begins dredging Hobble Creek in Springville.

3/12 Contractor hurrying FC project on American Fork River.

3/13 Landslide begins on Hwy. 6 over Billies Mountain.

3/14 Heavy rainstorms begin.

3/14 County Commissioner requests $10 million for Jordan River.

3/16 Road closes for third time over Billies Mountain.

3/18 Spanish Fork Canyon closes indefinitely due to slide. Coal miners cut off from workplace.

3/23 Four mile diking project at Lakeshore begins on Utah Lake.

3/26 Salt Lake-Utah Counties sign dredging agreement.

3/30 UDOT reopens Billies Mountain.

4/1 Provo Canyon aqueduct unstable. Flood volunteers organize.

4/3 COE awards $2 million for lower Jordan and Surplus Canal dredging plus south side levees.

4/8 Mudflow hits Sundance Resort.

4/10 Orem City organizes flood task force.

4/18 Mountain slides near Pleasant Grove, debris basins filling up. Slate Canyon debris basin in Provo already full.

5/2 Sandbagging along Provo River may save Utah Valley Hospital.

5/14 Payson River floods homes, flooding in Springville.

5/15 Water running down street in Provo, Payson homes evacuated.

5/17 Spanish Fork Canyon landslide closes railroad line, Amtrak passengers are bused into Salt Lake.

5/23 Abandoned dam above Genola leaking, no threat determined, American Fork Canyon slide moves slowly, crews keep river flow open.

5/24 Genola residents watching irrigation pond closely.

Salt Lake County

3/6 West Jordan has danger of flooding.
3/14 Localized flooding, power outages, hail, storm drain covers blow off allowing street to flood.
3/14 County Commissioner asks for $10 million to dredge Jordan River.
3/26 Salt Lake & Utah Counties sign dredging agreement.
4/1 One-hundred volunteers fill sandbags at PW complex in Midvale, more volunteers requested.
4/2 City & County reorganizing flood duties.
4/6 Flood mitigation work completed along Big Cottonwood Creek in Holladay.
4/8 GSL innundates station road.
4/9 Emigration Canyon slide occurs, no injuries or property damage.
4/16 Heat wave reactivates slide in Emigration Canyon.
4/18 More flooding, slides in Emigration Canyon.
4/19 Cold snap halts melt, rain causes SLC street flooding, pops manhole covers.
5/8 County holds sandbag "shovel off" contest.
5/14 Sandbag channel being built in Liberty Park, Big Cottonwood Canyon closed due to six slides and flooding.
5/17 Landslide forces evacuation of six families in Emigration Canyon.

Davis County

3/24 Sheets of ice driven by wind on Farmington Bay.
4/8 County crews work to complete flood projects, clean debris basins and drainage channels.
5/2 Bountiful monitoring two slides, working on debris basin.
5/14 Large mudslide crushes six E. Layton homes, thirty people evacuated as a precaution.
5/24 Additional slides threaten Weber Canyon (Farmington) residents prepare to evacuate. Large slide rolls into Rudd Canyon debris Basin.

Weber County

3/8 Major landmass detached in Baer Canyon above Fruit Heights, city awards contract for debris basin.
4/8 Large slide moving in Ogden Canyon, voluntary evacuation notices distributed.
4/13 Cleanup begins on slide.
5/15 Culvert collapses, runoff flood flows block section of Riverdale Road.
5/24 Causey reservoir spillway overflows, floods twenty summer homes in Ogden Canyon.

Tooele County

3/15 I-80 near Lake Point now open, U-199 to Dugway being eroded by runoff.
3/21 Crews diking , hauling fill for repair to transmission lines beside GSL damaged by shifting ice.
3/28 Six mile section of I-80 flooded by GSL, declared "State of Emergency" by Governor, UDOT requests emergency funds to raise roadway four feet.
5/14 Middle Canyon Creek floods road in Erda county, snadbags roads near Lake Point, Grantsville subdivision partially flooded.

Millard County

4/17 Retention basin above Kanosh built in 1930's by CCC for irrigation is leaking and many fear it will give way.
4/21 City and County crews working furiously to divert runoff from retention basin.
5/5 Small dam above Kanosh bursts, floods town.
5/15 Two in pickup injured trying to cross Salt Creek Bridge near Fillmore.
5/26 Sevier Dry Lake now thirty-five feet deep.

Juab County

3/29 Culinary water line serving Levan threatened by 100,000 yd. three slides in Chicken Creek Canyon. FEMA restored same facility in 1983.
4/20 Floodwater threatens Salt Creek Bridge in Nephi, workers trying to save it.
5/14 Raging Salt Creek knocks out Nephi water line, city begins pumping from emergency wells. Levan landslide threatens water supply again, floods close I-15 at Levan Junction.
5/24 Rumor sets off Yuba Dam scare. Some thought it would go over the top.

Sanpete County

4/21 Workers digging through slide that threatens Ephraim water supply.
4/29 Manti, Fairview, Mt. Pleasant, Spring City, and Ephraim could all lose water lines due to landslides.
5/3 Two towns declare disasters because of broken water lines - Ephraim and Fairview.
5/4 Manti goes on boil order because of water source contamination, joins list of cities declaring disaster in County.
5/24 Extensive flooding of farm land along Sanpitch River.

Sevier County

4/21 Several small slides near I-15 in Salina Canyon.
5/11 UP&L transmission lines go down because of slide 15 miles southeast of Salina.
5/24 Monroe Creek flooding farmland, workers trying to control damage.

Box Elder County

4/23 Slide perched above Willard threatens thirty homes and three dairy farms, volunteers sandbag.
4/24 Slide appears to stabilize.
5/3 Dry Creek flooding closes road between Brigham City and Logan.

Morgan County

5/4 Weber River floods between Peterson and Mountain Green, homes being undermined by earth movement.

Carbon County

5/14 Mudslide kills one and injures another above coal mining town of Clear Creek 90 miles southeast of Salt Lake City, several homes destroyed.

Appendix Three
Dates of Disaster Declarations For Utah Counties

THE FOLLOWING IS THE STATUS OF COUNTY AND STATE DISASTER DECLARATIONS

County/City	Date County Declared	Date Governor Declared
Box Elder	May 22, 1984	May 26, 1984
Cache	August 7, 1984	June 28, 1984
Davis	May 13, 1984	May 14, 1984
Emery	June 6, 1984	June 12, 1984
Juab	May 11, 1984	May 12, 1984
Millard	May 8, 1984	May 18, 1984
Morgan	June 13, 1984	June 15, 1984
Rich	May 21, 1984	June 15, 1984
Salt Lake	April 9, 1984	May 16, 1984
Sanpete	May 18, 1984	May 24, 1984
Sevier	June 18, 1984	June 15, 1984
Summit	May 22, 1984	May 24, 1984
Tooele	May 15, 1984	May 15, 1984
Uintah	May 29, 1984	June 15, 1984
Utah	May 12, 1984	May 15, 1984
Wasatch	May 16, 1984	May 16, 1984
Weber	May 16, 1984	May 16, 1984

APPENDIX FOUR
STUDY ON POTENTIAL FUTURE EARTHQUAKE IMPACT

A Study On Potential Future Earthquake Impact

A 1976 study done by the U.S. Geological Survey entitled *A Study of Earthquake Losses in the Salt Lake City, Utah Area* describes the potential impact of a major earthquake in the Weber, Davis, Salt Lake, and Utah Counties area; the following information is taken from that study. Two earthquakes were postulated for this study, having magnitudes that could rationally be supported as possible in the area. Analyses of the events indicate that under the worst condition as many as 2,300 people would die, and 9,000 additional persons could suffer injuries requiring hospitalization or immediate medical treatment. The number of deaths could be as high as 14,000 if deaths from dam failure are included in the casualty total. Such casualties would occur under the worst conditions of exposure, as during rush hours, but could be approximately as great at any time during the working day. Conditions of exposure are altered at night, when people are at home, resulting in a reduction of casualties to a level of about 5-10 percent of the daytime losses. It is possible that as many as 30,000 people would be homeless or would require temporary shelter pending reestablishment or reduction.

The same study indicates that for planning purposes, the number of homeless people in the four-county area (Weber, Davis, Salt Lake, and Utah Counties) would be doubled (60,000 homeless people) if either postulated earthquake event were to occur during the winter months (November through March). The combination of freezing or subfreezing temperatures, and either unsafe structures or a loss of electric power and natural gas for heating would make it impossible for many people to remain in their homes after a major earthquake.

Considering the impact on hospitals, the study looked at each county. Weber County would have an estimated 26 percent bed loss, Davis County over 50 percent bed loss, Salt Lake County over 80 percent, and Utah County also about 50 percent. In each county many police, fire and ambulance services would be moderately to severely impacted. Communication, transportation, and schools would also be severely impacted.

A separate study currently underway with the U.S. Department of Energy indicates that the major source of petroleum products for the states of Utah and Idaho originates at the North Salt Lake City refineries, approximately 126,000 barrels of products per day. These refineries are sited along the Wasatch Fault. Engineering experts on the structural effects of earthquakes on energy facilities suggest that major damage would result to those refineries. A study by the Utah Seismic Safety Advisory Council came to the same conclusion. Storage of petroleum products at both the refineries and products terminals along the products pipeline is only about one week. The loss of 126,000 barrels of petroleum products per day would be difficult to replace in total. Refineries in adjacent regions would need to ship products to the intermountain area, but it is unlikely that the supply would be sufficient to maintain normal activities.

APPENDIX FIVE
Questionnaire Used In Gathering Recommendations

QUESTIONNAIRE

This questionnaire is an important part of preparing the State 406 Hazard Mitigation Plan as required by Federal Law and by agreement between the Governor of the State of Utah and the Federal Emergency Management Agency. Due to deadline commitments with FEMA, your prompt reply to the questionnaire is important. Please have it returned to me no later than March 20, 1985.

Answers from county directors should represent their county and not only their emergency services office. Therefore, each county director will need to consult with his other county offices, as necessary, to respond to the questions. A responder from a city government should likewise consult with his other city offices, as appropriate. Answers from representatives of State and Federal Agencies should represent their entire agency, as appropriate. Please respond to these questions on separate sheets of paper; a handwritten response will be sufficient.

Please Provide The Following Information:

I. Name of responder.
Title of Responder.
Responder's Agency/Office
Brief description of agency's hazard mitigation responsibilities.

II. We are trying to gather together several viewpoints on the meaning of "hazard mitigation." Please provide your understanding of the term "hazard mitigation."

III. Based on our last two years' experiences with natural disasters in Utah, what kinds of plans, programs, or actions would your agency/office like to see implemented in the state to better deal with natural hazards in general? These suggestions need not reflect your own agency/office, but should be general observations for the state.

IV. In dealing with the last two years' disasters, did you learn any new concepts or methods that should be shared with others? This could include funding, communication, engineering, planning, interpretation of guidelines, understanding of hazards, predictability of disasters, education of the public or officials, resource literature, resource consultants, coordinating efforts between agencies/offices, how to correct overlap in responsibilities between agencies/offices, etc. Please describe the more important of these.

V. **Site Actual Existing Hazards: Specify** hazards currently of concern and indicate the recommended mitigation measures relating to each of these hazards. Briefly discuss your capabilities and/or difficulties in mitigating these hazards. Give an estimate of the dollar cost of this mitigation. Give an estimate of lives and money saved by mitigating the hazard.

Example: Earthen dam in Big Canyon, Dry County, likely to fail in next spring flood

Mitigation Measures
Enlarge spillway and reinforce dam
Dredge river from spillway to town.
Install warning system
Educate townspeople
Capabilities in Mitigation
County can provide equipment and manpower.
Difficulties in Mitigation
Mitigation will require engineering and funding assistance.
Dollar Cost of Mitigation
About $200,000.00.
Lives and Money Saved by Mitigating
An estimated 350 people could die should the dam fail.
Money saved by mitigating the hazard estimated at $2,500,000.00 due to otherwise probable flooding of town and campgrounds.

A. Discuss specific hazard mitigation items that appear to require urgent attention.
(events of highest funding priority that are likely to happen within the next few months.)
B. Discuss specific hazard mitigation items that appear to

be of a primary nature.
(events not immediately threatening but of high funding priority)

C. Discuss below specific hazard mitigation items that appear to be of a secondary nature.
(events not immediately threatening and of intermediate funding priority)

D. Discuss below specific hazard mitigation items that appear to be of a long-term nature.
(events of low funding priority)

E. Which, if any, of the hazards listed above are repetitive. Give particulars.

VI. **How Can Your Agency Improve Its Hazard Mitigation Capability:** Indicate general areas in which your agency might improve its hazard mitigation capability given the kinds of hazards we have in Utah and your agency's/office's capability in dealing with them.

Examples:

Perform more frequent dam safety inspections.
Lack adequate manpower and funding
Can provide materials, time, and part of funding.

Maintain educational materials for training people.
Lack funding for visual aides and brochures.
Have personnel with time to provide training.

Assign hazard mitigation responsibilities to existing personnel.
Problem in deciding on priorities.
Many assignments have already been made.

Seek training opportunities for employees involved with hazard mitigation.
Problem with knowing what training is available.
Training would enhance our response to hazards.

Purchase additional heavy equipment.
Problem with funding.
Can work up mutual agreement with adjacent county to share equipment in an emergency.
Already have sufficient equipment to handle most problems.

Note: The terms "urgent" "Primary," "secondary" and "long-term" may be defined strictly by your sense of need.

A. Urgent:

B. Primary:

C. Secondary:

D. Long-term:

VII. Describe the authorities (laws, codes, ordinances, regulations, administrative guidelines, etc.) under which your agency or office operates for the various kinds of hazards (floods, earth movements, earthquakes, avalanches, etc.):

VIII. Briefly describe in chronological sequence your agency's/office's involvement in the 1984 Presidentially Declared Disasters. Name the events and discuss in a time sequence the activities of your agency/office relating directly to the mitigation process. A county director should answer for all county offices within his county, as appropriate. A responder from a city government should answer for offices within his city. Discuss the repetitive nature of any of these disasters. Indicate the expense involved in the mitigation.

IX. With what monies did you do hazard mitigation, and in what approximate amounts were they granted?

FEMA
Non-FEMA
Eligible Bureau of Public Water Supplies
SB-15, Disaster Relief Board
Water Pollution Control Committee
Utah Department of Transportation
Utah Division of Water Resources
Other, please specify

X. Discuss your recommendations on how to better fund hazard mitigation.

XI. What grants have been applied for in your recovery efforts? Please list.

XII. Discuss existing hazard mitigation plans and programs being used in your agency/office.

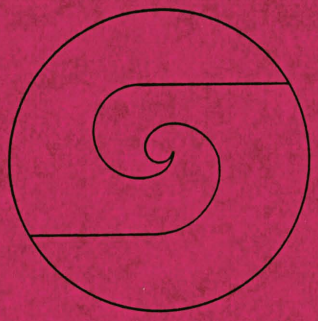
Please return the completed questionnaire to:

Fred May, State Hazard Mitigation Officer
Utah Division of Comprehensive Emergency Management
P.O. Box 8100
1543 Sunnyside Ave.
Salt Lake City, Utah 84108

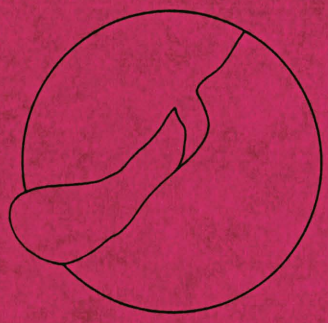
If you have any questions in responding to the questionnaire, please contact:

Fred May, Utah CEM: 533-5271

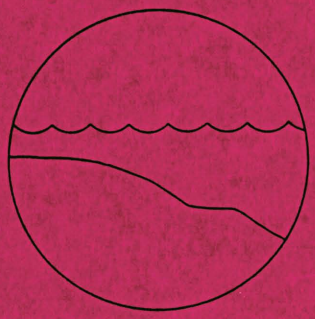
Utah's Geologic Hazards



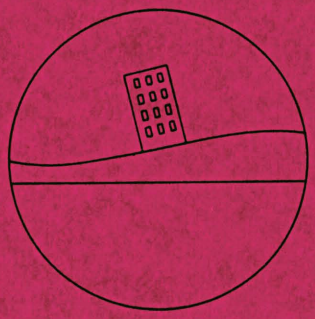
Floods



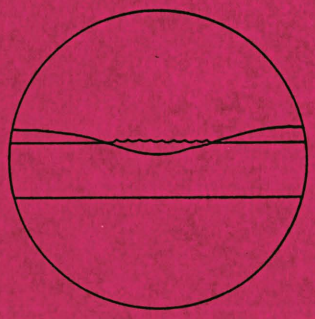
Landslides



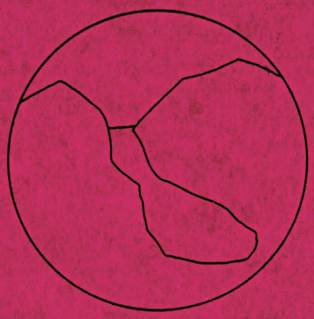
Lake Level Rises



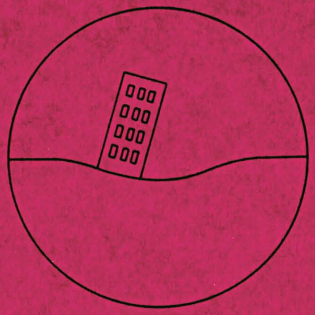
Swelling Soils



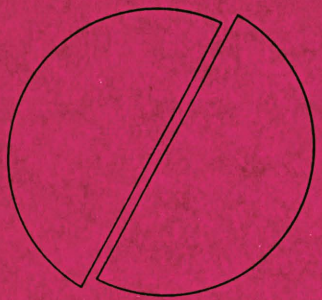
High Ground Water



Mud Flows

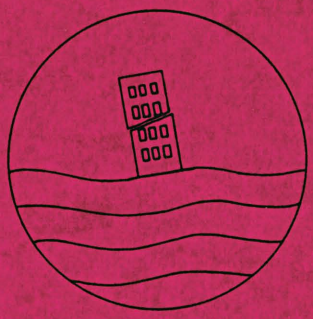


Subsidence

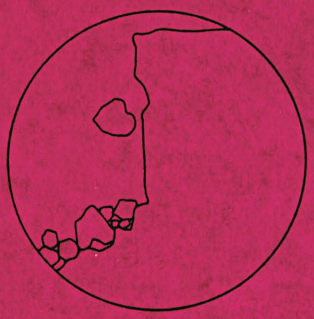


Earthquakes

Ground Cracking



Liquefaction



Rock Falls