disaster preparedness report

September 1978

National Weather Service

Presidential Reorganization: At the time this report went to press, Congress had still not acted on the President's proposed reorganization of disaster agencies. Present indications are that FEMA (the Federal Emergency Management Agency) will be approved and that by early 1979, following selection and Congressional approval of top level positions, the agency will commence operations. Some of the Disaster Preparedness (DP) activities of the National Weather Service (NWS) will likely be transferred to FEMA, but a strong NWS-FEMA interforce is anticipated.

NWS Needs Disaster Photos: Photos are an important part of the NWS DP and Warning Awareness Programs. We have many good photos now, but we still need more. If you have good pictures depicting floods, flash floods, tornadoes, weather-caused damage, etc. please mail them to us so we can incorporate them into our slide lectures and other presentations. We've come up with a release form too, for your use. It's included on the reverse side of this page. You can duplicate the form if you need additional copies.

DP PEOPLE IN THE NEWS

Herb Lieb retired from the WSH DP Staff on May 8. Herb headed the NWS DP program since its formal inception in 1974 and has been instrumental in giving the program needed visibility and support. He brought the "Owlie Skywarn" concept to fruition and fostered a strong interdisciplinary dialogue among sociologists, engineers, the media, hydrologists and meteorologists. Herb plans to remain at his Silver Spring, Maryland home with his wife Millie and his son David and remain "active" in the disaster preparedness arena.

H. Michael Mogil left the NWS Staff on September 22 to appear with two other NOAA meteorologists on the new Public Broadcasting Service show, "AM Weather." The show will air nationwide on or about October 30 and will originate from the Maryland Center for Public Broadcasting (Owings Mills, MD 21117).

Mike had been with the DP Staff for just under a year, but had made important contributions to the DP Program. He developed last winter's DP information exchange conference, helped revise numerous publications, and instituted the NWS Warning and Preparedness Handbook.

US Department of Commerce
NOAA/National Weather Service

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Walter R. "Andy" Anderson has been selected as the new Flash Flood and Severe Weather Preparedness Meteorologist at Southern Region Headquarters. Andy has managed the severe weather preparedness program for several years but now has the added responsibility of putting his expertise to work in the flash flood preparedness area.

May 16 was Alan Moller Day in Fort Worth, TX. Moller, a Disaster Preparedness Meteorologist at the Fort Worth Weather Service Forecast Office was cited for his activities in recruiting severe weather spotters in the area. Moller has trained amateur radio tornado spotters to recognize and understand the structure and life cycle of tornadoes and the thunderstorms that produce them. His training has added to the expertise of more than 400 spotters in the Fort Worth area who report severe weather to the National Weather Service, Civil Defense, and news media. This is in addition to the more than 2,000 spotters Moller has trained throughout the rest of North Texas, as part of his tornado preparedness activities.

Support Weather and Weather-hazard societies: There are many organizations, societies, and councils that represent various groups involved in weather and weather related hazards. Some of these include,

American Meteorological Society
45 Beacon Street
Boston, Massachusetts 02108

National Weather Association
Box 243
Clinton, MD 20735

US Civil Defense Council
P.O. Box B370
Portsmouth, VA 23705

In addition, there are several publications that you may want to subscribe to:

Journal of Civil Defense
P.O. Box 910
Starke, FL 32091

Natural Hazards Observer
IBS #6
University of Colorado
Boulder, CO 80309

Environment/Weatherwise
Heldref Publications
4000 Albemarle St., NW #504
Washington, DC 20016

If you, the readers of the DP Report want to add to this list, please let us know.

NEW PUBLICATIONS, SLIDE SETS, ETC.

James Abernethy, Associate Professor of Architecture, Lawrence Institute of Technology, Southfield, MI, is presently working with us on "Tornado Safety in Residences," a slide set and commentary. He's also working on "Cartoon Tornado Safety Tips," 4 pages of cartoon characters explaining tornado safety tips. This slide series will be available later this fall.

Les Lemon, National Severe Storms Forecast Center is leading an effort to develop a tornado spotter slide set. This set should be available early next year.

Dennis Henize, Weather Service Office (WSO) Key West, Florida is working with the DP Staff on a lightning slide set. The set should be available by next spring.

H. James Owen, Community Engineer in Palo Alto, CA, is working on an educational kit of materials relating to the field of water resources with emphasis on flood control entitled "Summary of Water Resources Information." We hope to have it printed and distributed by early November.

Ira Geer, State University College at Brockport State Univ. of NY is currently conducting a study of the status of hurricane education activity in the Atlantic and Gulf Coastal states. From this study a plan of action will be created for the development and implementation of education programs leading to adequate hurricane awareness, preparedness and response by the public. The title is "Increasing Weather Awareness - Hurricanes." It should be completed by November.

William Barry Furlong, writer, Washington, DC, has completed a draft of a safety planning guide for hospitals and nursing homes during natural disasters. The guide has been sent, in draft format, to at least two dozen governmental agencies, health care facilities, and medical organizations for technical review. We expect to publish this guide by early 1979.

"An Engineering Analysis: Mobile Homes in Windstorms" by W. Pennington Vann, and James R. McDonald has recently been completed and submitted to the DP Staff. It has also been submitted to National Technical Information Service. This report contains a detailed analysis of the various aspects of mobile home behavior in windstorms. The report is available for $5 from the Institute for Disaster Research, Texas Tech University, Box 4089, Lubbock, TX 79404.

And a review of the publication, Storm Data, gives the following information on mobile homes damaged or destroyed in the period January through November 1979:

Tornadoes or Windstorm Events involving mobile homes	Mobile Homes Damaged or Destroyed	Deaths	Injuries
366	at least 1,013	11	at least 224

Although we recognize that the resources devoted to gathering and publishing the information given in Storm Data do not yield complete statistics, other tabulations for this same period show that 1) tie downs do not guarantee safety in a direct hit by a tornado; 2) some attempts at tie down are inadequate; 3) Tie-downs do help. However, in high wind situations, evacuation to a substantial structure is still the recommended procedure.

DCPA has just released a new film entitled "Day of the Killer Tornadoes." The film portrays disaster warning and response during the April 3-4, 1974 super outbreak of tornadoes.

"Flash Flood!", a new NWS dramatic film about flash flooding, is in the making. It should be ready for distribution by early 1979.

Radio/Television Public Service Spots

NOAA's Office of Public Affairs offers public service announcements on tape, film, and slides providing safety tips to help protect life and property during severe weather, and other public service material. The following is a list of those currently available:

Radio (spots are both 30 and 60 seconds)

Tornado Safety
Hurricane Safety
Flood and Flash Flood
Winter Storms
Heat Wave and Lightning
Arnold Palmer on Lightning Safety

Also available:

"How to Prepare for a Hurricane"
A 4:30 interview Dr. Neil Frank, Director of the National Hurricane Center. (For Gulf and East Coast states.)

Television

Tornado
Tornado Safety Rules
Flash Flood
Hurricane House
Hurricane Storm Surge
lightning
Lightning, golfers
Winter Storms
Tornado (wallet cards)

In Process

Guice, Storm Surge
Flash Flood Car Rescue
Night Disasters

In Planning (Not approved yet by Dept. of Commerce)

Lightning Spots
Winter Storms

DCPA and FDAA have also prepared some weather safety spots for radio and television.

The film, Hurricane Decision won several awards recently and the President of the Virgin Islands International Film Festival stated the film was a "...brilliant and creative entry...."

A complimentary copy of the film has been presented to each Governor

of the coastal states from Maine to Texas. The MIC's made the presentations offering several more prints if necessary for distribution to Civil Defense officials, law enforcement officials and others. Our understanding is that the project was extremely worthwhile.

Tornado: A Spotter's Guide continues to receive accolades. The film has been shown throughout the US and is now being made available to 2,000 ARRL-affiliated amateur radio clubs throughout the U.S. and Canada during the next several months

The film "Tornado at Pleasant Hill" was reviewed by all grade levels in West Park School, Moberly, MO. The Principal of the school had these encouraging words to say "...it opens up and stimulates discussion concerning storms and our safety procedures. I would recommend this film for other schools."

DP ACTIVITIES

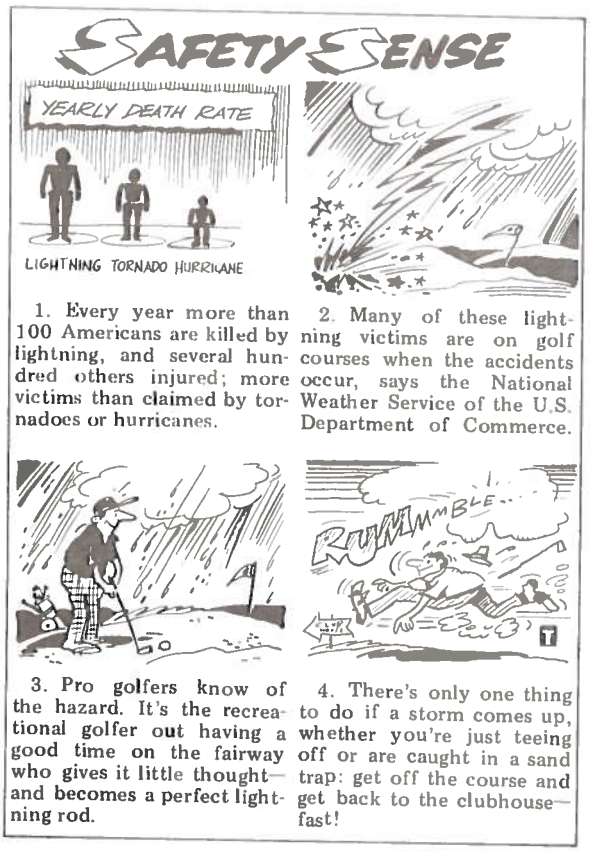
The following describes only a small fraction of the total NOAA/NWS involvement in Disaster Awareness and Preparedness. We apologize in advance for omitting the activities of some offices and/or individuals:

- Several of the Weather Service Forecast Office (WSFO) Cleveland staff developed an exhibit and provided demonstrations for an International Scout Jamboree held on Kelly's Island, Ohio. Twelve thousand Scouts and leaders were in attendance. Messrs. Boyce, Kennedy, Paddock, and Simmons gave presentations. The National Weather Service exhibit was acclaimed "the best" at the Jamboree.

- Jack Hummel, Meteorologist In Charge (MIC), Weather Service Office (WSO) Burlington, Vermont, has arranged for Storm Spotter Guides (stickers) to be affixed to the dashboards of all State police vehicles in Vermont. Other law enforcement and public service agencies have expressed an interest in these Guides and will most probably allow them to be placed in their vehicles, as well. These actions will greatly strengthen our storm reporting networks in Vermont.

- WSFO Birmingham Disaster Preparedness Meteorologist (DPM) Bob Kilduff reports that letters were sent to most of the golf and country clubs in the Birmingham area discussing the dangers of lightning on the golf course. A few lightning and thunderstorm publications were included for posting in the pro shop and for a limited distribution to members.

  In addition, NOAA's Public Affairs Office prepared some "lightning safety for golfers" cartoons and distributed them to several hundred newspapers nationwide. (See next page.)



- WSO Wilmington, N.C., prepared a 20-page pamphlet for distribution to press, radio, TV, County warning offices, etc., discussing NWS products, forecast zones, terminology, etc. This is an excellent job of public relations and will be contributing to improved use of NWS forecasts.

- A surprise test was conducted by the Amateur Radio Emergency Service (ARES) of Milwaukee County, Wisconsin. The purpose of the test was to measure the availability of HAMS to serve as storm spotters. The test was conducted during the hours that a tornado was most likely to occur and on a weekday because it would present the "worse case" in that most amateurs would be at work and not available to serve as spotters. Despite this, there were nearly 90 stations in the general Milwaukee area and over 150 from other areas of the State that were available during the test. The test was conducted from the WSFO where HAM equipment is routinely manned by a member of the ARES unit during storm threats.

- Forecaster Training Tape. The Southern Region developed a videotape titled, "Tornadoes and Warning Readiness." It emphasizes the importance of WSFOs working closely with the WSOs to insure the best possible readiness posture for incipient tornadoes. Although WSOs issue about two thirds of our tornado warnings, they lack some of the advantages available to the WSFO forecaster, such as frequent satellite photos, which can help to show when and where in a watch area development is most likely. Also included in the tape are basic concepts of tornado forecasting, climatology, and some visual aspects which may be helpful in interpreting spotter reports.

- Gene Hafele, DPM at Houston has made it a regular practice to send a brief, pleasant follow-up letter to the community where he has made contact on preparedness matters. We're sure this bit of extra effort is appreciated by the recipients who have worked at making a meeting a success. In those few instances in which the DPM's reception may not have been as favorable as we would have liked, the follow-up notes serve to put on record that the DPM has tried and now it's up to the community if they decide later they'd like some help from NWS. We know a number of offices try to follow this practice and believe it is a good one.

- Chuck Stwertnik, Chicago DPM, is undertaking a project to give spotter training to administrative, custodial and maintenance personnel in schools. Training has been accomplished in all schools in two districts and planning is in progress for the Cook County districts. There are also plans for a meeting with the Catholic school administrators to discuss the project.

- Gil Russell, of our Evansville, Indiana office, has been teaching a meteorology and disaster preparedness course at a college in Mt. Carmel, Illinois. The course was designed for Illinois Civil Defense officials. Gil also serves on the Emergency Preparedness Advisory Work Committee on disaster preparedness course planning.

- A Disaster Preparedness Meteorologist Information Exchange Conference was held February 14-16 at Wheaton, Maryland. The DP Staff hosted the Conference.

  Approximately 20 Weather Service DPMs, NWS and NOAA headquarters staff, and representatives of Federal and other organizations discussed programs, progress, and problems of natural disaster warnings and preparedness at all levels, with special emphasis on flash flood preparedness, an area of major concern.

  Presentations during the conference included those from the American Red Cross, the International Association of Chiefs of Police, and the National Association of Broadcasters. Federal agencies represented included the Defense Civil Preparedness Agency and the Federal Disaster Assistance Administration.

- MIC Marian Peleski, WSO Wilmington, Delaware, gave a presentation on summer thunderstorms and flying weather to Civil Air Patrol pilots; met with a group of RSVP Spotter volunteers and conducted a training session; and discussed with Carolyn Thoroughgood, Associate Sea Grant Director at the University of Delaware the University's interest in publishing a brochure similar to "Hurricanes , Florida and You" for Sussex County, Delaware.

- John Purvis, MIC, WSFO Columbia, South Carolina is distribuitng copies of the NOAA news release, "Thunderstorms: Nature's Weather Factories," to the Civil Defense Directors at the county level, various weekly newspapers, and the radio/television stations throughout the state.

- Dick Wood, Official In Charge (OIC) working with the Southern Arizona Mobile Home Owners Association, has distributed numerous disaster preparedness publications in the Tucson area. The president of the association, which represents 285 mobile home parts and 6,200 members, was contacted by Dick and agreed to assist in the distribution of literature on flash floods and protecting mobile homes from high winds. Many areas have mobile home owners associations, and heads of these groups are excellent contact points for distributing preparedness literature.

- Larry Mowery, Flint, OIC will hold classes in spotters' training for 350 Community Radio Watch (CRW) CB'ers. John Graff, Minneapolis MIC reports that all State Patrol Officers have received spotter training.

- WSFO St. Louis conducted a very successful Broadcaster's Workshop recently that was attended by 17 local broadcasters. Bob Hamilton, MIC, commended Sue Touzinsky, DPM, for her hard work and excellent organization in preparing the program. Bob, Sue, Bill Waldheuser and Chuck Kurtz, made the presentations and served as discussion leaders.

  Sue also completed her DP activities in Southeastern Missouri during the second week in February. Work, including media, local and state official broadcaster contacts, was completed in 14 counties. During the trip she conducted four spotter training sessions involving most of the counties and was the main speaker at the Southeastern Missouri Area Civil Defense Directors Association. She found increasing interest in the statewide drill, in school safety and in the NWR (NOAA Weather Radio) planned for the area.

- Six Australian civic leaders toured WSMO, Marseilles, IL recently with particular interest in severe weather. The group stated "...the number one natural disaster killer in Australia was flash floods."

- Storm Awareness For The Deaf. WSFO Birmingham, Alabama, has added an interesting aspect to the severe weather awareness effort. A special visit of students from the Alabama School for the Deaf was arranged at the WSFO. There the students with the aid of a sign-language interpreter, viewed tornado films and learned basic severe storm safety rules.

- Don Davis, MIC, Grand Island, reports that his office is still presenting a course on severe weather to all classes at the Nebraska Law Enforcement Training Center. This includes training of local law enforcement officers from throughout Nebraska. WSO Grand Island has been doing this for several years.

- Marvin Shimp, Marquette OIC, recently presented a letter of commendation from the Director of the NWS Central Region to the Eighth District of the Michigan State Police. The presentation was made to the

District Commander, Captain Harold Morrison. The Eighth District has assisted greatly in making imporvements in storm reporting and watch/warning dissemination in the Upper Peninsula during the past year. They have participated in many of the local meetings and spotter training sessions.

- o Western Kentucky University in Bowling Green, Kentucky, has a meteorology class that is concerned with disaster awareness/preparedness. The students are used as tornado watchers during March, April and May. They are hoping to expand this program in the future.

- o Elroy Jagler, MIC, WSFO Milwaukee reports 9 major activities took place with HAM radio groups including a very successful statewide drill and the training of 180 HAM spotters. HAMS have been used in several severe weather situations over the past few years.

- o Harold Lowman, OIC, WSO Concordia, trained 450 to 500 spotters in Concordia's 14 counties, appeared on two TV shows and taped two interviews and 11 public safety spots that were used by 10 radio and TV broadcasters in Kansas and Nebraska during the storm season. Safety seminars were conducted for 1300 students in two school districts and for 350 senior citizens in five different cities.

- o Jack Cooley, MIC, WSO Grand Rapids, received a letter from the Michigan State Veterans' Facility in Grand Rapids praising a preparedness presentation he made at the facility, a hospital and nursing home. About 70 people from eight counties attended. Each person prepared an evaluation sheet. The only criticism was that they would have enjoyed a longer presentation.

- o Jim Bagnell, OIC, WSO La Crosse, and the local Director of Emergency Government wrote 50 letters offering personal tornado preparedness assistance to all organizations in town where it was thought a large number of people would be congregated. This included motels, factories, restaurants, schools, hospitals, nursing homes and numerous businesses. About 10 organizations accepted the offer right away and others are requesting assistance at the rate of one every week or two.

- o Ralph Robb, (OIC) and Charles Francisco, Gary Johnson, Paul Stry and John Ward, Weather Service Specialists (WSS) have been active in WSO Waterloo's preparedness efforts. During March and April the staff conducted 32 organizational, training, and safety meetings. Total participation was over 1400 people.

- o Marvin E. Miller, MIC WSFO Cleveland reports that a recent issue of the Ohio School Slate contained an article offering NWS resources for school tornado preparedness. He has received requests for information from 189 school systems in 62 counties. Mr. Miller says "...this article has provided us with an excellent vehicle to get preparedness information into the schools."

- o And, speaking of schools, Glenn Schwarz, DPM at WSFO Atlanta has been working extremely closely with state school officials and civil defense in developing statewide tornado drills for all schools in Georgia. In addition to numerous discussions, Glenn spoke to nearly

100 school administrators at a statewide meeting in July. If Georgia does opt for tornado drills in schools, they'll become the 10th state to require them.

- o Don Stoltz, MIC, Bismarck, reports that 11 Truck Regulatory Ports of Entry (weight stations) have been added to the ND reporting network. These will be particularly valuable for winter storm reports. All stations operate 24-hours a day and some are equipped with anemometers.

- o Leighton Schneider, Dubuque OIC, and Carl Weinbrecht, DPM Des Moines, report that the new winter storm slide series has gotten extensive use in their areas. Among other showings, it has been presented to all personnel in the Dubuque Police Department, to many County Sheriffs Deputies, and to driver training instructors in the area school systems. It has also been made a part of the driver training course which is taken by 90% of all high school students in the Dubuque area.

- o Amateur Radio and the National Weather Service has been reprinted and is now available from Central Logistics Supply Center in limited quantities. The booklet has no PA number so be sure and mention the title when ordering.

- o WSO Evansville had their first good test of the spotter capability of the Tri-State Amateur Radio Club since a base station was established in the WSO. During a recent severe storm outbreak accurate and timely reports were received over the area from southwestern Illinois well into western Kentucky. In at least one case a report of a damaging tornado was received from the HAMS several minutes before it was relayed to the NWS via National Warning System (NAWAS).

- o Maury Pautz, WSFO Denver, also reported a highly successful HAM spotter operation during recent tornado and flash flood situations in northeastern Colorado. In a number of cases the mobile HAMS provided information that saved the WSFO from putting out warnings that would otherwise have been issued based on radar.

- o John Schwab, DP Focal Point, WSFO Denver, has layed the groundwork with the Amateur Radio Network and RACES*officials to incorporate their organizations into the Colorado Severe Weather Net. They will be used for the relay of storm and flood information and for warning dissemination.

- o REACT Groups of Pennsylvania Meeting. Recently, MIC Cliff Goodall, WSO Harrisburg, PA, addressed about 100 state-wide representatives of the Pennsylvania Emergency and Communications Council in an effort to enlist their aid in the SKYWARN program, and perhaps in the dissemination of warnings over their CB Radio Networks.

- o Glenn Trapp, MIC, WSO Detroit has made considerable progress in arranging for direct storm reporting to the WSO base station from HAMS throughout the WSO's county area by several meetings with HAM radio groups. Roland Loffredo, MIC Evansville, reports that 30-40 HAMS will be installing rain gauges at their homes with devices

* RACES - Radio Amateur Civil Emergency Service

that will enable a HAM operator to "demute" the receiver so that reports can be received at the office even when the WSO doesn't anticipate severe weather or heavy rain.

- o REACT International recently held its third annual leadership training meeting in Berea, Ohio. Discussions focused on several important topics, including the use of combined HAM/CB radio networks for severe storm spotting. Mike Mogil (DPS, WSH) gave an invited presentation.

- o NOAA Weather Radio Receivers for Wichita Falls Public Schools. Frank Cannon, OIC, WSO Wichita Falls, reports that all local public schools now have tone-activation NWR receivers. The school children periodically practice tornado drills and the safest area in each building has been determined. The NWR receivers were a gift to the schools from area businessmen.

- o Paul Woolard, OIC Norfolk, reported that Norfolk-Madison County CD has just installed a HAM base station in the office. The WSO now has both HAM and CB base stations.

  The City of Colorado Springs has donated a CB base station to the WSO there according to MIC Herb Moore.

- o MIC John Purvis, WSFO Columbia, South Carolina, advises that the South Carolina Disaster Preparedness Agency and ETV representatives made plans to introduce a Bill in the Legislature requesting appropriations to procure NWR receivers in most South Carolina schools. Matching DPA funds would enable the program to be completed.

- o Bob Beebe, Cheyenne MIC was a speaker at the recent Wyoming Governor's Civil Preparedness Conference. Bob concentrated on the need for spotters and the planned NWR network in the state. A picture of a Wyoming tornado (an unusually healthy one) on the front cover of the program gave the NWS a favored spot in the conference.

- o MIC John McClain, WSFO Raliegh, N.C., has been active in trying to involve Flash Flood preparedness with "Community Watch" programs. Community Watchers are individuals organized by the State Crime Control and Public Safety Division, who keep local police advised of local crimes, strangers in the community, etc. In flood-prone areas, the same network and communications can be utilized during periods of heavy rain or severe weather.

- o Kudos for John Murray of the Williamsport WSO for his "...outstanding and unselfish job...in assisting Lycoming County (PA) in the organization and implememtation of a local Flash Flood Warning Service." Lycoming County is the largest in the State of Pennsylvania with more miles of streams than any other county.

- o MIC Max Cagle and Principal Assistant Jim Meese, WSO Bristol; Dean Braatz, River Forecast Center (RFC) Cincinnati; and Joe Goldman, Eastern Region Headquarters (ERH); attended a meeting of Federal and

local officials to discuss the Flash Flood situation along the Levisa River in the Central Appalachians. With the participation of the agencies represented at the meeting, there are plans to install a telemetered river gage in Grundy, VA., This will add to the warning capability of Buchanan County, which already has a Local Flood Warning Program and a Flash Flood Alarm System.

At an evening meeting of the Buchanan County Chamber of Commerce, Goldman described NWS Flash Flood programs and Braatz showed slides of recent flood disasters. Attendees were very interested and the presentations were well received.

o Chris Hill, Lead Forecaster at Reno WSFO, appeared with a representative of USGS on a thirty-minute local television program "Attitudes." The program, which focused on flash floods and community awareness, was taped and aired three times during Nevada's Flash Flood Awareness Week.

o MIC Earnest Rodney, WSO Asheville; Tom Zickus, WSFO Raleigh; and Joe Goldman, ERH, met with officials of Rosman, North Carolina, to discuss local flash flood problems. The town has had an alarm system for several years and wishes to add to its warning capability with a local flash flood warning system.

Joe Goldman also offered the local flash flood warning system to officials of Cortland County, N.Y., and NWS expects to negotiate a memorandum of understanding with that community shortly.

o Sue Touzinsky, St. Louis DPM, recently spoke to a meeting of Civil Defense (CD) directors from throughout Missouri. The emphasis was on ways of helping themselves and the NWS. Flash Flood preparedness and use of the NWR were prime topics.

Sue also prepared a display that was exhibited at the Missouri State Teachers Association Convention. The display, which covered the full range of NWS services. including preparedness, was one of the most popular at the convention.

o Art Valdemar, OIC Springfield, MO, reports excellent results in training and recruiting amateur radio operators this year. Early in the year he presented training to HAMS in Joplin. HAM organizations from Oklahoma, Kansas and Missouri were represented. HAMS from extreme southeastern Missouri and adjoining portions of Kansas and Oklahoma will report storms to the Joplin Emergency Operations Center (EOC). The EOC has NAWAS and will relay the reports to the WSO. Other groups will relay their reports directly to local law enforcement officials. There are plans to establish HAM base stations in the Springfield EOC and the WSO.

The office in Springfield found it impossible to do everything that was needed and were aided in preparedness efforts by the Joplin CD Director, the USAF Observer in Charge at Ft. Wood and a professor from Southweat Missouri State College.

o Larry Mowery, OIC, WSO Flint, began working with the Genesee County Amateur Radio Emergency Service (ARES) about a year ago in the formation of a SKYWARN group within the county. Leaders in the ARES organization have since taken the initiative and expanded the operation throughout much of WSO Flint's county area and southward to form a continuous network with ham groups that are linked to WSO Lansing and WSFO Detroit. They have taken it on themselves to assist WSO Flint in the entire preparedness effort by talking to schools, civic groups, industry and broadcasters in the promotion of community warning operations and public safety education and have themselves organized and trained a number of new spotter networks in Genesee and other counties. They have worked very closely with WSO Flint and were directly responsible for getting NWR receivers in the schools in two districts.

DRILLS

Several large companies in St. Louis participated in the fourth annual statewide tornado drill during the Governor's Disaster Preparedness Week.

There was wide participation of schools and hospitals in a county-wide tornado drill conducted in Vanderburg County (Evansville, IN) during the late spring. All 40 of the public schools, all the Catholic schools and all hospitals participated. MIC Roland Loffredo reported that WSO operations were carried out as planned and there were 50 HAM spotters that checked in during the drill.

Paul Woolard, Norfolk OIC, reports that all schools in the WSO's 15-county area conducted several tornado drills prior to and during the last tornado season. Several years of planning have gone into this project.

Don Stoltz, Bismarck MIC reported that earlier this year "...the North Dakota Branch of the American Radio Relay League participated in the nationwide simulated emergency test. The purpose of the drill was to see how the Amateur Radio operators would respond during a disaster. The National Weather Service in Bismarck, ND, participated directly in these drills. A HAM operator was located in our office both days. The first day a widespread tornado outbreak was simulated with warnings and reports being sent via the Amateur Radio Net. The second day consisted mainly of gathering weather data from particular areas of the state as requested by the Bismarck office.

Illinois, Kansas and Missouri participated in a joint statewide tornado drill this spring. Iowa held a drill, too. Each year the

participation increases and the benefits grow. We hope more states will be involved next year. But now is the time to start planning for such a drill.

And three-hundred ninety-seven more schools participated in the third annual Illinois statewide tornado drill. DPM Chuck Stwertnik, Chicago was successful in bringing the parochial schools in Illinois into this year's drill. Thus, there will be 140,000 additional students and 6,000 additional teachers that will be skilled in taking cover when a tornado warning is issued. The parochial school system's TV network with a receiver in all schools of the most densely populated four counties around Chicago will broadcast the drill tornado warning and, in the future, will broadcast all tornado warnings. The network has also agreed to broadcast the NOAA TV safety spots.

WSFO Pittsburgh and River Forecast Center (RFC) participated in a flash flood drill in southwestern Pennsylvania this summer. According to the news articles in the local press, the drill was quite successful.

The tornado drill in the Topeka-Shawnee County area of Kansas was a success. According to Phil Shideler, MIC, the planning and preparation that went into the drill was critical. The point of the drill is to get coordination and cooperation started early between NWS, Civil Defense, law enforcement agencies, the news media and radio clubs.

Governors and Mayors Nationwide Recognize Weather Hazards. Numerous states and cities have proclaimed weather awareness days, weeks or months this year. Some of these include:

o Governor Dolph Briscoe, State of Texas: "Severe Weather Awareness Month".

o Governor David Pryor, State of Arkansas: "Weather Awareness Week".

o Governor Mike O'Callaghan, State of Nevada: "Flash Flood Awareness Week."

o Governor Richard D. Lamm, State of Colorado: "Colorado Flash Flood Awareness Week."

o Governor Edwin Edwards, State of Louisiana, "Louisiana Hurricane Preparedness Week."

o Governor George Ariyoshi, State of Hawaii, "Severe Weather Awareness and Preparedness Week."

o Mayor Charles B. Wheeler, Kansas City, Missouri, "Disaster Preparedness Month."

Calhoun County in Michigan hired a CETA employee to help survey and identify places in the county to be designated as tornado shelters. The State of Michigan has an applicable statute to protect both the County and persons allowing their premises to be used, from any liability.

Tennessee Tornado Education Week was held in Tennessee March 19-25. Along with the NWS, the Tennessee State Civil Defense, the State Department of Education, and the Agricultural Extension Service of the University of Tennessee, participated in this project.

Dan Houser and Ann Arbor DPM, Charles Matthews, worked hard to bring about the first ever Tornado Preparedness Week in Michigan. The work of all MIC's and OIC's in the State has contributed to greatly increased state level cooperation in NWS warning programs. In particular, Jack Cooley, MIC, Grand Rapids, has been highly effective through his presentations to State sponsored organization and training sessions.

MIC Jay Hull, WSO Cape Hatteras, N.C., forwarded material prepared by the Dare County Civil Preparedness Agency for their recent Hurricane Exercise. A lot of work went into a very extensive program, which had "Hurricane DARA" affecting the Outer Banks in a realistic scenario.

North Carolina Hurricane Awareness Meetings. Al Hinn (MIC, WSO Wilmington, N.C.) advises that Wilmington had a "Hurricane Preparedness Week" during August 14-20. Dr. Neil Frank was a guest at three Marine Resource Centers (Manteo, Bogue Banks, and Fort Fisher) during that week. Several DP publications were handed out at the meeting.

And "Hurricane Awareness Week" was held in Carteret County, N.C. during August 22-26; it was hosted by the N.C. Marine Resources Center, Pine Knoll Shores, N.C. More than 700 persons attended exhibits and talks presented over a week's time. Media coverage was excellent.

Terry Ritter, MIC, WSO Norfolk, Va., was the recipient of a plaque from the Virginia Office of Emergency Services for services rendered during the recent Virginia Hurricane Exercise. A local Norfolk newspaper is preparing a hurricane evacuation map along the lines of a similar one published last year by a St. Petersburg, Florida newspaper.

George Yount, MIC, WSO Charleston, S.C. participated as a panel member in the Georgetown County Hurricane Preparedness meeting. MIC John Purvis, WSFO Columbia, S.C., discussed hurricane preparedness over WBLR Radio, Bateburg, S.C.

Carl Weinbrecht, DPM Des Moines is working on requirements for tornado shelters in mobile home parks in Iowa. To date no states have requirements.

The Department of Safety, Kent State University, has prepared an excellent publication describing "Tornado Watch and Warning" procedures pertinent to Kent State University. The information and instructions contained in this booklet took two years to develop. A publication such as this would prove valuable to other schools, hospitals, public buildings, etc.

National Flash Flood Conference. The American Meteorological Society, the State of California, the Corps of Engineers, the National Weather Service and other groups held back to back flash flood conferences in May 1978 in Los Angeles. One conference dealt with the hydrometeorological aspects of flash floods; the second conference concentrated on the human aspects. Three papers from this conference are being reprinted as part of this Report.

About 300 meteorologists, hydrologists, engineers, government officials, media experts, and others attended the four-day conference. There are tentative plans to hold a similar conference in May 1980 in Atlanta, Georgia.

Natural Hazards Meeting. The Natural Hazards Research and Information Center in Boulder, Colorado recently held a three-day meeting dealing with natural hazards. Nearly 150 governmental representatives (Federal, state, local), scientists, and others attended. Topics such as sociological and interdisciplinary research into natural hazards, the Federal Disaster Reorganization, and plans for the Center were discussed. Similar meetings have been sponsored during the past two years by the Center.

Earl Estelle, Chief, Public Services Branch, in a recent assessment of the NOAA Weather Radio (NWR), says it "...has the potential to make 'NOAA' a respected, household word." and, "...we have the attention of the public and that this provides both an opportunity and a responsibility..."

Some of the highlights of the NWR program include: more than 200 transmitters presently in place nationwide; thirty-two states and Puerto Rico have agreed on cooperative NWR programs with NWS; over the past few years, Radio Shack alone has sold over 1.4 million receivers; Consumers Reports has recently evaluated several receiver sets.

NWR's are being given to buyers and potential buyers of various car models in Evansville, Indiana, and Springfield, Missouri. There's also a television station in Springfield that gives a NWR receiver to each advertiser who buys broadcast time from the station.

One of the major selling points of cable TV stations to motel operators in southwest Wisconsin is the availability of travelers forecasts. The CATV operators in the area are carrying the NWR broadcast out of LaCrosse as the audio portion to the CATV video weather instruments channel.

And at Miami Dade Community College (Miami, Florida), NWR broadcasts and a radar display are being carried on the college's television

system thanks to the efforts of the college's meteorology group.

MUZAK System Offers Additional Warning System. Local Civil Defense directors in a number of cities throughout the United States have come up with a new warning method for the public.

Jim Kraft, director of Yellowstone County Civil Defense in Montana, reports that for approximately $200 equipment can be installed on the MUZAK system to warn citizens of impending disaster.

He pointed out that the MUZAK system was already installed in many public buildings such as supermarkets, shopping centers and office buildings which might not hear siren warnings.

Kraft suggested a contact to your MUZAK Systems representative can give you a valuable warning device that could possibly save many lives.

The Automobile Club of Southern California (ACSC) has prepared some briefs on weather and driving safety and includes these in travel packages mailed to their members. Flash flooding, dust storms, and winter weather are treated. (See one of three reprints attached describing the ACSC program).

The Texas Coastal and Marine Council completed a study on the public response to Hurricane ANITA. Two points derived from the study were:

1. TV was the most heavily relied upon source during the warning period.

2. Newspapers provided the most used source for a hurricane safety checklist. All local papers should be supplied with copies of hurricane safety rules. If a Watch is issued, papers should be reminded to re-publish the list.

Weather Safety Shopping Bags. About 6 million shopping bags with imprinted hurricane and hurricane safety information have been distributed to residents of Hawaii and Texas.

Foodland Super Market Ltd., and WSFO Honolulu were responsible for the Hawaii effort; the Western Craft Paper Group (a producer of shopping bags) and the Texas Coastal and Marine Council effected the Texas project.

ALL FTS NUMBERS UNLESS
OTHERWISE INDICATED

9/78

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San Francisco Operator	556-0220

* Unlisted Number

** Dial Washington FTS Operator to get overseas FTS operator (809) 791-3490

Conference On Human Aspects Of Flash Floods

Jeanne Daughton

Automobile Club of Southern California
Los Angeles, CA 90007

This presentation was delivered in May, 1978, at a "Conference on Human Aspects of Flash Floods" conducted in Los Angeles by the U.S. Army Corps of Engineers. It was part of a panel devoted to a discussion of the techniques for cultivating awareness and preparedness.

Before we can discuss the specific methods or techniques, for cultivating public and community awareness, we need to consider these facts:

A. There is a lag between scientific knowledge and public understanding of the flash flood phenomenon. At the Arizona conference on flash floods last year, we concluded that most of the people who perished in the Big Thompson Canyon flood in Northern Colorado in 1976 lacked the basic knowledge of how flash floods occur and how severe they can be. In that particular situation, state patrolmen ordering immediate evacuations found their warnings unheeded. The apathy of residents and ignorance of tourists resulted in 139 fatalities.

B. We must consider how people learn. Each of us, here today, develops a particular outlook, or opinion, about a specific subject based on a combination of:

1. Culture
2. Language
3. Philosophy
4. Value System

We make assumptions based on fact or fallacy.

As people concerned with cultivating public awareness of flash floods, we have an obligation to make sure the facts are presented clearly and accurately so that homeowners and tourists in flash flood prone areas will make sound decisions when a warning is given, and react quickly but calmly to minimize danger and injury. This presupposes that we communicate the skills, safety precautions and desired behaviors prior to a flash flood watch or warning signal.

It is difficult, if not impossible, to educate, and mobilize the community, in a life-threatening situation when evacuation is imminent. What is needed, then, is an educational approach offering specific guidelines, directions and instructions before a flash flood warning is in effect. I believe that public and community service organizations can be very instrumental in providing assistance in this regard.

C. We must consider the audience. Will we be talking to adult recreation enthusiasts? to residents of secluded, but picturesque, canyons? to motorists traveling throughout Southwest deserts and mountains?

At the Automobile Club of Southern California, we study the needs of our audience carefully and then make a determination on the technique to be utilized and the specific content of our message.

Now let's turn our attention to the techniques, or methods, employed by the Auto Club to communicate flash flood information. What are we doing to bridge the gap of misunderstanding?

Auto Club members, who finance our safety information campaigns, hear the latest information about traffic, transportation and legislation affecting the driver, the road, and the automobile in a bi-monthly magazine called the "News Pictorial." With a readership of over 2 million, the "Pictorial" is an excellent vehicle for explaining the scope of the flash flood problem -- it's threat to life and property -- and for describing step-by-step what should be done if caught in a vehicle, at a campsite, or another locale, when a flash flood warning is issued.

Auto Club maps, tour books and trip-tiks also feature instructional materials for motorists, alerting them to the danger of flash floods when traveling in deserts, mountainous terrain or low-lying ravines.

Since the average annual death toll from flash flooding during the 1970's has tripled from the rate since the 1940's, positive instructions are essential to minimize confusion and combat apathy. Before we can expect people to take action, we must help them to understand that a problem exists.

Health and driver education instructors at public, private and parochial high schools throughout the 13 Southern California counties are also part of our "target group" for generating public awareness. A newsletter entitled "The Steering Column", published four times a year, recently featured a full page story with this headline:

"FLASH FLOODS: NUMBER 1 NATURAL DISASTER"

The story went on to describe the causes of flash floods and the precautions that should be

taken if traveling or camping in flash flood prone areas. This information was presented to encourage classroom discussion between driver education teachers and their students taking behind-the-wheel instruction. As an editor, I would recommend that lines of communication be kept open with driver education teachers because they are in a position to shape the attitudes of young drivers regarding the tactics and skills needed to operate a vehicle in fog conditions, floods, etc.

"The Journal of Traffic Safety Education" and "Family Safety" magazine are just two of the national publications I would recommend to experts in the audience who wish to contribute articles for cultivating awareness and preparedness to respond.

Recognizing that a comprehensive educational program is needed to turn the tide on the number of flash flood victims -- averaging 200 per year since 1969 -- we developed a press release two months ago for newspapers and magazines in Southern California. The three-page press advisory explained what-to-do if caught in a sudden flash flood, inside a partially submerged vehicle. This was a follow-up to an earlier press release which defined the meaning of the term flash flood; described some of the meteorological and climatological causative patterns and provided practical guidelines for protecting one's life and property in times of a flash flood crisis.

As you might expect, the press releases prompted many calls from radio stations for taped interviews, which brings me to an interesting point.

A major report recently compiled by the Radio Advertising Bureau revealed that radio audiences have grown 38%, between 1968 and 1977, as contrasted with 13% for television, 5% for magazines and an actual 2% decline in newspaper circulation. It is a known fact that 50 to 90% of the households in major U.S. cities do not receive the leading newspapers. From this, we can conclude that radio is fast, flexible, economical and effective when communication traffic safety messages.

Looking ahead, I can envision public and community service organizations working together to put greater emphasis on the development of fact sheets, press kits, counter displays, articles in specialized publications (like employee house organs) and slide presentations to generate widespread understanding and support of flash flood warning systems.

In conclusion, I would like to mention that there are many fences blocking effective communication and understanding. These fences are not made of wood, but they are shaped by words, values, and past experiences. I hope I have been able to share with you some of the methods and strategies we rely on at the Automobile Club of Southern California to hurdle these fences, and successfully implement educational campaigns as critical to the public welfare as tropical storm awareness.

Reprinted courtesy of the American Meteorological Society: Hydro-meteorological Conference on Flash Floods--May, 1978

EVENT-REPORTING INSTRUMENTATION FOR REAL-TIME FLASH FLOOD WARNINGS

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1. INTRODUCTION

Flash floods are a frequent visitor to many areas of California. In most years the steep hillsides of this state are visited by heavy Pacific rains which arrive with such intensity that minor streams and even dry canyons are rapidly transformed into torrents of water which can sweep man and his creations into the sea. This year within a few miles of this assembly, nature has demonstrated once again the suddenness of its transformation. For many years, the California-Nevada River Forecast Center has been attempting to develop a capability which would allow effective warnings under such circumstances. Although warnings would not prevent such situations, they would allow a measure of time in the hopes of reducing the deathly toll which nature so frequently imposes.

The problem of providing effective flash flood warnings which generate appropriate and timely reactions requires a two-pronged attack. The first is the adequate identification of hazard areas associated with flash floods, and the second is the development of a definitive warning and reaction program. People generally fail to respond unless warnings specifically apply to their own identifiable situation. A general warning is usually considered as applying to the other guy, as optimism or inbred inertia frequently prevent response to a poorly identified threat. In order to provide specific flash flood warnings to a population center in a timely manner, information is needed from the drainage basin above it. Due to the brief time period before heavy upstream rains generate damaging downstream flows, the maximum time advantage can be gained by monitoring upstream precipitation gages, evaluating from meteorological conditions the expected duration of the heavy rain, and using hydrologic techniques for assessing the runoff threat.

In order to obtain and analyze the appropriate information and integrate it into an effective warning before the flood waters reach dangerous levels, a substantial level of automation is necessary. This paper will deal primarily with the design and operation of a system for collecting real-time precipitation data, while a subsequent paper will develop the systems approach concept which utilizes the data in the generation of discrete flash flood warnings. The resultant system allows the effective interaction between local data collection networks; various data distribution systems, including the National Weather Service's newly designed AFOS system; and analysis techniques developed at the California-Nevada River Forecast Center to provide accurate and timely warnings.

2. INSTRUMENTATION REQUIREMENTS

The basic data collection system designed for short-fuse flood warnings is based upon networks of remote precipitation gages which provide immediate real-time data utilizing one of the most cost-effective automated rainfall measurement systems yet devised. Such a system, in comparison to other automated equipment, is comparatively low in initial cost, appropriate for use in remote locations, possesses a real-time self-initiated reporting capability, and utilizes the simplest available technology in the design of the field components.

Precipitation gages which adequately measure the high-intensity rainfalls capable of producing devastating flash floods must frequently be located at remote sites in the headwaters of the catchment. Ideally, such gages should be self-contained such that they require no external power supply or communication link. Gages at such locations should also possess sufficient physical durability to operate dependably for long periods of time under severe environmental conditions without significant maintenance. The gage design must permit simple installation procedures in order to reduce environmental impact while minimizing installation costs at these remote sites. The design should also be such that the potential for vandalism is at a minimum.

The concept of real-time data collection initiated by a change of status at the sensor site as opposed to the collection of regularly scheduled reports, provides the alert capability required for timely forecasts of flash flooding in response to heavy rainfall in headwater areas. The network of self-initiating remote gages produces precipitation data which can be transmitted to a local site where all sensitive equipment for receiving and processing the network data is housed secure from environmental stress and vandalism. This transfers the record-keeping function from the field unit to a more secure site and allows a substantial reduction in the complexity of the field unit. Such a design also permits varying of the alert criteria at the local collection site as required by changing circumstances

without necessitating any field adjustments of the basic sensors. Additionally, this approach permits the utilization of a mini-computer processor at the local collection site for automatically accumulating and processing the network reports and transmitting them to the central site in a mode suitable for generating automated warnings, all within the required short time periods.

3. SYSTEM DESIGN

The instrumentation and associated equipment comprising the data collection system were designed in response to the above requirements over a period of several years at the California-Nevada River Forecast Center (RFC) in Sacramento. The system consists of three basic components (Figure 1): 1) a network of gages which measure incoming precipitation and transmit change-of-status reports to a local collection site, 2) equipment for receiving and assembling the data at the local collection site, and 3) facilities for transmitting the assembled information to the central site for subsequent analysis.

The basic field unit in this system, the precipitation gage (Figure 2), entails a modular design comprised of components for precipitation measurements, structural support, and data transmission. The structural component of the gage is fabricated from 12-inch aluminum irrigation pipe of sufficient height to provide a buried well for shielding on-site electronics and stabilizing battery and electronic temperatures, as well as providing an integral support for the antenna system. The 12-inch pipe provides a 30.5 mm orifice with no external shoulders. This configuration was chosen on the basis of many years of experience in testing equipment under particularly severe weather conditions in the Sierra Nevada mountains. Such an orifice appears to provide substantially improved catch efficiency and in field tests has demonstrated a level of precipitation catch similar to standard gages using wind shields. A recent comparison is provided in Table 1. Precipitation is caught in an aluminum funnel assembly and measured by a tipping bucket mechanism. Each 1 mm increment of precipitation causes the radio transmitter contained in the electronic package to transmit a

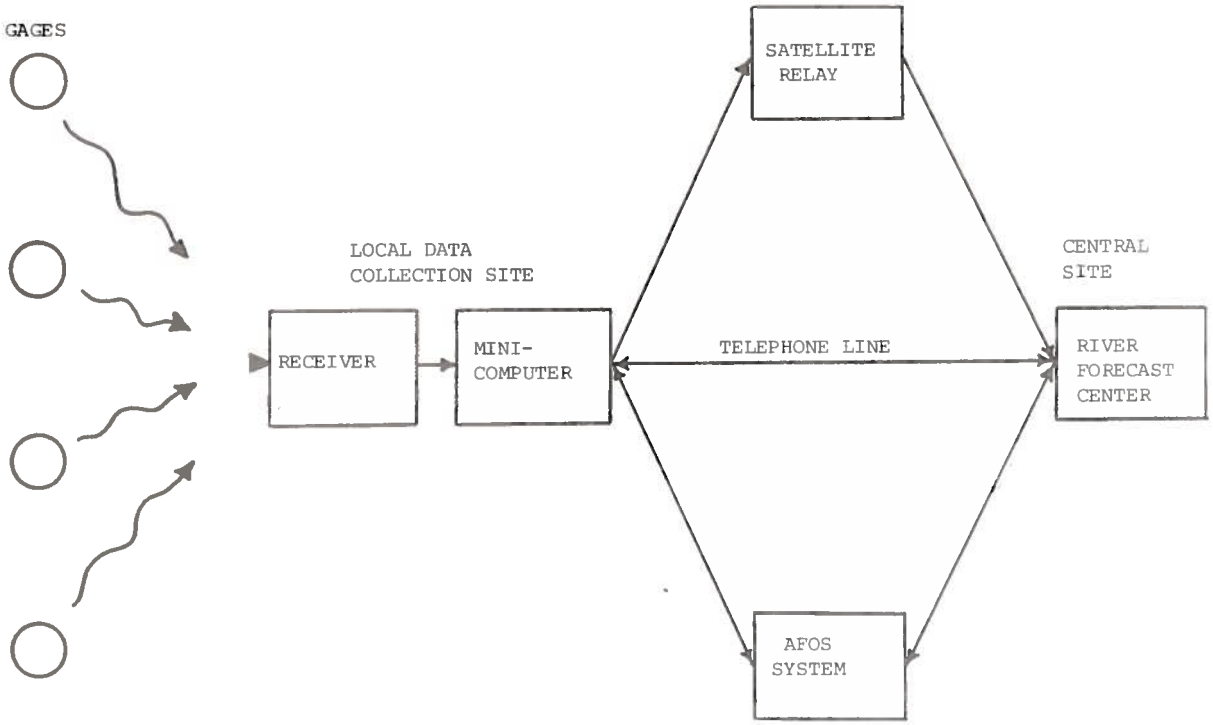

Figure 1. Alternative data collection paths for real-time flash flood warning system.

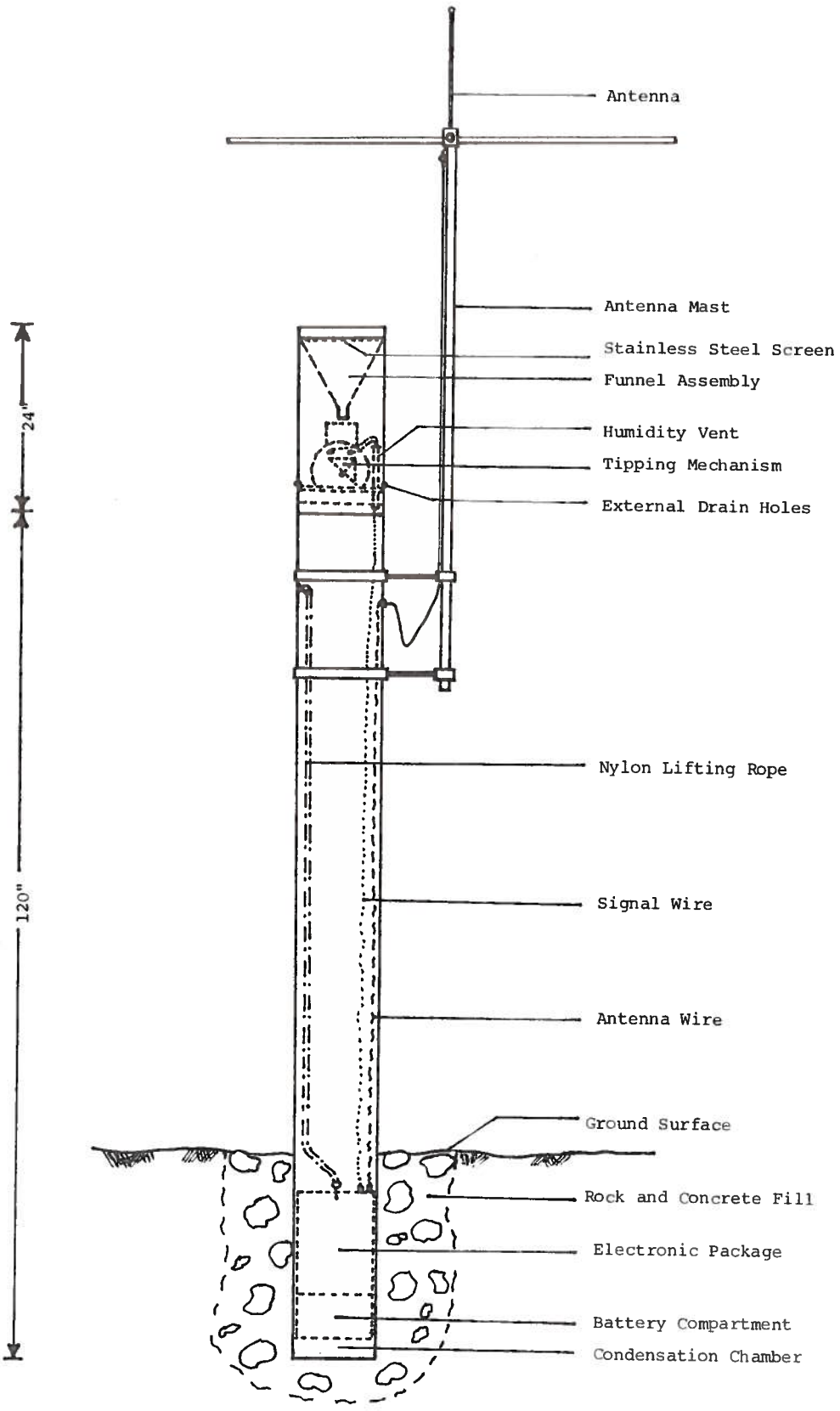

Figure 2. Schematic diagram of installed precipitation gage.

two-digit gage identification number and a two-digit rainfall accumulation value on an appropriate hydrologic radio frequency. Considerations in the design of the field unit include:

1) A whip antenna with ground plane mounted to eliminate drip into the orifice.

2) A straight-sided gage to reduce the vertical lift over the orifice induced by slope-sided or shouldered gages (Jones, 1969).

3) A large orifice diameter, 30.5 cm, to compensate for the pressure jump effect at the leading edge of the orifice which tends to carry precipitation across the throat of smaller gages (Robinson and Rodda, 1969).

4) A stainless steel non-corrosive strainer set deeply into the throat to prevent debris from choking the tipping bucket mechanism.

5) An enclosed tipping bucket mechanism which requires a full throw and alternating tips for signal transmission.

6) A tipping bucket sized at 1 mm to provide good resolution while preventing wind flutter and precipitation balancing frequently found in buckets of .25 mm or less. (Kelway, 1975).

7) A self-contained leveling device to assist in proper placement of the tipping unit.

8) Electronics located below ground for temperature stabilization and protection from errant marksmen.

9) No ground level doors or openings in order to discourage vandalism.

10) A clock option which sends a daily check signal for verification of system operation.

11) A transmission interval of less than 100 milliseconds to minimize battery drain and reduce contention problems between gages operating on the same radio frequency.

12) An integral accumulator which prevents loss of volumetric data if transmissions are occasionally blocked.

13) Modular electronic components for simplified maintenance.

14) A switch-selectable station ID to simplify installation and maintenance.

15) Rechargeable gel cell battery supply with adequate power for over two years of data transmission between charges.

16) A high orifice level to discourage pranksters.

17) A simple cylindrical container to provide a gage enclosure, electronic security and antenna support with minimum environmental impact.

18) Elimination of every function from the field site which can reasonably be performed by the local receiving site.

Table 1. Comparative accumulated precipitation catches (in inches) at Blue Canyon, California, during November 21-22, 1977*.

Time Interval	Mean Wind Speed	Peak Wind Speed	Type of Gage		
			Universal	AMOS	Self-Reporting
0400-0700	16	27	0.81	0.76	0.76
0700-1000	16	29	1.57	1.46	1.48
1000-1300	16	26	2.33	2.11	2.38
1300-1600	13	21	3.15	2.89	3.04
1600-1900	12	25	4.20	3.89	4.12
1900-2200	18	37	5.24	4.86	5.12
2200-0100	19	36	5.55	5.16	5.44
0100-0400	11	24	5.56	5.17	5.48

*First full day of operation for the self-reporting gage.

NOTE: Both the Universal and the AMOS gages have Alter wind shields, while the self-reporting gage is unshielded.

As indicated earlier, the minimization of both installation cost and environmental degradation were important considerations with regard to gage design. Once a valid radio path has been verified, installation of a gage, including operational checkout, has generally been accomplished by a team of 3 people in less than 4 hours. The actual placement of the gage is accomplished by digging a one meter square hole approximately 70 centimeters deep, inserting the gage, and anchoring it with rock and concrete fill. The electronic package is then lowered into position, the electronic and antenna connections made, the tipping mechanism installed and leveled, and the funnel unit attached. The calibration of the tipping mechanism is then verified by pouring a known volume of water into the orifice. This provides a simultaneous check of all operating components and a verification record at the local data collecting site.

The local site, which collects data transmitted by a network of gages and performs some preliminary data assembly, provides an intermediate location where the collection process can be monitored and system equipment maintained and housed in a secure environment. The local collection site should be located such that good communication between a reasonable number of gage locations is possible. It should also provide a convenient location for operation and maintenance. It is anticipated that such sites will be located in continuously manned offices such as County Flood Control offices, National Weather Service Offices, or other involved organizations.

Equipment at the local data collection site includes a radio unit capable of receiving the data transmitted from gages in the network, converting it from audio to digital form, and transferring it to a small on-site mini-computer. The mini-computer, as the other primary component at the data collection site, functions to organize the data, retransmit it to the central site, and prepare information for local interests.

The final component of the data collection system consists of facilities for transmitting the organized data to the RFC for hydrologic analysis and assessment of flood potential. Transmission can occur through one or more of three mediums, 1) the National Weather Service's new data communication system, AFOS (National Weather Service, 1974); 2) collection by satellite communication techniques; or 3) telephonic communications. The National Weather Service AFOS system, which will become operational this year, brings a unique real-time capability for the exchange of information between major Weather Service Offices and cooperating agencies. Entry of rainfall data into any AFOS link will provide nearly simultaneous availability to all appropriate offices.

The use of satellite communications capabilities is expected to provide a highly important method of data transmission into the system where AFOS links are not immediately available. Satellites can collect all available processed data from a local data collection site on synoptic (6-hourly) or more frequent intervals and transmit them to the central site. Such a procedure offers the advantages of satellite data collection from a large number of precipitation gages while requiring the substantially more sophisticated and expensive transmission equipment required for satellite use only at the local collection site rather than at each field gage. The potential for reduced field costs and reduced installation and maintenance expense are substantial with such an approach. The local data collection unit will also have the capability to monitor its received data and if criteria is reached, automatically alert the central site of possibly dangerous situations arising between reporting intervals via commercial telephone. These links, which provide system safeguards in the event emergency communications are required (National Oceanic and Atmospheric Administration, 1977), furnish the necessary redundancy appropriate to a warning system designed to safeguard the lives of those susceptible to rapid flooding.

4. SUMMARY

A precipitation measurement system has been designed to provide substantially more real-time data than has been generally available before. It is designed to do so at a cost which is substantially less than that of other available systems. Complete field gages of the type described have been obtained from commercial sources at a cost of less than $2500 per unit. This compares with field equipment costs for less responsive automated equipment which have averaged over three times as high. In addition, field installation costs of the new equipment have been considerably lower than for other telemetered equipment. The elimination of local power and telephone requirements at the gage site represent a substantial savings at installation in both time and money. Further, the elimination of these factors lowers continuing costs and provides a more secure data system during extreme weather periods when the data is most urgently needed.

In summary, the precipitation gage described in this paper has been designed to provide the capability needed for realistic flash flood warnings based on the availability of reliable real-time data, obtained at a cost which is substantially less than any known alternative.

5. REFERENCES

Jones, D. M. 1969. Effect of housing shape on the catch of recording gages. Mon. Wea. Rev., 97, 604-606.

Kelway, P.S. 1975. The rainfall recorder problem. J. Hydrology, 26, 55-77.

National Oceanic and Atmospheric Administration 1977. Johnstown, Pennsylvania Flash Flood of July 19-20, 1977. National Disaster Survey Report 77-1, Rockville, Maryland, 60 pp.

National Weather Service 1974. Program Development Plan - Automation of Field Operations and Services (AFOS). Silver Spring, Maryland, 113 pp.

Robinson, A. C., and J. C. Rodda. 1969. Rain, wind, and the aerodynamic characteristics of rain-gauges. Meteorological Magazine, 98, 113-120.

Reprinted courtesy of the American Meteorological Society: Hydro-meteorological Conference on Flash Floods--May 1978

A FLASH FLOOD WARNING SYSTEM

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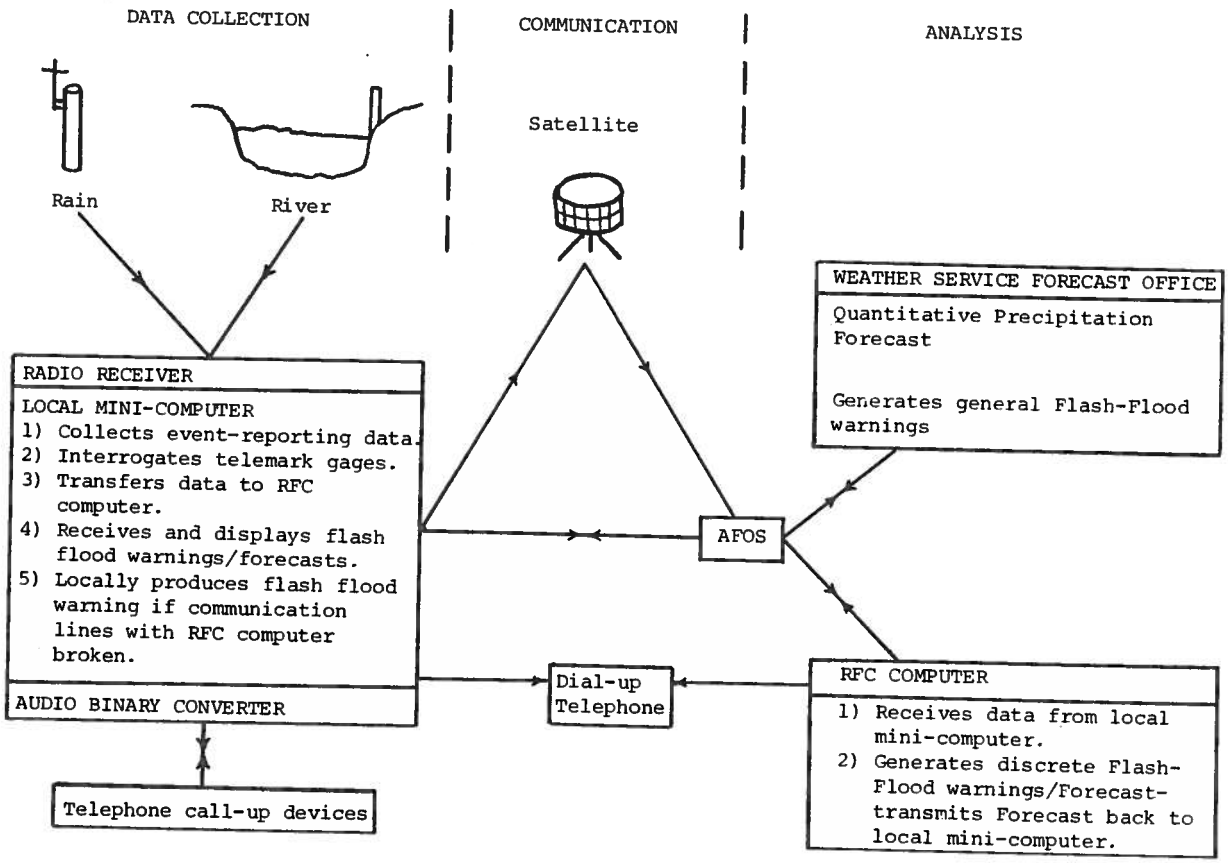
1. INTRODUCTION

The availability of continuous real-time precipitation data of the type described in the previous paper, combined with real-time computing capabilities available in the form of small, inexpensive mini-computers, has allowed the California-Nevada River Forecast Center to develop a highly responsive, automated Flash Flood Warning System. The basic components of the system are shown in Figure 1. The local mini-computer and central RFC computer system are programmed to work together to perform the many different tasks which make up the warning system. The warning system is described in terms of these tasks. Also shown in Figure 1 is a schematic diagram indicating what tasks are performed by the various components of the warning system. It will be helpful to refer to the diagram while reading through this paper.

Figure 1.

FLASH FLOOD WARNING SYSTEM



2. TASK ONE - COLLECTION OF EVENT-REPORTING DATA

Task Number One is the event-reporting data task. This task was discussed in some depth in the paper, "Event-Reporting Instrumentation for Real-Time Flash Flood Warnings", by Burnash and Twedt, and is referred to here for completeness. Briefly, in this task the local mini-computer accepts data from event-reporting gages through a radio system and organizes the data into a convenient form, keeping track of rainfall rates at each gage.

3. TASK TWO - COLLECTION OF TELEMARK DATA

Task Number Two is the "Telemark" interrogation task. This is an optional task in the Flash Flood Warning System, but one which can make use of an existing network of telephone Telemark gages to augment reports from event-reporting radio gages. In this task, the local mini-computer interrogates available Telemark gages at a frequency determined by rainfall rates being reported by the self-reporting gages. For example, during periods of light precipitation, the Telemark gages may be interrogated only occasionally. However, during periods of heavy rain, the interrogation interval may be as short as required to define the streamflow response. Thus, the mini-computer uses the rainfall rates being reported by the event-reporting gages as a cue as to how frequently to interrogate the Telemark gages. In order to perform this task, the computer must be equipped with the appropriate hardware. The hardware required includes a standard auto-call unit which allows the computer to dial the telephone, and an inexpensive Audio-Binary Converter which is a device that converts audio Telemark signals to computer readable data which can be decoded by appropriate software.

It is appropriate to note at this point that telephonic data collection, based on a history of past flash floods, is susceptible to failure during extreme weather situations. The use of radio from the remote sites and the proper location of the local data collection facility in an area not subject to flooding, can help to alleviate this weakness.

4. TASK THREE - TRANSFER OF DATA TO RFC COMPUTER SYSTEM

Task Number Three is the data relay task. In this task, the data collected by the field mini-computer is transferred to the RFC computer system. Presently, the data transfer occurs via telephone communication between the two computers. That is, the field mini-computer makes a telephone call to the RFC computer system or, if appropriate, the RFC computer calls the field mini-computer. Once a communication line is established, the field computer sends and the RFC computer accepts the data that has been collected by the field mini-computer. The field mini-computer must be equipped with an Auto-Call unit for this task to be accomplished.

Although the present version of the Flash Flood Warning System utilizes telephone lines to transfer data, it will be possible at many field sites for the data transfer to occur through the National Weather Service's data communication system (AFOS) when it becomes operational later this year.

An additional communication path which is needed to provide system stability and effectiveness during extreme weather, involves a data transfer capability from the remote data collection mini-computers to the RFC or AFOS systems via satellite relays. This capability is being developed for several hydrologic programs, and should be available in the future for application to the flash flood problem.

The frequency of data transfer between the local site and the RFC is a function of rainfall intensity. For example, during periods of light precipitation, data may be transferred to the central computer site at six-hour intervals. However, should rainfall rates become large, the data transfer would be accelerated to a level appropriate to the threat potential.

5. TASK FOUR - STREAMFLOW FORECAST/FLASH FLOOD WARNING GENERATION

Task Number Four is the streamflow forecasting task. In order for a forecast of discharge (rate of flow of water) at some point on a stream to be computed from a knowledge of the amount of rain that has fallen on the basin, some type of hydrologic model must be employed. The more realistic the model treats hydrologic processes, the better the model should be able to produce accurate forecasts. The model used by this Flash Flood Warning System is a version of the Sacramento Streamflow Simulation Model, which has proved to be very reliable in its ability to produce accurate streamflow simulations for small watersheds.

In this task, the data received by the RFC computer system in Task Three is used as input into the streamflow forecasting model. An additional input into the model is an estimate of the amount of rain that will fall over the area of concern in the next few hours. Known as the Quantitative Precipitation Forecast (QPF), this input is very important to the forecasting task in that it can help provide additional time between when the forecast (warning) is issued and when the flood event occurs. The Quantitative Precipitation Forecast originates at the Weather Service Forecast office, which has basic weather forecasting responsibility for the area of concern. The availability of real-time rainfall reports, transferred to the Weather Service Forecast Office via AFOS, allows integration of the precipitation pattern with satellite analyses and numerical weather prediction models. The Weather Service Forecast Office then provides precipitation guidance information, which is placed in the RFC computer for use by the hydrologic streamflow simulation model. The streamflow simulation model uses the observed and forecasted

precipitation to produce a streamflow discharge forecast for a specific point on the stream in question.

The RFC computer system then converts the forecast discharge values into forecast stream stages and produces a worded forecast based on these stages. The worded forecast, along with the forecast discharge and stages, are displayed at a monitor station in the RFC. The monitoring hydrologist is then given a short period of time by the computer to decide if changes should be made to the forecast being displayed, or if the forecast should be sent as-is. If the hydrologist does not respond within the given time period, or if he decides to use the computer-generated forecast unchanged, the forecast, as displayed in the RFC, is transmitted back to the local mini-computer, which then displays it on the desired output devices so that immediate action can be taken by the appropriate personnel. If enhancements to the computer-generated forecast are made by the hydrologist on duty, the revised forecast is transmitted to the local mini-computer instead of the original.

As a backup measure, in the event that the communication line between the field mini-computer and the RFC computer system is lost, the field mini-computer can have the optional capability of being able to perform the streamflow forecasting task locally. This is done, however, at the cost of losing the QPF input, thus shortening the warning lead time.

Due to substantial computer size and data base differences, the model intended for use in the local mini-computer does not contain the same capability which exists at the RFC. It provides a fail safe technique which is intended to provide up to 48 hours of capability in the event of communication failure between the local data collection site and the RFC.

6. SUMMARY

In summary, the proposed system which is now operating in portions of California, is intended to provide an effective warning system for one of nature's most damaging events, the flash flood. It provides for effective interaction at the warning level between local communities and the hydrologic and meteorologic capabilities of the National Weather Service.

Complete system development will be dependent upon the involvement of local communities in providing the sensors and data accumulation equipment which are necessary at the local level. The National Weather Service is providing design information, software support, local review and the integration and systems capability which are intended to allow discrete flash flood warning capability for a growing portion of California and Nevada.

The entire system approach, which is based upon real-time data acquisition, processing and evaluation, is presented as an attempt to eliminate the information deficiencies and substantial time delays currently inherent in collecting data and in producing and disseminating timely warnings. It is largely these factors which have frustrated efforts to provide a more effective flash flood warning capability. It is hoped that the extra minutes, and in some cases hours, gained by the approaches outlined here will result in a warning process which, in many instances, can provide the difference between life and death.