

FLASH FLOOD PREDICTION PROGRAM HIGHLIGHTS

by

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Communications and Product Dissemination

Ask any experienced emergency manager...what's the weakest link in achieving a successful emergency response?...and almost without exception the answer will be "communications." Past issues of *Flood Hazard News* have discussed many technological and procedural changes which are now integral components of the District's 15-year-old Flash Flood Prediction Program (F2P2). Many of these changes have directly affected the way we communicate today.

The fax has proven itself an extremely useful tool. In 1992, the District's contract meteorologist, Henz Meteorological Services (HMS) made a total of 11,482 program-related fax communications to 43 emergency service and public works agencies in the Denver area. The fax continued to be used extensively in 1993 to disseminate the following F2P2 products:

Message Forms are prepared uniquely for each F2P2 dissemination point with fax capabilities. These computerized forms are similar to those used by 911 dispatchers to document and relay voice communications (i.e. internal alerts, watches, warnings and updates). Whenever possible, messages are faxed to communication centers immediately prior to making the required voice contact. HMS meteorologists verify receipt of the fax, review its contents with the duty dispatcher and answer any questions. The dispatcher then follows internal procedures for relaying the weather information. This process has essentially eliminated the need to write down the specifics of the message and greatly reduced the potential for misunderstanding its meaning and communicating incorrect information.

Heavy Precipitation Outlooks or HPOs are issued daily by 11:00 a.m. When necessary, the HPO is updated by 4:00 p.m. This fax product is also available via the District's dial-up Electronic Bulletin Board (EBB). The EBB has been in operation since 1988, but not all agencies have computers with

modems, whereas, most offices do have fax machines.

Internal Message Status (IMS) reports are prepared only when the program is functioning in an alert mode. The IMS is disseminated as soon as possible after F2P2 messages have been issued to required county contact points. This product is also identical to the one available from the EBB. The intent of the IMS is to keep all parties updated concerning the message status for the entire District area. Relative to voice communications, this product has a lower priority and is not relied upon as a means of initial notification of flood potential or warning. When "high-touch" operations are in progress at HMS, it may or may not be possible to update the IMS.

Quantitative Precipitation Forecast (QPF) is another fax disseminated EBB product which contains technical information designed primarily for hydrologists and other technical personnel. It is prepared only for days having a 1.5-inch or greater one hour rainfall potential. The QPF contains probability forecasts of storm duration, rainfall intensity and cumulative amounts for three possible scenarios based on current atmospheric data and predicted short-term changes. The probabilities of occurrence for each storm type are identified for twelve major drainage basins. This QPF product has been used since 1989.

StormTracks (ST) provide an easy-to-understand map showing predicted impact zones, movement, timing, stalling potential and relative size of a storm or multiple storms expected to cross the District. Text is added to summarize conditions and the estimated magnitude of the flood threat. STs are only issued on "Message Days" and are not available on the EBB. Lead times for issuing the ST vary according to flood potential and the availability of current meteorological data. Lead times of 3-hours or more are attempted when the flood potential is very high. For lower flood potentials (10-year or less), lead times of 30- to 60-minutes are generally provided. Updates are issued

as the event progresses. The ST may now be the most anticipated and relied-upon product offered by the F2P2.

By the end of the 1992 flood season, the number of fax dissemination points had increased substantially, and timely delivery of fax products posed a concern due to single fax machine limitations. Certain products required 30-minutes or more to transmit to the programmed call list. This bottle-neck was eliminated in 1993 by using a new U.S. West service known as "Broadcast Fax." The 30-minute transmission time was reduced to two minutes by sending a single one-page fax to a central fax number. Once received, the central fax sends the product simultaneously to the District's user list. The delivery status is promptly reported to the fax machine originating the call. The only difficulty encountered was during World Youth Day activities in August. Like the mid-west floods of 1993, this temporary loss of service can be considered a rare event. The 1993 test of Broadcast Fax was judged a success and this service is expected to continue. To control costs, the service will only be used when multiple "priority" communications are appropriate. Daily HPOs and non-critical IMSs and QPFs are not disseminated by this method.

The EBB continues to serve year-round as an excellent way for users to obtain hard-copy weather information. Six phone modems are now available. In 1992, more than 1300 logins were recorded for EBB access alone. As a result of wide-spread fax usage and other system improvements, this figure was reduced to 500 in 1993. The National Weather Service (NWS) does not disseminate weather information by fax, making the EBB still one of the best ways for Denver area emergency managers to obtain NWS text products.

In 1992, the City of Aurora added EBB dissemination capabilities through some innovative programming by staff engineer, Bruce Rindahl. Currently, whenever any EBB weather product is received at the District from either HMS or NWS, the information is automatically relayed via phone modem

to five other ALERT base stations in Aurora, Denver, Boulder (2 sites) and at HMS. Audible alarms and flashing color displays accompany this delivery of these weather products.

A fax modem was added to Aurora's ALERT base station in 1992 resulting in the ability to send high resolution graphics, ALERT data, alarm messages, EBB products, and other text files to any fax machine. By the end of 1993, many innovative communication applications had been implemented by Aurora including: digital pager notification of base station alarms; inter-departmental local area network (LAN) linkage between the base station and networked computers running DOS; automated internal EBB dissemination over the LAN; and color graphics display capabilities for LAN terminals.

Even with these useful computerized enhancements, the telephone remains the program's primary means of communication. Ham radio operators are available to assist with backup communications when requested and a cellular phone is also available. The fax and EBB have greatly increased the program's ability to get information to people quickly and have reduced the potential for misunderstandings. Along with the now 4-year-old procedure for issuing "Red Flag" messages, these electronic devices have minimized the number of direct contacts with 911 dispatchers, as recommended by Denver area emergency managers and communications supervisors. But, regardless of how it is accomplished, the "wake-up call" will continue to be relied upon well into the future.

While all these high-tech developments may seem impressive, the potential for communication failure must remain a major concern of the flash flood program. Steps to further minimize this potential will continue through annual flood exercises, increased news media involvement, more rapid dissemination techniques and refinements based on actual experience. Low cost video communications are already being used by some public safety organizations and we know that seeing is believing. Such techniques can be expected to evolve in the future including the delivery and presentation

of better high-resolution maps along with other easy-to-interpret products.

Advice from Denver area emergency managers has been relied upon heavily in developing standardized communication procedures for the F2P2 and their high degree of involvement must continue in order to achieve the desired response when "the big flood" occurs. It is interesting to note that although a major flood has not occurred in Denver since 1973, or maybe some would argue 1965, the F2P2 remains one of the most recognized local flood warning programs in the United States. We believe that our perceived success status exists because of the network which has been built and maintained by many committed individuals, organizations (public and private), and local elected officials working as a team and dedicated to protecting the public's safety and welfare.

The 1993 ALERT System

The District-operated ALERT system has been collecting rainfall and stream level data since the Lena Gulch network was installed 1985. This system, which initially consisted of nine remote gaging stations and a single radio repeater, has grown substantially. By Spring of 1994, 139 ALERT stations will be in operation collecting data from more than 200 sensors.

New Installations

Four new ALERT gaging stations were installed in October and November of 1993. These stations will be fully operational by next flood season. Three of the sites are part of the Bear Creek system and the fourth site is located in Brighton. All four stations will report rainfall using standard 1 mm ALERT tipping buckets. The Morrison gage also includes a float shaft encoder for continuous monitoring of water levels in Bear Creek. The three new Bear Creek gaging stations represent the final components of the flood detection network project which began in 1989. The City of Brighton is already considering upgrading their rain gage to full weather station status.

Annual Report Standardized

Since 1990, the District has been preparing comprehensive annual maintenance and progress reports for

local government sponsors involved with flood detection networks. Each year special efforts have been made to consolidate required reports into a single publication which includes summaries of ALERT data collected by the District during the previous flood season. While the data reduction task is very time consuming, the benefit of having these reports readily available has been realized. Requests for ALERT data are increasing and the annual report has become a convenient source for fulfilling such requests. The front-end effort of preparing statistical data summaries has reduced staff time in handling requests for information.

The process of preparing the now standardized statistical summaries continues to become easier as software improvements are routinely made. Also, the past three years of work on the entire O&M report has brought us to a comfort level with its format. Due to the size of this document, complete copies are provided only to project sponsors and a few other organizations that actively participate in the F2P2. One copy of the report is available in the District's library for public use.

Emergency Power

Installation and testing of a 10-KW generator was completed last April for the District. This diesel driven unit is located at the District's office building and supplies emergency power to critical equipment on three floors of the building including: two ALERT base stations; radar and satellite receivers and display equipment; weather message fax machine; NOAA Weather Wire; and other components critical to F2P2 operations. The generator also supplies power for the District's Prime Computer, front office lighting and our primary word-processing computers. All computers are provided with individual Uninterruptible Power Supplies.

Radio Paths Re-configured

A dual repeater system for handling all ALERT radio traffic was installed in 1993. Its unique design provides for selectable radio path options should a major system component fail. The two principle repeaters are located at Lookout Mountain west of Golden and at Smoky

Hill in southeast Aurora. Prior to 1993, the Lookout Mountain repeater served the entire ALERT system and represented the weakest radio link.

In a normal configuration, optimum radio paths are utilized which essentially means that data transmissions from remote gaging stations in the eastern portion of the District are repeated by Smoky Hill and the western gage data is handled by the Lookout Mountain repeater. Should one repeater fail, the remaining repeater can be switched to a "pass all" mode and take over operations for the entire system until the failed repeater can be repaired. Should both repeaters fail during an event, which is highly unlikely, most ALERT base stations have dual frequency receivers allowing them to receive data from the remote gages having a direct line-of-sight radio path. This design change has greatly increased system reliability and allows for future system expansion without compromising radio integrity. The system was designed by DIAD, Inc. of Boulder, the District's ALERT system maintenance contractor, and the electronic components were supplied by High Sierra Electronics of Grass Valley, California.

Significant Hydrologic Events

The 1993 flood season was relatively uneventful, particularly in the shadow of the catastrophic mid-west flooding last summer. There were 28 message days in 1993; three in May, seven in June, seven in July, eight in August, and four in September.

The hydrologic records continue to improve as more emphasis is placed on sensor calibrations and routine maintenance. Statistical ALERT data summaries are provided in the annual report for each stream gage in the network. Anyone wanting specific site information should contact the District. The following provides a brief summary of annual peak flows for a few selected stream gages: Ralston Creek at Carr St., June 17, 760 cfs; Van Bibber Cr. at Hwy. 93, June 17, 440 cfs; Westerly Cr. at Montview, Sept. 18, 550 cfs; Harvard Gulch at Logan, July 5, 470 cfs; Goldsmith Gulch at Eastman, June 17, 520 cfs; Toll Gate Cr. at 6th Ave., Sept. 18, 460 cfs; S. Platte River at Dartmouth, June 18, 890 cfs; Cherry

Creek at Wazee, July 13, 680 cfs; and Sand Creek at Brighton Rd., Sept. 18, 580 cfs.

Based on these figures and other records, one might think that the most significant hydrologic event for Denver in 1993 was drought. Regarding the future, Denverites must remember that it has been more than 20 years since a flood has caused major wide-spread impacts here, and history tells us that this string of good fortune should not be expected to continue much longer.

NEXRAD Arrives in Denver

On September 3, 1993, a Kavouras RADAC 2100 computer was installed at the District, replacing the RADAC 1000 which has been displaying color radar data for the F2P2 since 1979. The new system also replaces the Vista 500 satellite downlink system which was installed in 1988. This upgrade provides capability to display a variety of high resolution hydro-meteorological products made possible by the nationwide installation of the WSR-88D radars known as NEXRAD. Denver's NEXRAD radar, located near Watkins, was installed in April of 1993 and was accepted for performance testing by the National Weather Service in May. Full commissioning of this radar is planned for August, 1994.

On November 30, Kavouras installed a data distribution transmitter at the District to allow other users access to radar products via a local phone line. Outside users are responsible for purchasing their own display equipment and making arrangements with Kavouras for data access. The District's decision to act as a communication hub for Kavouras was made to give existing radar users, currently on the District's dedicated phone circuit from Limon, a more affordable option for continuing their radar service. The choice to obtain a RADAC 2100 allowed the District to utilize existing satellite downlink equipment and abandon the expensive long distance phone service which has been in use since 1979. Anyone wishing to connect to the communications hub at the District should contact Dan Modeen with Kavouras, Inc. in Minneapolis at 1-800-328-2278. Existing radar users should contact their Kavouras representative.

ENGINEERING FOUNDATION CONFERENCE ANNOUNCED

A five-day Engineering Foundation conference on "Stormwater NPDES Related Monitoring Needs" will be held August 7-12, 1994, at the Grand Butte Hotel in Crested Butte, Colorado. It is co-sponsored by the Urban Water Resources Research Council of the American Society of Civil Engineers, American Public Works Association, U.S. Environmental Protection Agency, and U.S. Geological Survey. The list of sponsors is expected to expand to also include the Water Environment Federation, American Water Resources Association and the American Institute of Hydrology.

This is a focused conference to explore the needs and technology associated with stormwater monitoring that has to take place under municipal and industrial NPDES stormwater discharge permits. The technology of stormwater monitoring to achieve compliance, runoff characterization, BMP effectiveness and the monitoring needed to define long term trends in receiving waters will be thoroughly examined. Institutional issues, affordability, economics, and what we would like to achieve vs. what is practicably achievable will also be addressed.

It is a fact that stormwater monitoring is very expensive. In addition to the millions of dollars already spent, much more will be spent over the near-term future. This conference will provide a forum for examining where monitoring is at this time and what we, as professionals and as a nation, need to be pursuing and what technology we should be using to achieve the various goals set forth for stormwater in the Clean Water Act and the NPDES regulations.

Because of limited space, attendance will be limited to approximately 120. If you have an interest in this topic and would like to participate in a series of discussions with some of the leading experts in this field, request early registration forms from the Engineering Foundation by contacting Barbara Hickernell in writing at 345 East 47th Street, New York, NY, 10017, by telephone at 800-541-7016, or via FAX at 212-705-7441.