REPORT TO ADMINISTRATOR, NOAA, ON

BUFFALO CREEK (WEST VIRGINIA) DISASTER

FEBRUARY 26, 1972

April 17, 1972

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PREFACE

At the request of the Administrator, a NOAA disaster survey team was formed to investigate the Buffalo Creek (West Virginia) Disaster of February 26, 1972. The team was charged with reviewing the natural hazards warning system and the performance of all elements of NOAA who participated in providing data for the warning service. This document is a report by the team on their findings and their recommendations on the deficiencies that were evident.

The team consisted of: Mssrs. Donald Baker, team leader: Albert Kachic, Eastern Region - National Weather Service representative; and Herbert Lieb, Public Affairs representative. Very able field assistance was provided by: Mssrs. A. W. Roche, Official-in-Charge Huntington, W. Va.; John McClain, Meteorologist-in-Charge Charleston, W. Va.; and Donald Willson, Substation Network Specialist/WSFO/Pittsburgh, Pa.

Additional assistance to the team was provided by: Dr. George Cressman: Mssrs. Don House, Walter Castle, and Alex Sadowski.

Interagency field coordination was maintained by the team through the field representative for the Office of Emergency Preparedness, Mr. Don Hammonds.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

EXECUTIVE SUMMARY

Buffalo Creek (W. Va.) Disaster

At approximately 8:00 a.m. on the morning of February 26, 1972, a coal-slag "dam" failed on an upper branch of Buffalo Creek in the coal-mine section of Logan County in southwestern West Virginia. The extremely rapid and almost total collapse of the dam produced a flash-flood crest over 30 feet high with attending heavy loss of life and structural damage. At the mouth of the Creek, this flood wave had been reduced to about a 1-foot crest. Its time of travel over the 17 mile distance from dam to mouth was approximately three hours. All major flooding and resultant loss of life and structural damage in Buffalo Creek Basin during the 2-day general rains was confined to an area below the ruptured dam.

Hydrological/Meteorological Situation: During the period February 24-26, two storms of moderate intensity moved across the central U.S., causing widespread moderate rainfall over the mid-Atlantic States. Each storm produced an average rainfall of 1"-2" over West Virginia. Flood crest forecasts for the major streams and flash-flood watches for southwestern W. Va. were issued for both storms.

The NOAA Survey Team found no evidence of major or destructive natural flooding. The flood forecasts and flash-flood watches for the area, issued on the evenings of the 24th and 25th, were in effect at the time of the disaster and the flood crest forecasts were reasonably accurate. NWS issued at least 8 flood watches or flood-crest forecasts, between 8:30 p.m. on February 25th and 4:30 a.m. on February 26th, for portions of W. Va. that included the disaster area. All NOAA services functioned well. There was nothing further NOAA could have done that would have made any difference.

The Survey Team, while investigating this disaster, looked into the broader matter of NOAA flood-warning services in W. Va. In doing so, it found some unfilled service needs and some problem areas needing further attention. These led to findings and recommendations highlighting in the following:

1. COMMUNICATIONS AND DISSEMINATION

   Findimgs: NOAA Weather Wire does not exist in W. Va. Local teletypewriter circuits operate in the greater Charleston, W. Va., areas. The AP and UPI have access to these circuits. Availability

of NOAA Weather Wire would have permitted a wider distribution of the warning information. Vital forecasts and warning information are also disseminated by telephone to users in remote areas. Frequent contact was made with the two radio stations located in Logan, W. Va. These two stations are the primary means of disseminating forecasts and warnings to an estimated 250,000 people in the area. People in the affected area do have, and in many cases were watching, television which in this mountainous region is strictly cable TV. Some TV viewers in the disaster area reported flash-flood watches were announced on channel 8 which is the Charleston station. There is no direct input to this TV station by the Charleston Weather Service Forecast Office. It is presumed that this information was obtained over press-wire service. Huntington Weather Service Office does disseminate information by a local loop to the two local TV stations.

Adequate staffing exists for routine services at Huntington and Charleston; during an emergency period, staffing is augmented by recalling off-duty personnel on an overtime basis. This was done at Huntington which had the principle responsibility for the warning situation. The telephone load during this storm period was such that receiving or outputting data and forecasts by telephone was difficult.

Recommendations:

--NOAA Weather Wire be implemented throughout West Virginia.

--An unlisted dedicated telephone line in the Charleston and Huntington office be established immediately for the exclusive use of the news media to receive and relay forecasts and warnings. This is especially needed to service localities at some distances from the NWS offices.

--Investigate with the TV stations means to make TV, including cable transmission, more effective for the immediate dissemination of local warnings of all natural hazards. The capability to interrupt programming in local areas should be pursued.

--Install better communication relay equipment at Charleston, W. Va., to enable quicker dissemination of vital weather information over teletypewriter circuits and to reduce workload during critical forecast periods.

2. COMMUNITY PREPAREDNESS PLANS AND ACTIONS

Findings: In the case of the Logan County-Buffalo Creek disaster, the survey team found no evidence of any community preparedness plan, or centralized authority, to deal with a severe weather emergency situation.

Recommendations:

--The NWS should take the lead or, in consort with the Office of Emergency Preparedness and the Office of Civil Defense, assure the development or motivation of preparedness plans where no such plans now exist, and in the maintenance of community action plans where they do exist. Increase in personnel as well as funds should be sought for NWS community preparedness program.

--Meetings with local, state, public safety, and civil defense officials, and with the news media servicing and area, should be held regularly.

--The use of sirens--fire department, civil defense, and police vehicles--should be explored for warning purposes in all areas.

3. RADAR

Findings: Currently, WSR-57 radars at Cincinnati and Pittsburgh provide only marginal coverage for much of the Charleston, W. Va., area of warning responsibility. Upon completion of the projected Bristol, Tenn. radar installation, the Buffalo Creek disaster area will be within that system's normal operating range, but the Central W. Va. area coverage will continue to be marginal.

Recommendation:

--Install local use or gap-filler radar at Charleston, W. Va., as soon as practicable.

4. FLASH FLOOD EDUCATION

Findings: There is some evidence of public and media confusion about differences between a flash-flood watch and warning and the safety precautions that should be taken.

Recommendations:

--Distribute newly issued flash-flood safety rules and terminology widely and continually.

--Develop and distribute recordings for use by radio stations.

--Develop and distribute spon announcements for TV use.

--Develop a flash-flood slide-lecture series for use at preparedness meetings.

5. FLASH FLOOD ALARM DEVICE

Findings: The survey team understands that the first installation of a flash-flood alarm system is now scheduled for Wheeling, W. Va., in April.

Recommendation:

--Installation of more of these alarms through W. Va.'s flash-flood prone areas should be started as quickly as feasible. For a more positive indication of dam failure, the present alarm system should be modified so that it could be placed in reservoir above a dam as well as in stream below a dam.

6. POST DISASTER NOAA OPERATIONS

Findings: During the rescue and rehabilitation period after a disaster, there are a considerable number of rescuers and equipment in the disaster area which could be subject to another natural disaster, e.g. flooding.

Recommendation:

--Special emergency forecast services (e.g. meteorological, hydrological, etc.) should be provided as soon as possible during a post disaster period. Installation of temporary equipment, observations, and a briefing service should be considered as a part of these forecast services. The disaster survey team should determine the period of need for such services.

CHAPTER I

THE EVENT AND ITS IMPACT

During the morning of February 26, 1972, sometime between 8:01 a.m. and 8:09 a.m., a coal "dam" on a tributary of Buffalo Creek ruptured and released about 15 acres of impounded waters onto 16 downstream communities killing approximately 118 persons.

Buffalo Creek, a tributary of the Guyandotte River, is about 17 miles long and its drainage area is approximately 45 square miles. This Creek is located wholly within Logan County, W. Va., and empties into the Guyandotte River about 12 miles SE from the county seat of Logan, W. Va. Some of the "larger communities" along Buffalo Creek are Man, Kistler, Accoville, Amherstdale, Lorado and Saunders (Three Forks), shown in Figure 1.

In addition to the approximately 118 known dead, twenty persons are still (as of this date) missing from the valley's total population of 4,500. Over 100 persons were severely injured and about 300 other persons were treated for minor injuries. Four hundred buildings and homes were completely destroyed, 400 badly damaged and about 2,200 partially damaged. In the Buffalo Creek Valley, all the numerous bridges above Man, W. Va. were destroyed along with most of the only paved road, the power and telephone lines.

Preliminary estimates indicate that the flood loss, including clean-up, is in excess of ten million dollars.

During the night of February 23 and most of the 24th, about 1 1/2 to 2 1/2 inches of rain fell in Southern W. Va. resulting in rises on the main stem of the Guyandotte and the Levisa and Tug Forks of the Big Sandy River and causing minor overflows in numerous small streams. Three-day total precipitation for West Virginia is shown on isohyetal map, Figure 2.

In the early evening of February 25, thunderstorms developed in eastern and central Kentucky and moved into W. Va. Between 8:00 p.m. on the 25th and 8:00 a.m. on the 26th, these thunderstorms generated approximately another 1 1/2 to 2 inches of precipitation over southern W. Va. Where precipitation recordings in a network are sparse, supplemental rainfall amounts are obtained from containers not normally used for catching precipitation, such as cans, buckets, barrels, etc. A supplemental precipitation survey turned up evidence that a total of 3 3/4 inches of rain had fallen in a small area of Buffalo Creek during the night. One receptacle located in Lorado, W. Va. indicated about 3 3/4 inches had fallen between 8:00 p.m. on the 25th to about 9:00 a.m. on the 26th. This amount was verified by another container and witness located about 20 feet further north.

Including the supplemental precipitation figures, it is estimated that as much as 5.6 inches of rain fell in Buffalo Creek from the evening of February 23 to 9:00 a.m. on February 26.

No snow had been reported in Buffalo Creek hollow nor in the nearby hollows for the past several days. The supplemental precipitation survey team talked to witnesses who indicated that there were about 6 inches to a foot of snow in the higher elevations prior to February 25. None was evident on March 2, 3, or 4.

The dam which caused the disaster varied from 45 to about 60 feet in height and was constructed of porous mine waste. It stored about 21 million cubic feet of water in a 15 to 18 acre lake. Its purpose was to store mine drainage water and silt.

The dam break released a wall of water, coal silt and debris about 30 to 35 feet high near its source. The estimated peak flow was 49,000 cubic feet per second with an average velocity of 15 to 20 feet per second. After the flood reached Accoville, the channel widened and the water lost much of its force. By the time it reached Man, W. Va., its danger was confined to depositing debris and a thick layer of coal silt.

The valley is approximately 17 miles long and the surve took approximately 3 hours to reach the basin's mouth at Man. At most points along Buffalo Creek except in lower reaches high water persisted for less than one-half hour before the Creek receded into its channel. At Man the creek flows into the Guyandotte. Eyewitnesses along the river reported that the already swollen Guyandotte River rose more than a foot as it received the Buffalo Creek wave of water. Eyewitness accounts indicated the water level, prior to the rupture, was about one to two feet below the "dam's" crest. Early on the morning of February 26 there were some indications that mine officials were worries that the dam might be overtopped. There were mine crews at the dam site and it was reported that they were to cut a channel across the dam top to relieve the pressure. There were also many reports that the dam exploded just prior to its rupture. The "dam's" coal slag had been burning for several years. One theory advanced is that the water seeped into the burning slag and built up enough steam pressure to cause the explosion.

Personal observations by members of the NOAA survey team failed to find evidence of unusual or excessively high discharges in the smaller tributaries within the Buffalo Creek area. These tributaries had been bank full or slightly over but there was no indication of a magnitude of flooding that would cause widespread destruction.

It is the unanimous opinion of the NOAA survey team that there would have been little or no flooding on Buffalo Creek because of the rain alone. No official reason has yet been presented as to why the dam ruptured.

CHAPTER II

NOAA PREPAREDNESS ACTION, INFORMATION AND WARNING

The River and Flood Services

The broad-scale objective of the river and flood services of National Weather Service (NWS) is to provide a single, authoritative source of forecasts and warnings for the protection of life and property and for efficient management of water-control structures. To carry out the responsibilities for river and flood forecasting and warning in keeping with this objective, the NWS has both meteorological and hydrologic systems to acquire and collect data, process data, and prepare forecasts and warnings. The significant features of the two systems applicable to West Virginia are as follows:

The National Weather Service (NWS) of the National Oceanic and Atmospheric Administration (NOAA) provides the general public with weather and flood forecast and warning services.

Meteorological analyses and predictions are made available through a forecast system consisting of three levels--National, State or large portions of States, and zones.

1. The National Meteorological Center (NMC) at Suitland, Md., mainly through computerized operations, provides various broad-scale analyses and predictions in graphic form for the Northern Hemisphere. Similar products that show greater detail are made available for the conterminous States and adjacent marine areas. This basic (synoptic-scale) guidance material covers forecast periods to 72 hours and is distributed to Weather Service Offices over the National Facsimile System (NAFAX). Quantitative precipitation forecasts for 12-, 24-, and 48-hour periods also are provided for the conterminous States.

2. Weather Service Forecast Office, Charleston (WSFO) is responsible for weather forecasts and warnings for West Virginia. The WSFO provides main field forecast support and guidance to local Weather Service Offices.

3. Weather Service Office, Huntington (WSO) is responsible for local weather forecasts based upon guidance from the two higher echelons. This guidance is expanded by Huntington station when local observations indicate a need. This WSO is the most direct link to the public and is responsible for preparing and disseminating warnings of severe weather events to designated counties in its immediate vicinity.

Hydrologic analyses and predictions are provided through a forecast system consisting of two levels--River Forecast Centers and River District Offices.

1. River Forecast Center, Cincinnati (RFC) analyzes precipitation and stream data for established regions and prepares river and flood forecasts for use and dissemination by district offices in its region. It also provides routine headwater advisory and flash flood guidance.

2. The River District Office (RDO) maintains the rainfall and river reporting networks in its established district, transmits the data to the river forecast center and disseminates the RFC forecasts to the public and Federal and State agencies. RDOs in Eastern Region of NWS have responsibility to issue Flash Flood Watches for their service areas. WSO Huntington is also the RDO.

Coordination and monitoring of forecasts, watches and warnings, and the issuance of Flash Flood Alerts in the Eastern Region is the responsibility of the Regional Weather Center (RWC) located in New York City.

Meteorology: February 23-26, 1972

The upper winds at the 500 MBS level were near zonal throughout the period with minor short waves rapidly moving eastward and with indications of considerable moisture aloft.

The surface pattern was more complicated. On Wednesday, February 23, filling was occurring on a low moving slowly eastward through Minnesota while at the same time a coastal low pressure system was developing near the Virginia Capes. From this developing low a front extended through Tennessee and Kentucky into Alabama. Warm moist tropical air was overrunning a portion of this front causing rain throughout West Virginia on Wednesday evening and Thursday. Heaviest amounts of rainfall were in southern West Virginia. The rain ended early Friday morning.

On Friday morning February 25, 1972, a wave developed on the warm front in western Tennessee and moved eastward to West Virginia by early Saturday morning. This low was accompanied by thunderstorm and heavy rains. These rains reached southern West Virginia around 8:00 p.m. Friday night and ended late Saturday morning.

National Meteorological Center's Analysis and Prediction Guidance:

The analyses and prediction of large-scale weather patterns prepared and distributed by the National Meteorological Center (NMC) at Suitland, Maryland, satisfactorily depicted the significant large-scale weather features. The 12-hour surface prognostic charts transmitted over facsimile circuit for the period from Thursday, February 24, at 1200Z through Saturday, February 26, at 1200Z showed the frontal zone in the area and the waves traveling along the front producing the rains followed by no rain for a period on Friday as occurred. The 24-hour surface

prognostic chart depicted the actual weather as faithfully except on Friday when the forecast was out of phase by depicting rain behind the time of actual occurrence of rain. However, it showed faithfully the development of the wave on the front which gave the heavy rains early Saturday. The 36-hour and 48-hour surface prognostic charts were as accurate in presenting fronts, waves, and precipitation except they showed rain falling throughout the entire period. Thereby, they missed the interval of no rain on Friday.

The guidance on the amount of precipitation to expect presented in the facsimile transmissions entitled Quantitative Precipitation Forecasts (QPF) was extraordinarily accurate. A measure of this accuracy is shown in Table I which was prepared from information furnished by the Quantitative Precipitation Forecast Branch. The areal extent evaluated was the state of West Virginia below the 38th parallel. It should be noted that this area is much larger than that concerned in this report. The threat score is the correct area of the forecasted precipitation area divided by the sum of the forecast and observe precipitation areas minus the correct area. The post agreement is the correct area divided by the forecast area. The closer these values are to one, at the same time, the better the forecast.

Table I QPF Verification - Areal

Totals; 12-hour Forecasts: February 24, 25, and 26, 1972

For One-quarter inch isohyetals:

Threat = 0.70
Post agreement = 0.79

For One-half inch isohyetals:

Threat = 0.63 (Observe area is larger than forecast area)
Post agreement = 0.91

Another measure of the guidance can be shown by picking verifying points closer to the area concerned and comparing the total precipitation forecast and observed. This was done for Charleston, West Virginia which is a National Weather Service manned station and for Logan, West Virginia which is a cooperative observing station. The results are shown in Table II below.

Table II QPF Guidance Verification - Point Values

0000Z 24th February until 1200Z February 26, 1972

Rainfall total, incremented in periods of:		Forecast	Observe
Charleston, West Virginia	12 hours	2.20 inches	2.41 inches
	24	2.00	2.41
	30	2.50	2.41
	42	1.90	2.41
	48	3.00	2.41

Rainfall total, incremented in periods of:		Forecast	Observe
Logan, West Virginia	24 hours	2.75 inches	3.72 inches
	30	2.95	3.72
	42	2.00	3.72
	48	3.30	3.72

The total rainfall for Logan is representative of the Buffalo Creek area when checked by the isohyetal lines drawn in Figure 2.

Service Operations in West Virginia

Weather Service Office (WSO) Huntington, West Virginia service area includes the Buffalo Creek and Guyandotte River areas. Huntington WSO's main meteorological field forecast support and guidance comes from Weather Service Forecast Office (WSFO) at Charleston, West Virginia. WSO Huntington main hydrological field support and guidance is provided by the Cincinnati, Ohio River Forecast Center (RFC).

During February 23-26, 1972, these offices were concerned with high water, some flooding, or potential flooding in West Virginia areas other than Buffalo Creek: such as, in southern portion of the state on Tug Fork and Levisa Fork of the Big Sandy River; and in northern portion of state on the Tygart River. This northern area is serviced by WSFO at Pittsburgh, Pennsylvania, and the Cincinnati RFC.

The following is a resume of the National Weather Service operations that are pertinent to southern West Virginia.

A.M. February 25, 1972. On this morning the Huntington Weather Service Office had been briefed by the Official-in-Charge on the hydrologic and meteorologic situation and on the trouble that was expected early Saturday morning (February 26).

6:30 p.m. The Official-in-Charge (OIC), Weather Service Office (WSO) Huntington returned to the station. The Hydrologic Service Technician was already on duty. The Hydrologist had been sent home by the Official-in-Charge because he had been on duty most of Thursday and Thursday night.

7:00 p.m. WSO HTS called the Civil Defense at Paintsville, Ky., via the Flash Flood Radio transceiver network and Williamson, W. Va. by telephone advising them of the meteorological development in eastern Kentucky which could cause more trouble. These CD groups had been in operation on February 24 because of the rains which had caused rises on the main stems.

7:30 p.m. WSO Huntington staff discussed the possibility of a Flash Flood Watch (FFW). This action was triggered by a telephone call to WSO Huntington from the Cincinnati Radar at about 6:15 p.m. The radar had indicated thunderstorms forming in Central and Eastern Kentucky with tops around 36,000 feet. WSO Huntington called Weather Service Forecast Office (WSFO) Charleston, West Virginia and discussed the situation. It was decided that a FFW should be issued for southern W. Va. which includes the Buffalo Creek area. At 8:30 p.m. the FFW was issued.

9:00 p.m. The Regional Weather Center (RWC) called WSO Huntington and suggested a FFW should be issued for the whole state except the panhandle.

9:05 p.m. The Official-in-Charge, WSO Huntington called WSFO Charleston and briefed them on the RWC's recommendation.

9:09 p.m. WSFO Pittsburgh issued a FFW bulletin for north central, W. Va.

9:15 p.m. A revised FFW for the state was issued by WSO Huntington. WSFO Charleston called WSO Huntington to coordinate the Pittsburgh and Huntington FFW releases which were to be issued by Charleston to the AP, UPI and NAWAS.

9:45 p.m. WSO Huntington telephoned the radio stations WVOW and WLOG located at Logan, W. Va., and passed on the FFW. The radio stations advised that it was raining heavily and it was concerned about this rain affect on the crest forecast for the Guyandotte River at Logan, W. Va. Huntington advised the stations that they would call back with the updated information as soon as it was available.

10:15 p.m. WSO Huntington called WVOW in Logan and gave them the preliminary updated forecast of 32 feet for Saturday afternoon (Flood Stage 23 feet). The WSO Huntington was in contact with the radio station 4 or 5 times during the night. Also the station received separately a continuous flow of phone calls with regards to flooding; so many, that it was difficult for radio station WVOW and WLOG to use their telephones.

11:45 p.m. Forecast crest stage for Guyandotte River at Logan was received from RFC Cincinnati and was passed on to the radio stations. The new forecast was for the river to crest at 29 feet on 7:00 p.m. Saturday, February 26, 1972.

Midnight WSO HTS released a Flood Statement. This statement was transmitted on RAWARC, local loop and called to the radio stations in Logan, W. Va.

2:00 a.m. February 26, 1972. The Huntington Official-in-Charge and the Hydrologic Technician left the office for a few hours rest. Both reported back to the station at about 6:00 a.m. At this time they began the collection of river and rainfall reports. The rainfall at this time was generally light and tapering off. The first reports indicated that about 1-1/2 to 2 inches had fallen over the southern part of the river district during the night. Only a trace of snow on the ground had been recorded from the reporting network since February 24.

7:00 a.m. WSO Huntington called WSFO Charleston and discussed extending the FFW. It was agreed to extend the watch until noon.

8:30 a.m. A Flash Flood Watch statement was issued that extended the watch until noon. WSFO Charleston also highlighted the FFW in their 4:30 a.m. Zone Forecasts and also extended the watch at 8:30 a.m. in Zone Forecast Areas 2, 3 and 6. (Buffalo Creek is in Zone 6.)

10:30 a.m. It was difficult to reach the radio stations in Logan, W. Va. because of the volume of telephone calls both the National Weather Service offices and the radio stations were receiving. Appalachian Power Co. called WSO Huntington and reported that some sort of dam had broken near Lorado, W. Va. There was a two foot crest of water reported on Buffalo Creek heading downstream toward the Guyandotte River.

The Official-in-Charge and the Hydrologic Technician determined the location of the town and stream from a topographic map and measured its length to determine the feasibility of issuing a Flash Flood Warning. The Appalachian Power Co. indicated that a dam had broken at approximately 9:00 a.m. The Huntington staff, based on information at their disposal, decided that a Flash Flood Warning would be too late and ineffective and therefore none was issued.

The Hydrologic Technician immediately called RFC Cincinnati to pass on the information and to request information on how a two foot wave of water would affect the Guyandotte River and especially its effect on the previous crest forecast for Logan, W. Va. The RFC indicated a foot increase, at the most, would occur at Logan, W. Va. The Cincinnati RFC forecast at this time (not released to public) was for a stage of 27 feet (F.S. -23 ft). The WSO Huntington attempted to reach the Logan radio stations to question them about the dam break.

11:00 a.m. The Huntington Official-in-Charge finally got through to radio station WVOW. The latest river information was passed on and the radio station was questioned about the dam break. The radio station had no information but said they were sending a reporter to Lorado and vicinity. The off-duty Hydrologist called with the report that a Logan radio station was reporting seven people killed in a dam break.

11:02 a.m. The Huntington Official-in-Charge called RFC Cincinnati, Ohio to pass on the latest information and to request an updated forecast. The forecast for Logan was revised to a crest stage of 29 ft. occurring at about 4:00 p.m.

11:30 a.m. WSO Huntington contacted radio station WVOW by going through the operator on an emergency basis. Huntington passed on the new river forecast and in turn received fresh information on the dam break. After this call the WSO relayed the forecast to the State Police and Civil Defense.

12:00 Noon On February 26, 1972, the Huntington Official-in-Charge called Chief WXAP, ER and relayed the report of casualties and the dam break.

It should be pointed out, that all forecasts were transmitted over RAWARC and local loops. By this means, the Huntington-Charleston television stations received the watches and forecasts. However, the watches were only carried on the 11:00 p.m. news February 25, 1972. WSFO Charleston was relaying all releases as well as including Watches and Warnings in their zones to AP, UPI and NAWAS.

In reviewing the foregoing activity, it is in the opinion of the survey team that the NWS services offices involved performed excellently. WSO Huntington's outstanding job is exemplified by its initiative to determine feasibility of a flash flood warning to be issued for Buffalo Creek "dam" break and by its tenacity in pursuing the collection of hydrologic data to aid the RFC Cincinnati in the forecast for Guyandotte River at Logan, West Virginia.

CHAPTER III

DATA COLLECTION AND COMMUNICATIONS

Surface Observations

As noted before the nearest NWS stations to Buffalo Creek are WSFO Charleston and WSO Huntington, W. Va.

Most of the precipitation and river data in this area is received from substations. These substations are private citizens who act as a cooperative observer and provide the NWS with river and rainfall reports. Token payments are made to these substation observers for taking and reporting river and/or rainfall measurements.

There are no precipitation or river substations in the Buffalo Creek basin. There are four substations located nearby which are listed in Table III below. The nearest river gage is located on the Guyandotte River at Logan, W. Va. This gage is telemetered for telephone interrogation.

TABLE III SUBSTATIONS NEAR BUFFALO CREEK

Station	Type	Distance-From Disaster Area
Logan	River & Pcpn. Reporting	19 miles NNW
Kopperston	Pcpn. non-reporting	7 miles SE
Dry Creek	Pcpn. non-reporting	12 miles ENE
Naomi	Pcpn. non-reporting	12-1/2 NE

Weather Radar Observations

Modern weather radars such as the WSR-57 detect precipitation, making it possible to estimate precipitation amounts as well as to identify and track squall lines, hurricanes, tornadoes, and other severe storms. They provide systematic observations of the location, height, and estimated intensity of precipitation. Radar reports of precipitation amounts are made hourly when echoes are observed within about 125 miles of the radar, and more frequently when conditions indicate severe storms or rapidly changing weather.

The radars that presently provide service for Southern W. Va. are located at Cincinnati, Ohio and Pittsburgh, Pa. Both radars did not show any unusual weather in Logan County. It should be noted that Logan County is well outside the 125 nm hydrologic radar range from both of these radars. The Bristol, Tenn. radar which is presently being installed will be able to provide weather surveillance for southern W. Va. including Logan County. However, with all three WSR-57 radars operating there will remain an area around Charleston, W. Va. with marginal radar coverage.

Communications

Meteorological and hydrologic data are normally collected by a number of different communications systems, including teletypewriter circuits, radio and telephones. However, in the area concerned the only system used for data collection and dissemination was via telephone.

Post Disaster NOAA Operations

In the Buffalo Creek basin after the disaster, there were a considerable number of rescuers and much heavy equipment which could have been subjected to another disaster. Recognizing this possibility the NWS provided the following services: (1) Special meteorological (public and aviation) and hydrological forecasts were issued by the Charleston WSFO for the area concerned during the approximate two weeks of rescue operations, and (2) A temporary cooperative observer was hired by Mr. Willson to make precipitation reports based on criteria useful for issuing flash flood watches and warnings.

Recommendations

From the National Weather Service operations reported in Chapter II, from the foregoing information in this Chapter, and from statements by Meteorologist-in-Charge at Charleston, W. Va. to the survey team (such as difficulties caused by having to recut teletype tapes for retransmission of information on local teletype loops to UPI and AP), the following recommendations are in order:

1. NOAA Weather Wire be implemented throughout West Virginia.

2. An unlisted dedicated telephone line in the Charleston and Huntington offices should be established immediately for the exclusive use of the news media to receive and relay forecasts and warnings. This is especially needed to service localities at some distances from the NWS offices.

3. Investigate with the TV stations means to make TV, including cable transmission, more effective for the immediate dissemination of local warnings of all natural hazards. The capability to interrupt programming in local areas should be pursued.

4. Install better communication relay equipment at Charleston, W. Va., to enable quicker dissemination of vital weather information over teletypewriter circuits and to reduce workload during critical forecast periods.

5. Install local use or gap-filler radar at Charleston, W. Va., as soon as practicable. Local use radar even with its more limited range provides information for short-period forecasts and warnings in the immediate area.

6. Installation of flash flood alarms through W. Va.'s flash-flood prone areas should be started as quickly as feasible. One future means of communicating flash flood warnings to users is a flash flood alarm system similar to the one which is being installed at Wheeling, W. Va. This alarm's scheduled operation is expected in April 1972.

7. For a more positive indication of dam failure, the present alarm system should be modified so that it can be placed in reservoir above a dam as well as in stream below a dam.

8. Special emergency forecast services (e.g. meteorological, hydrological, etc.) should be provided as soon as possible during a post disaster period. Installation of temporary equipment, observations, and a briefing service should be considered as a part of these forecast services. The disaster survey team should determine the period of need for such services.

CHAPTER IV

USERS RESPONSE AND SERVICE BENEFITS

Known users of NOAA products in the Buffalo Creek disaster area are the local officials and public, state police and news media.

Based on post-disaster interviews, it was found that the response of local individuals to flash-flood watches and warnings and flood-crest forecasts varied considerably. Upon receipt of watches, etc., from TV, radio, or word-of-mouth, the people's actions ranged from "ho-hum" to moving into someone's house that was considered safer.

Even a local deputy sheriff's alarm of an impending dam break was not heeded by all who heard him. Deputy Sheriff Otto Mutter of Logan County stated that he went up Buffalo Creek Valley with his siren going about 2 hours prior to the dam's rupture. Evidently, previous false alarms on possible dam failures had lulled the people into believing this was just another one.

Several local people were not alerted to potential flash floods the evening prior to the disaster because they turned off their means of communications (radio-TV) or retired before the first flash-flood watches were disseminated. Furthermore, the earliness of the disaster, about 8:00 a.m. on a Saturday morning, may have caught the people entirely by surprise.

Again, based on local interviews that included the news media, it was evident that community emergency preparedness is practically non-existent in Logan County. There is no well-organized centralized focal point for action to be initiated upon receiving warnings, watches, or forecasts; neither is there a systematic dissemination of these alerts other than by the news media.

A brief resume of the local interviews upon which the foregoing findings are based is as follows:

Approximately 50 persons were questioned on knowledge of the NWS watches issued during the evening of February 25 and morning of February 26 and the means by which they received them. The following is the summary of results of this unofficial survey:

TABLE IV SUMMARY OF INTERVIEWS

Radio WVOW	Radio WLOG	TV Chs. 3, 5, 8	Other*	Not Heard
6	1	8	2	33

* Newspaper and telephone

Two themes kept appearing in these interviews. (1) With heavy thunderstorms in the area, many persons turned off their TV's and radio sets because of fear of damage and static. (2) Many people seem to retire early in this area, around 9:00 or 10:00 p.m. These facts imply that our dependence on mass dissemination via radio and TV may require further study for their effectiveness in certain areas.

There had been no visits to the Civil Defense, the radio stations or the local officials in Logan County for about two years. The OIC at WSO Huntington, W. Va. had visited Logan, with the station hydrologist, about a year ago. The primary purpose of this visit was to locate a cooperative observer to continue the river and rainfall observation at Logan, W. Va. and for familiarization. While there, they also visited the local newspaper. There was insufficient time and travel funds to expand the trip to visit the other groups. For about 2 years, Huntington had been understaffed because of personnel illness and transfers. This understaffing required the OIC to fill in thus reducing effective liaison time. The station personnel problem finally stabilized about six months ago. However, during the shortage period, liaison was continued at the state level and with those counties or towns that had an active Civil Defense operation.

It was rewarding to note how a nearby community with an emergency preparedness plan operated during this same storm period. All watches and forecasts were quickly received and passed on to "need-to-know" persons who took appropriate actions. The Paintsville, Kentucky civil defense operations indicated that communities with prepared natural disaster plans and focal points make the National Weather Service dissemination of warnings easier and surer.

Based on information gained from many of the people interviewed and news media releases, it is obvious there is confusion on the difference between a flash flood watch and a flash flood warning.

Recommendations

1. The NWS should take the lead or, in consort with the Office of Emergency Preparedness and the Office of Civil Defense, assure the development or motivation of preparedness plans where no such plans now exist, and in the maintenance of community action plans where they do exist. Allowance in future budgets should be made for the increase in funds and personnel that will be needed for this effort.

2. Meeting with local, state, public safety, and civil defense officials, and with the news media serving the area should be held regularly.

3. The use of alternate alarms or alerts--such as sirens of fire departments, civil defense, and police vehicles--should be explored for warning purposes in all areas.

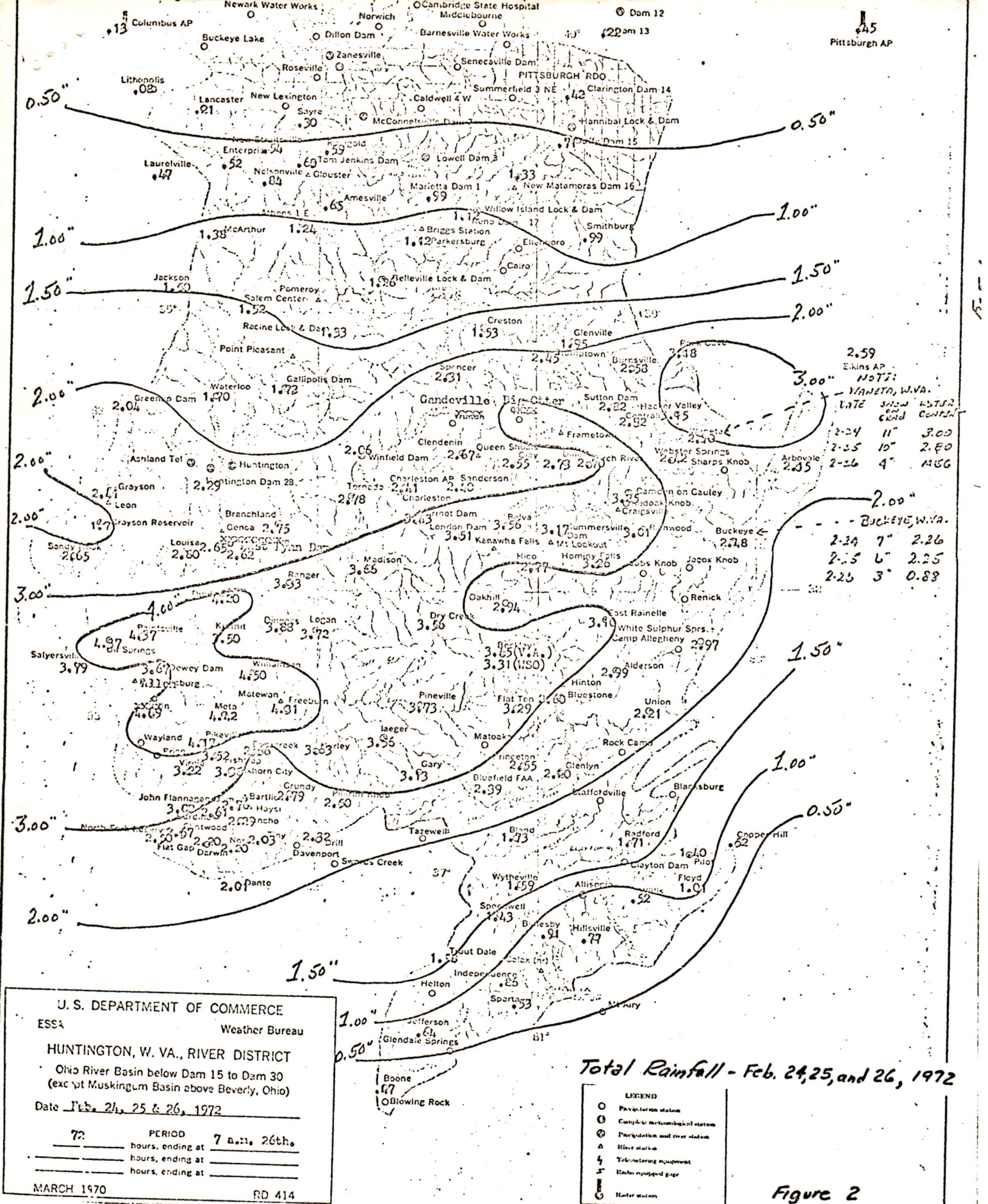
4. Distribute newly issued flash-flood safety rules and terminology widely and continually.

5. Develop and distribute recordings for use by radio stations.

6. Develop and distribute spot announcements for TV use.

7. Develop a flash-flood slide-lecture series for use at preparedness meetings.

Ashland
Huntington
Charleston
Wayne
Louisa
Paintsville
Pikeville
Elkhorn City
Whitesburg
Big Stone Gap
Bristol
Logan
Buffalo Creek
Williamson
Chapmanville
Madison
Boone
Kanawha
Jackson
Mingo
Lincoln
Wyoming
Raleigh
Fayette
Nicholas
Webster
Braxton
Clay
Roane
Calhoun
Gilmer
Barbour
Upshur
Randolph
Pocahontas
Greenbrier
Monroe
Summers
Mercer
McDowell
Wyoming
Tazewell
Russell
Buchanan
Dickenson
Wise
Lee
Scott
Washington
Smyth
Grayson
Carter
Johnson
Floyd
Pike
Martin
Lawrence
Boyd
Greenup
Elliott
Morgan
Monongalia
Marion
Harrison
Doddridge
Tyler
Pleasants
Wood
Ritchie
Gilmer
Lewis
Taylor
Preston
Tucker
Barbour
Upshur
Randolph
Webster
Pocahontas
Greenbrier
Monroe
Summers
Mercer
McDowell
Wyoming
Tazewell
Russell
Buchanan
Dickenson
Wise
Lee
Scott
Washington
Smyth
Grayson
Carter
Johnson
Floyd
Pike
Martin
Lawrence
Boyd
Greenup
Elliott
Morgan
Monongalia
Marion
Harrison
Doddridge
Tyler
Pleasants
Wood
Ritchie
Gilmer
Lewis
Taylor
Preston
Tucker
WEST VIRGINIA TURNPIKE FARE SCHEDULE
How to read—The Toll figure at the intersection of the columns opposite the interchanges selected indicates the Toll between those points. For example the Toll between Charleston North and Berkley is $1.75.
*Mossy Interchange serves only traffic to and from the north.
(Passenger Cars)
Speed Limit 60m.p.h
Charleston (N.)
Charleston (S.)
Chelyan
Mossy
Beckley
Princeton
To Louisville, 182 miles
To Parkersburg, 43 miles
To Paris, 115 miles
To Somerset, 140 miles
To Huntington, 40 miles
For Continuation of Routes See Inset
To Asheville, 91 miles
To Knoxville, 121 miles
To Winston-Salem, 150 mi.
To Mountain City, 13 miles
Figure 1
Road Map - Southwestern W. Va.
16



Total Rainfall - Feb. 24, 25, and 26, 1972

Figure 2