FLOODS
and flood warnings

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U.S. DEPARTMENT OF COMMERCE
Environmental Science Services Administration

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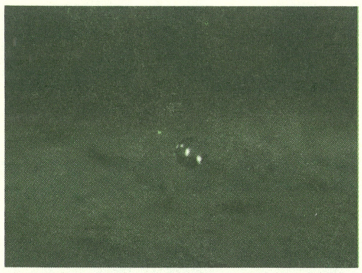
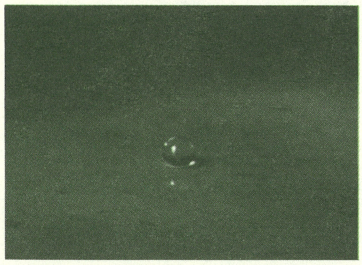
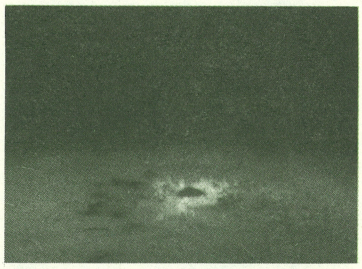
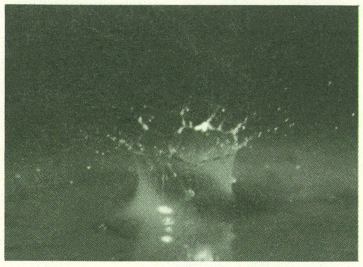
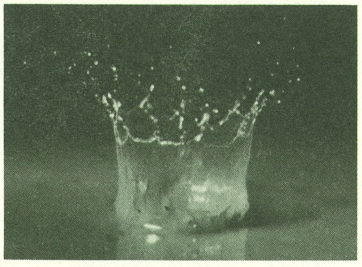
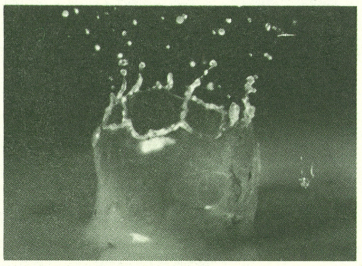












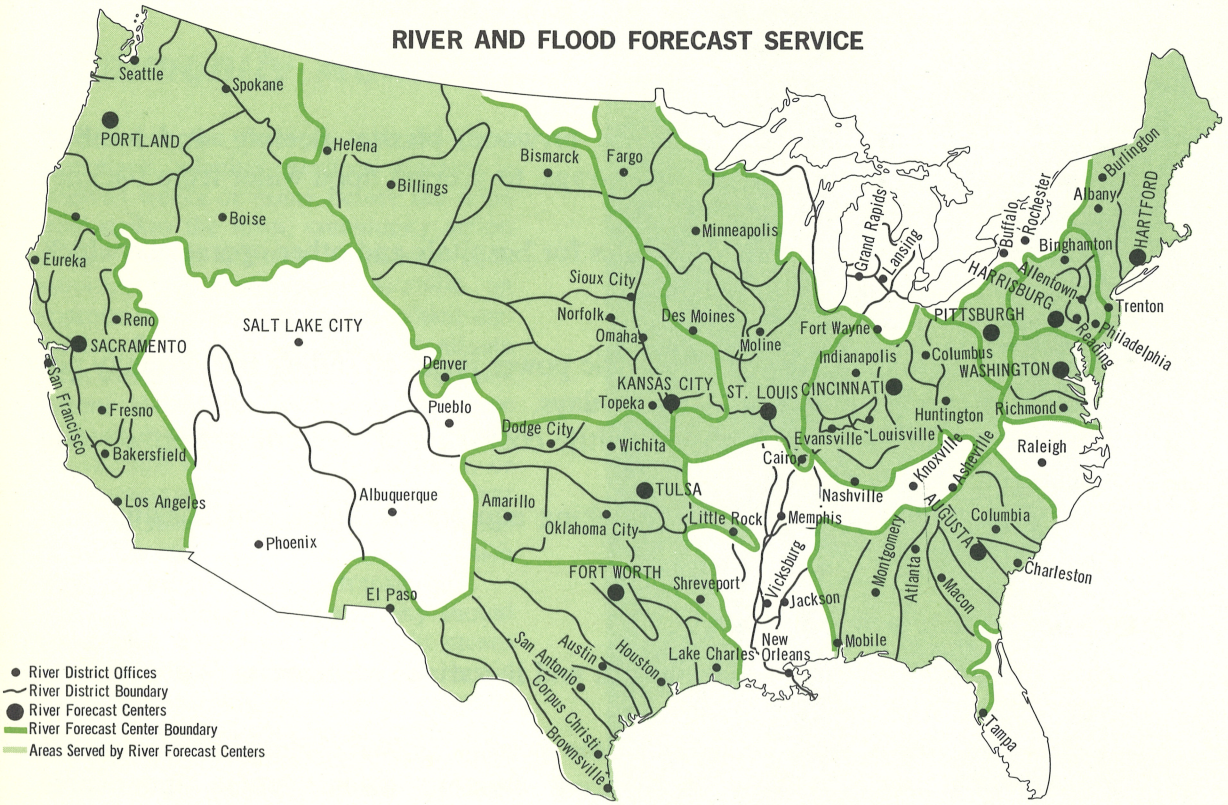
FLOODS and FLOOD WARNINGS

FLOODS are a natural and inevitable part of life along the rivers of our country. Some floods are seasonal, as when winter or spring rains and melting snows drain down narrow tributaries and fill river basins with too much water, too quickly. Others are sudden, the result of heavy precipitation—these are flash floods, raging torrents which rip through river beds after heavy rains, surge over their banks, and sweep everything before them.

The transformation of a tranquil river into a destructive flood occurs hundreds of times each year, in every part of the United States. Every year, some 75,000 Americans are driven from their homes by floods; on the average, 80 persons are killed each year. These destructive overflows have caused property damage in some years estimated at more than $1,000,000,000. Floods are also great wasters of water—and water is a priceless national resource.

ESSA, the Environmental Science Services Administration, keeps a round-the-clock, round-the-calendar watch on the Nation's rivers. Through its Weather Bureau, ESSA maintains a special river and rainfall reporting network, and continually analyzes river and rainfall data to provide river forecasts and flood warnings. The flood warning service is an integral part of ESSA's natural hazards warning program, which provides timely warnings of atmospheric hazards like hurricanes, tornadoes, and other severe storms, and of earthquake-generated seismic sea waves. As with the other warning services, ESSA's flood warnings offer time—time to evacuate low-lying areas, time to move property and livestock to higher ground, time to take necessary emergency action. This service saves many millions of dollars in flood losses annually—and an untold number of lives.

RIVER AND FLOOD FORECAST SERVICE



The field organization behind ESSA's river forecast and flood warning service is extensive. The Weather Bureau's River Forecast Centers monitor the meteorological and hydrologic conditions affecting rivers and water supply. From the Centers, water level predictions are provided for more than 1600 points on the Nation's rivers.

Individual river basins vary in size, topography, soil, ground cover, and climate, and may have engineering works (for example, dredged channels and dams) which affect the flow of water. Hydrologists in the River Forecast Centers design individual procedures for each river system, and revise these procedures as natural and manmade alterations affect stream channels and basins.

Forecast procedures are designed by studying the past history of each stream and the relationships of storm, melting snow, soil, and river conditions to floods. Through these analyses, hydrologists develop river forecasting procedures for predicting the amount of water that will find its way into rivers and streams—and the time it will take to reach them—under different conditions of temperature, soil moisture, and precipitation.

River forecasting methods vary for each part of a river system. For the headwaters, early forecasts and warnings are based on radar observations and measured rainfall. To forecast for points on major tributaries, hydrologists project headwater and precipitation forecasts downstream. Stages on the main stem of the river are predicted by combining all tributary forecasts and computing the time it will take the water to reach the forecast points.

River forecasts require continuous information on present and expected atmospheric conditions in the affected area. This information is supplied via special communications links by the National Meteorological Center in Washington, D. C., where satellite pictures, radar observations, computer models of the atmosphere, and data from thousands of observation points around the Nation are combined into accurate, up-to-date weather forecasts.

The area served by a River Forecast Center is divided into one or more river districts. In each district, one Weather Bureau station is designated as a River District Office. The district office maintains a network of observing stations that report river stages and precipitation amounts. These reports are collected and relayed from the district office to the River Forecast Center.

River forecasts based on atmospheric and hydrologic data are prepared at the Center and then transmitted to River District Offices for distribution to the public by radio, television, and newspapers, and to agencies responsible for flood protection.

Flood Warnings

Floods begin when soil and vegetation cannot absorb falling rain or melting snow, and when water runs off the land in such quantities that it cannot be carried in normal stream channels or retained in natural ponds and manmade reservoirs. River Forecast Centers issue flood forecasts and warnings when the rain that has fallen is enough to cause rivers to overflow their banks, and when melting snow combines with rainfall to produce similar effects.

Early flood warnings allow time for residents to leave low-lying areas, and to move personal property, mobile equipment, and livestock to higher ground. Sometimes valuable crops can be harvested in advance of a destructive flood. Emergency and relief organizations can prepare to handle refugees and to combat the inevitable health hazards caused by floods.

Flood warnings can be issued hours to days in advance of the flood peak on major tributaries. Main river flood forecasts can be issued as far as several days or even weeks in advance. In general, the time lapse between rainfall or snowmelt and the rise in river height increases with the size of the river.

Flood warnings are forecasts of impending floods, and are distributed to the public by radio and television, and through local emergency forces. The warning message tells the expected severity of flooding (minor, moderate, or major), the affected river, and when and where flooding will begin. Careful preparation and prompt response will reduce property loss and ensure personal safety.

Flash Flood Warnings

On small streams, especially near the headwaters of river basins, water levels may rise quickly in heavy rainstorms, and flash floods can begin before the rain stops falling. There is little time between detection of flood conditions and the arrival of the flood crest. Swift action is essential to the protection of life and property.

ESSA's Weather Bureau has helped set up flash flood warning systems in about 100 communities. In these, a volunteer network of rainfall and river observing stations is established in the area, and a local flood warning representative is appointed to collect reports from the network. The representative is authorized to issue official flash flood warnings based on a series of graphs prepared by the Weather Bureau. These graphs show the local flooding that will occur under different conditions of soil moisture and rainfall. On the basis of reported rainfall, the representative can prepare a flood forecast from these graphs, and spread a warning within minutes. Communities within range of a Weather Bureau radar have the additional protection of advance warning when flood-producing storms approach.

Successful operation of a flash flood warning system requires active community participation and planning, but very little financial outlay. Still, the communities with cooperative flash flood warning systems are only a small fraction of the thousands of communities which need them.

Flash flood warnings are the most urgent type of flood warning issued, and are transmitted to the public over radio, television, and by sirens and other signals.

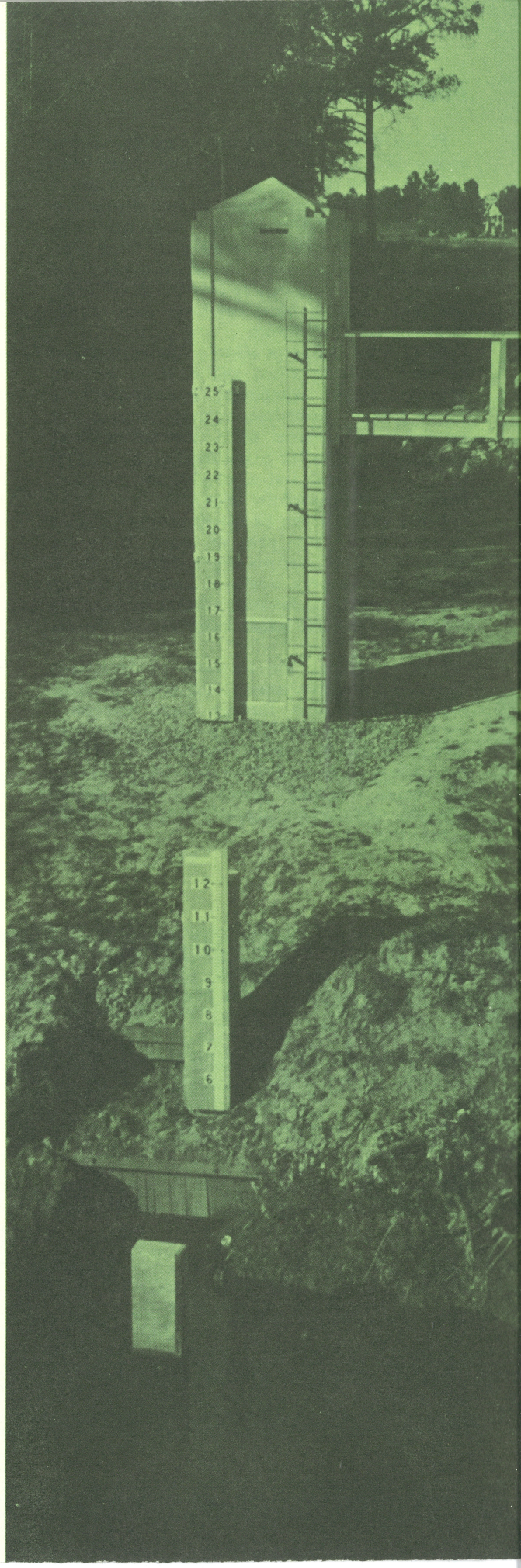
Community Action

■ Whether the flood is seasonal or a flash flood, whether the flood warning is received weeks or hours before the flood crest strikes the town, community action is the key to effective response. It is essential that communities establish an appropriate local organization which can receive flood warnings and disseminate them swiftly to the public. Such organizations should be headquartered where 24-hour operation can be assured, as in the sheriff's office, police department, or other emergency office. The nearest River District Office should be kept informed of the key staff and organization to which flood warnings should be transmitted.

Every member of a community should know what a forecast river height means in terms of his own situation. He should know, for example, how far his property is above or below anticipated flood levels, and how this elevation relates to the river gages for which forecasts are prepared. He should also know the location of safe areas. Many communities have supported flood mapping programs, which make such information readily available to individual citizens.

Community preparedness means that everyone can take positive emergency steps in the face of imminent disaster. Evacuation routes can be established, the emergency coordination center can be manned, Red Cross shelters can be designated, and municipal and enforcement officials can be fully mobilized in advance of a destructive flood.

FLOOD STAGE FORECASTS predict the river level at a specific river gage; **CREST STAGE FORECASTS** predict the highest stage, or level in feet, that a river is expected to reach at a specific gage location. These messages permit constructive planning of safe areas and evacuation routes. Ask the Weather Bureau River District Office in your area where the river gage nearest your home is located, and what gage levels mean in reference to your property.



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Safety Rules

Before the flood:

1. Keep on hand materials like sandbags, plywood, plastic sheeting, and lumber.
2. Install check valves in building sewer traps, to prevent flood water from backing up in sewer drains.
3. Arrange for auxiliary electrical supplies for hospitals and other operations which are critically affected by power failure.
4. Keep first aid supplies at hand.
5. Keep your automobile fueled; if electric power is cut off, filling stations may not be able to operate pumps for several days.
6. Keep a stock of food which requires little cooking and no refrigeration; electric power may be interrupted.
7. Keep a portable radio, emergency cooking equipment, lights and flashlights in working order.

When you receive a flood warning:

8. Store drinking water in clean bathtubs, and in various containers. Water service may be interrupted.
9. If forced to leave your home and time permits, move essential items to safe ground; fill tanks to keep them from floating away; grease immovable machinery.
10. Move to a safe area before access is cut off by flood water.

During the flood:

11. Avoid areas subject to sudden flooding.
12. Do not attempt to cross a flowing stream where water is above your knees.
13. Do not attempt to drive over a flooded road—you can be stranded, and trapped.

After the flood:

14. Do not use fresh food that has come in contact with flood waters.
15. Test drinking water for potability; wells should be pumped out and the water tested before drinking.
16. Seek necessary medical care at nearest hospital. Food, clothing, shelter, and first aid are available at Red Cross shelters.
17. Do not visit disaster area; your presence might hamper rescue and other emergency operations.
18. Do not handle live electrical equipment in wet areas; electrical equipment should be checked and dried before returning to service.
19. Use flashlights, not lanterns or torches, to examine buildings; flammables may be inside.
20. Report broken utility lines to appropriate authorities.

During any flood emergency, stay tuned to your radio or television station. Information from ESSA and civil emergency forces may save your life.

These safety rules were compiled from those published by Government agencies, insurance companies, and the American National Red Cross.

December 1966 • ESSA/PI 660030 For sale by Superintendent of Documents, Price 10 cents

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