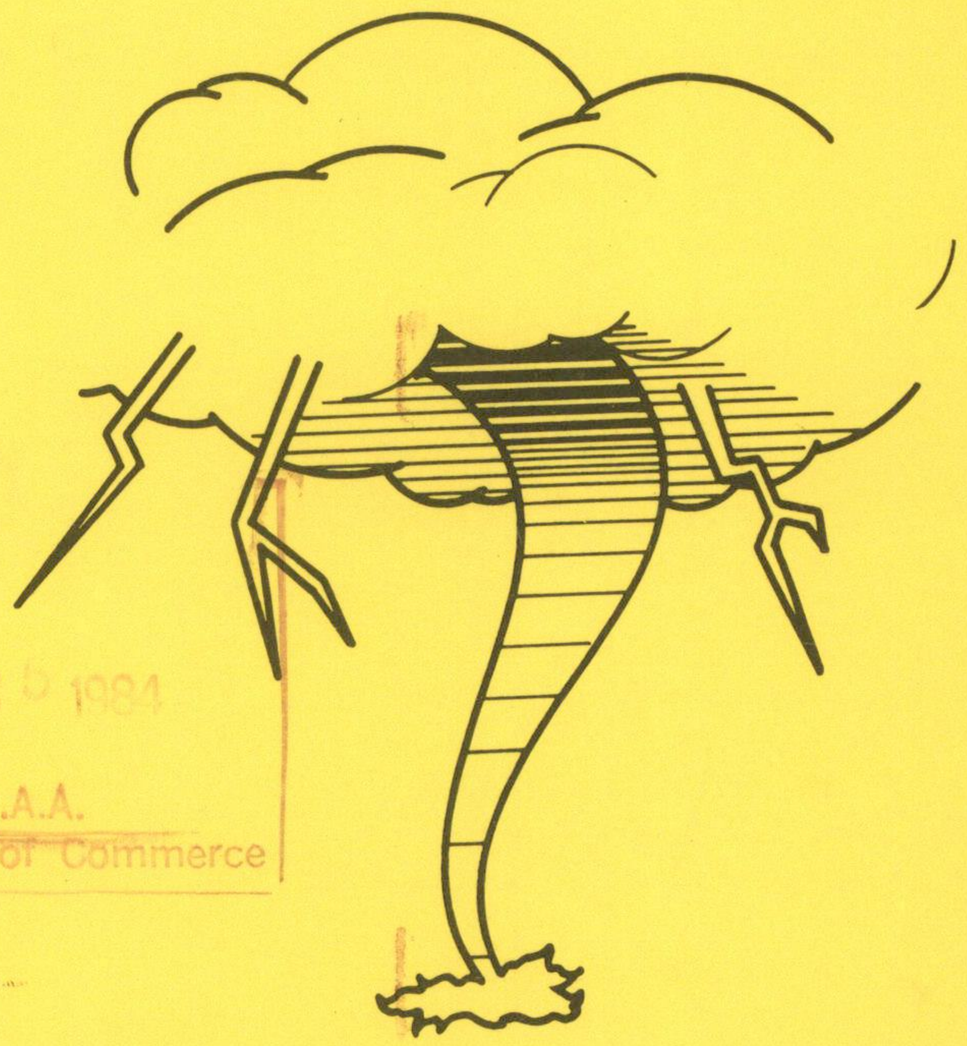
DEPARTMENT OF COMMERCE / National Oceanic and Atmospheric Administration

FEDERAL COORDINATOR FOR METEOROLOGICAL SERVICES AND SUPPORTING RESEARCH

National Severe Local Storms Operations Plan

FCM – P11-1984



Washington, D.C.
January 1984

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NATIONAL SEVERE LOCAL STORMS OPERATIONS PLAN

Washington, D.C.
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FCM-P11-1984

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FOREWORD

This is the seventeenth of an annual series of National Severe Local Storms Operations Plans that was developed after a 1967 request by the Federal Coordinator for Meteorological Services and Supporting Research. This plan is one of several operations plans produced under the auspices of the Federal Coordinator. It outlines the responsibilities of the various United States agencies which provide meteorological services in observing and forecasting severe local storms.

Interdepartmental Severe Local Storms Conferences, of which there have been seven, bring together cognizant Federal agencies to resolve problems of mutual concern related to the National Severe Local Storms Warning Service. Such conferences will be held every two years, if items warrant. National Weather Service Severe Local Storms Conferences are held as required.

This plan supersedes the 1983 version and incorporates changes recommended by the concerned agencies through their representatives on the Committee for Basic Services (CBS) Working Group for Severe Local Storms.

Agencies should be aware that the National Weather Service (NWS) plans to phase out the Radar Report and Warning Coordination (RAWARC) teletypewriter circuit by March 1985. The NWS plans to include the RAWARC functions in its Automation of Field Operations and Services (AFOS) system by that time.

NOAA Weather Radio is playing an increasing role in disseminating weather warnings among Federal agencies and during emergencies. For example, the USAF Air Weather Service uses this system as the primary means of receiving emergency warnings at its locations within the listening areas of NOAA Weather Radio broadcast stations. Therefore, a revised chart of the transmitter locations and a revised list of stations together with their frequencies have been included in this issue of the plan. The USAF Air Weather Service (AWS) uses the NOAA Weather Radio warning alarm system to receive notification within the receiving areas providing the AWS sites are equipped with the radios. Additional information describing the warning programs of the participating agencies can be found in Air Weather Service Regulation 105-8, Meteorological Watch Program; National Weather Service Operations Manual Chapter C-40, Severe Local Storm Warnings; and Operations of the National Weather Service.

William S. Barney
Federal Coordinator for
Meteorological Services and
Supporting Research

1984 January

NATIONAL SEVERE LOCAL STORMS
OPERATIONS PLAN

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1. RESPONSIBILITIES OF COOPERATING AGENCIES

1.1 National Weather Service (NWS).

The NWS shall provide:

a. Basic surface, upper air, and radar observations from its network of stations making such observations.

b. Additional observations, when required. These observations will be transmitted to any requesting agency on the appropriate communication circuits.

c. Basic analyses, forecast charts, and radar facsimile charts through the National Meteorological Center (NMC), Camp Springs, Maryland.

d. Severe Weather Watch Bulletins through the National Severe Storms Forecast Center (NSSFC) at Kansas City, Missouri.

e. Severe weather statements and warnings issued by Weather Service Forecast Offices (WSFOs) and Weather Service Offices (WSOs) throughout the United States.

f. Aviation Inflight Weather Advisories through WSFOs with aviation responsibilities for periods up to 6 hours for aircraft (civilian and military) and amendments to appropriate aviation forecasts whenever severe local storm(s) are possible or are in existence.

g. A concerted effort to collect and relay Pilot Reports (PIREPs).

h. Appropriate public educational materials concerning the severe local storms warning service and development of community preparedness plans in accordance with the Federal Emergency Management Agency (FEMA), National Oceanic and Atmospheric Administration (NOAA) Memorandum of Understanding Concerning the Coordination of Emergency Responsibilities.

i. For conferences with personnel of NSSFC and WSFOs, primarily through its Satellite Field Service Stations (SFSSs), either in person or by telephone.

1.2 National Environmental Satellite, Data and Information Service (NESDIS).

The NESDIS shall:

a. Operate satellite systems capable of providing coverage of selected portions of the United States and adjoining coastal areas during the severe storms season.

b. Receive and respond to requirements for coverage of specific areas and times from the NSSFC.

c. Provide appropriate satellite data to authorized research facilities.

d. Coordinate with the National Aeronautics and Space Administration (NASA) on providing data from its Research and Development (R&D) satellites to NOAA operational units for use on an as required basis.

1.3 U. S. Air Force (USAF).

The Air Weather Service (AWS) is responsible for weather warning support to USAF and U.S. Army units throughout the world. It shall provide:

a. Basic surface, upper air, and radar observations from its network of stations making such observations.

b. Additional observations, when required, making all such reports available to civil agencies through existing communications with Federal Aviation Administration (FAA) or, with prior DOD approval, directly.

c. A concerted effort to collect and relay PIREPs.

d. Through the Air Force Global Weather Central (AFGWC), Offutt Air Force Base, Nebraska:

(1) Weather warning support in the conterminous United States and 200 miles (370 km) offshore to:

(a) U. S. Air Force, U. S. Army, and selected U. S. Navy installations.

(b) Air Force and Army Reserve, and National Guard Units.

(c) Plant sites and facilities operated under Department of Defense (DOD) contracts.

(d) Airborne military aircraft when under military control.

(2) Via the USAF communications system:

(a) Military Weather Advisories for general areas of severe weather potential. Advisories will be issued daily in graphic and alphanumeric format valid for 12-hour periods beginning at 0300Z plus every 6 hours.

(b) Point Warnings in plain language, as required, whenever weather is expected to meet warning criteria. These Point Warnings are issued to about 500 locations in the conterminous United States.

(c) Summaries of severe convective weather occurrences.

(d) Military Weather Advisory Further Outlooks for general areas of severe weather potential. Further Outlooks will be issued twice daily in graphic and teletype format valid for the 12-hour periods beyond the 0900Z and 2100Z Military Weather Advisories.

(e) A continuous meteorological watch (METWATCH) of meteorological parameters for possible severe weather developments and of other weather phenomena for which AFGWC has warning responsibility.

1.4 U. S. Navy.

The Navy does not operate a centralized Severe Local Storms Warning Service. Requirements for early warnings of hazardous flying conditions and local destructive phenomena are met by NSSFC/AFGWC products interpreted locally by personnel of the Naval Oceanography Command. Full use is made of information received on the National Facsimile Network (NAFAX), military, and civil weather circuits.

1.5 Federal Aviation Administration (FAA).

The FAA shall provide:

a. Communication services and observations in accordance with the January 24, 1977 MEMORANDUM OF AGREEMENT between the NOAA and FAA to support the Severe Local Storms Operations Plan.

b. Dissemination/Broadcasting of Airmen's Meteorological Information (AIRMETs), Significant Meteorological Information (SIGMETs), and convective SIGMETs by Flight Service Stations (FSSs) during preflight briefings and to aircraft in flight.

1.6 Exchange of Data Between Agencies.

There shall be a mutual exchange of relevant data on the part of all concerned agencies outlined in Section 1. Because NSSFC and AFGWC are the units responsible for preparing centralized severe weather forecasts, data concerning such forecasts will be exchanged between these units. Direct telephone communications between AFGWC and NSSFC may be made over the Federal Telecommunications Service (FTS).

The coordination channel for exchange of data between NSSFC and AFGWC shall be between the Commander, AFGWC, and the Director, NSSFC. Unresolved differences will be referred to the Severe Weather Branch, Operations Division, National Weather Service Headquarters, and to the Headquarters, Air Weather Service.

At the present time, the National Weather Service, National Environmental Satellite, Data and Information Service (NESDIS), Environmental Research Laboratories' National Severe Storms Laboratory (NSSL), Air Force Geophysical Laboratory (AFGL), and Air Weather Service are actively engaged in developing objective severe weather forecasting and analysis techniques. These organizations will engage, whenever possible, in a joint technique development program and will exchange any objective techniques developed.

1.7 Requests for Special Observations.

Any special rawinsonde (RAWIN) or pilot balloon (PIBAL) observations needed during the continuous weather monitoring underway at NSSFC and at AFGWC are authorized and will be requested when needed.

When special upper air network soundings are required, the requests should normally be made for 0600Z or 1800Z. The lead forecaster, NSSFC, will initiate the request to the National Weather Service and National Aeronautics and Space Administration stations, and the Commander, AFGWC, will similarly request soundings from DOD stations. Although WSFOs have the authority to request special upper air observations during periods of potentially severe storms of all types, requests for special soundings during periods of potentially severe local storms should be made by NSSFC. The agency taking the special sounding is responsible for funding.

Air Weather Service requests for National Weather Service or NASA soundings should be made to the lead forecaster at NSSFC. National Weather Service requests for USAF soundings should be made to the AFGWC duty officer (402-294-2586 or FTS 864-3613).

NSSFC may also request special limited scan Geostationary Operational Environmental Satellite (GOES) data on critical severe storm days.

1.8 Backup Plan for NSSFC.

In the event that NSSFC is unable to discharge its severe weather forecasting functions, the AFGWC will provide backup. Backup procedures are documented in FCM-P14-1984, Federal Plans for Cooperative Backup Among Operational Processing Centers.

1.9 Notification of Military Installations.

Selected military installations, whose AWS detachments are not staffed by forecasters or whose radars are inoperative, will be notified by the NWS when severe convective weather is expected to affect them. The notification will be performed by selected NWS offices which have radar and/or other information available. Notification will be via NOAA Weather Radio Warning Alarms for those sites within the receiving area. This is the most rapid notification available. Otherwise, notifications will be according to "alerting agreements" between the AWS/NWS offices concerned. [Such written agreements are initiated by the AWS units, but require approval of NWS Headquarters before they can go into effect. See Appendix 2.]

The service to be provided is a wakeup/alerting service to cover severe convective weather occurrences with short lead times, i.e., those developments that the AWS' normal alerting system may miss. No other service will normally be required. As appropriate, radar data may be exchanged. Severe convective weather is defined as thunderstorms with winds 50 knots (25 m/s) or more, hail 3/4-inch (20 mm) in diameter or larger, and/or tornadoes.

Notification will be made to only one telephone number. Only one call will be made; however, if the line is busy, one additional call will be made. The notification will be made after the news media and Civil Defense authorities have been notified according to the NWS' present warning dissemination procedures and priorities. The agreement will specify the hours during which the alerting service is to be provided.

1.9.1 Military/NWS Locations Involved. Agreements for providing the alerting service have been signed between the following locations. Changes may be made to this list at any time.

Military Location	NWS Office
Barksdale AFB	WSO Shreveport, LA
Beale AFB	WSO Sacremento, CA
Bergstrom AFB	WSO Austin, TX
Blytheville AFB	WSFO Memphis, TN
Buckley ANGB	WSFO Denver, CO
Cannon AFB	WSO Amarillo, TX
Charleston AFB	WSO Charleston, SC
Columbus AFB	WSFO Jackson, MS
Davis-Monthan AFB	WSO Tucson, AZ
Dobbins AFB	WSFO Atlanta, GA
Dover AFB	WSO Atlantic City, NJ
Dyess AFB	WSO Abilene, TX
Edwards AFB	WSO Palmdale, CA
Ellsworth AFB	WSO Rapid City, SD
Fairchild AFB	WSO Spokane, WA
Francis E. Warren AFB	WSFO Cheyenne, WY
Ft. Campbell	WSO Nashville, TN
Ft. Hood	WSO Waco, TX
Ft. Knox	WSFO Louisville, KY
Ft. Riley	WSFO Topeka, KS
George AFB	WSO Palmdale, CA
Grand Forks AFB	WSO Fargo, ND
Grissom AFB	WSFO Indianapolis, IN
Holloman AFB	WSO El Paso, TX
Homestead AFB	NHC Miami, FL
Hunter AAF	WSO Savannah, GA
Kelly AFB	WSFO San Antonio, TX
Keesler AFB	WSO Mobile, AL
Kirtland AFB	WSFO Albuquerque, NM
Laughlin AFB	WSO Del Rio, TX
Little Rock AFB	WSFO Little Rock, AR
Luke AFB	WSO Phoenix, AZ
Maxwell AFB	WSO Montgomery, AL
McClellan AFB	WSO Sacramento, CA
McConnel AFB	WSO Wichita, KA
McGuire AFB	WSO Atlantic City, NJ
Minot AFB	WSFO Bismarck, ND
Moody AFB	WSO Savannah, GA
Myrtle Beach AFB	WSO Charleston, SC
Nellis AFB	WSO Las Vegas, NV
Offutt AFB	WSO Omaha, NE
Pease AFB	WSMO Brunswick, ME
Plattsburgh AFB	WSO Burlington, VT
Randolph AFB	WSFO San Antonio, TX
Reese AFB	WSFO Lubbock, TX

Richards-Gebaur AFB	WSO Kansas City, MO
Rickenbacker AFB	WSO Port Columbus, OH
Robins AFB	WSO Macon, GA
Scott AFB	WSFO St. Louis, MO
Selfridge ANGB	WSFO Detroit, MI
Shaw AFB	WSO Charleston, SC
Sheppard AFB	WSO Wichita Falls, TX
Tinker AFB	WSFO Oklahoma City, OK
Travis AFB	WSO Sacramento, CA
Whiteman AFB	WSO Kansas City, MO
Wurtsmith AFB	WSO Houghton Lake, MI

2. DEFINITIONS

This section defines those common meteorological terms, subject to multiple interpretations, which are used by agencies preparing severe local storms forecasts and warnings. Metric units contained in this plan are rationalized.

2.1 Funnel Cloud.

A rotating column of air forming a pendant from a cumulus or cumulonimbus cloud whose circulation does not reach the ground or water.

2.2 Severe Local Storms.

Dangerous storms that usually cover relatively small geographical areas or move in narrow paths and are of sufficient intensity to threaten life and property. For the purpose of this plan, a severe local storm is a tornado, funnel cloud, waterspout, or a thunderstorm with winds of 50 knots (25 m/s) or greater and/or hail 3/4-inch (20 mm) in diameter or greater at the surface. Wind damage may be used to infer the occurrence/existence of a severe local storm.

2.3 Severe Local Storms Season.

Although the center of maximum frequency shifts during the year, tornadoes and severe thunderstorms may occur anywhere in the United States at anytime during the year. The months of greatest total frequency are April, May, and June.

2.4 Squall Line.

A line of active thunderstorms or squalls which may extend over several hundred miles. It is the phenomenon of the mature or active stage of "instability-line" development and may be either a solid or broken line of thunderstorms.

2.5 Density/Risk of Severe Thunderstorms.

The following adjectives describe the possible density/risk of severe thunderstorms in an outlook area:

a. Slight risk - 2 to 5 percent coverage or 4-10 Manually Digitized Radar (MDR) blocks with severe thunderstorms per 100,000 square miles (250,000 km^2).

b. Moderate risk - 6 to 10 percent coverage or 11-21 MDR blocks with severe thunderstorms per 100,000 square miles (250,000 km^2).

c. High risk - greater than 10 percent coverage or more than 21 MDR blocks with severe thunderstorms per 100,000 square miles (250,000 km^2).

d. MIC (Maximum Instantaneous Coverage) - the percentage of the area that will be covered by cumulonimbus cells at the time of maximum activity. (Military Weather Advisories only.)

e. TAA (Total Area Affected) - the percentage of the area that will experience one or more thunderstorms during the applicable valid period. (Military Weather Advisories only.)

Adjectives such as the above will not be used to indicate the possible density of tornadoes in a watch. The Tornado Watch Bulletin will only state that the threat of tornadoes exists in the designated watch area.

2.6 Thunderstorm Intensity Categories.

Only the following thunderstorm intensity classes will be used in the forecasting and warning functions of concerned agencies:

a. Thunderstorm - Wind gusts less than 50 knots (25 m/s) and hail, if any, of less than 3/4-inch diameter (20 mm) at the surface.

b. Severe Thunderstorm - Wind gusts of 50 knots (25 m/s) or greater or hail of diameter 3/4-inch (20 mm) or greater at the surface. Wind damage may be used to infer the occurrence/existence of a severe thunderstorm.

2.7 Tornado.

A violent, rotating column of air usually forming a pendant from a cumulonimbus cloud, whose circulation reaches the ground. It nearly always starts as a funnel cloud and is accompanied by a loud roaring noise. On a local scale, it is the most destructive of all atmospheric phenomena.

2.8 Waterspout.

A rotating column of air usually pendant from a cumulus or cumulonimbus cloud which forms over a body of water and whose circulation touches the water.

3. FORECASTS AND WARNINGS

3.1 General.

Although every effort has been made to standardize terminology, adopt common definitions, and adjust criteria to a common base, each agency has differing operational warning criteria that must be met. Although standardization will be used wherever possible in forecasts and warnings, each agency retains the right to specify the forecast and warning criteria that are needed to carry out the mission of its service.

3.2 Other Warning Criteria.

All phenomena (other than those classified as severe storms, paragraph 2.2) described in the various warnings, bulletins, and advisories should be categorized as "other warning criteria" and are not called severe weather phenomena. Such other warning criteria will be listed separately in the appropriate National Oceanic and Atmospheric Administration-National Weather Service publications.

3.3. National Weather Service Watch/Warning Procedures.

3.3.1 General. The National Weather Service has statutory responsibility for providing a Severe Local Storms Watch and Warning Service for all 50 States. NSSFC does not issue watches for Alaska or Hawaii. Instead the WSFOs at Anchorage and Honolulu have the responsibility for maintaining weather watches and issuing warnings as needed for their respective States. Procedures described in this plan are followed to the extent that they are applicable.

This Watch and Warning Service is available to the general public and to aviation and is provided through the National Severe Storms Forecast Center at Kansas City, Weather Service Forecast Offices, and Weather Service Offices.

3.3.2 Watch/Warning Criteria. Events for which aviation and public severe weather watch and warning bulletins may be issued are the same. Any or all of the categories listed below may be mentioned in such bulletins to indicate more fully the severe weather possible/occurring.

3.3.2.1 Severe Thunderstorm:

a. Wind: Thunderstorm related surface winds (sustained or gusts) of 50 knots (25 m/s) or greater;

b. Hail: Surface hail 3/4-inch (20 mm) or larger. The word hail in a watch bulletin implies hail at the surface as well as aloft unless a qualifying phrase such as "hail aloft" is used.

3.3.2.2 Tornado: Severe weather watches/warnings that mention tornadoes imply that thunderstorm activity, usually severe, is also expected/occurring. Severe weather watches will not refer to funnel clouds.

3.3.3 National Meteorological Center (NMC). NMC is the central data processing center for the NWS. NMC issues prognostic charts, discussions, and other forecast materials.

3.3.4 National Severe Storms Forecast Center (NSSFC). NSSFC is responsible for issuing and cancelling severe local storm watches, convective SIGMETS (Significant Meteorological Information) and nonconvective SIGMETS, and for preparing other appropriate material essential to the Severe Local Storms Warning Service.

3.3.4.1 Combined Public and Aviation Watch Bulletins. Although a warning service is provided for public and aviation interests, separate watches are not issued for these interests, but are combined into one bulletin. Each combined watch bulletin (see example below) contains information for the general public (sections A and B) and aviation interests in discrete, alphabetical, sequential sections. When a section is not applicable, it will be omitted. The text will begin with the most serious type of severe weather expected - "Tornado Watch" or "Severe Thunderstorm Watch." The location of the area affected and the valid period of the watch which are common to both public and aviation sections are given in Section A. Combined watches are numbered serially begin- ning with number 1 for the first issuance of each calendar year. NSSFC will issue an unnumbered watch cancellation message whenever it cancels a watch.

3.3.4.2 Convective SIGMETs. NSSFC issues hourly at H+55 and as required Special Convective SIGMET bulletins over the conterminous U.S. based on these criteria:

a. Tornadoes;

b. Lines of thunderstorms;

c. Embedded thunderstorms;

d. Thunderstorm areas greater than or equal to Video Integrated Processor (VIP) Level 4 (LVL 4) with areal coverage of 4/10 (40 percent) or more;

e. Hail greater than or equal to 3/4-inch (20 mm) diameter.

Negative bulletins are issued if the criteria are not met.

3.3.4.3 Nonconvective SIGMETS. NSSFC issues nonconvective SIGMETS in the conterminous United States for severe or extreme turbulence, severe icing, and widespread dust/sand storms lowering visibilities to below 3 miles (5 km).

Example of Watch Bulletin

BULLETIN IMMEDIATE BROADCAST REQUESTED
TORNADO WATCH NUMBER 392
NATIONAL WEATHER SERVICE KANSAS CITY MO
620 PM CDT SAT MAY 14 1983
A... THE NATIONAL SEVERE STORMS FORECAST CENTER HAS ISSUED A TORNADO WATCH FOR

MUCH OF WESTERN AND CENTRAL OKLAHOMA
PARTS OF CENTRAL AND SOUTHEASTERN KANSAS

FROM 7 PM CDT UNTIL 12 MIDNIGHT CDT THIS SUNDAY EVENING.

TORNADOES ... LARGE HAIL ... AND DAMAGING THUNDERSTORM WINDS ARE POSSIBLE FOR THESE AREAS.

THE TORNADO WATCH AREA IS ALONG AND 70 STATUTE MILES EITHER SIDE OF A LINE FROM 50 MILES SOUTH SOUTHEAST OF HOBART OKLAHOMA TO 50 MILES EAST OF SALINA KANSAS.

REMEMBER ... A TORNADO WATCH MEANS CONDITIONS ARE FAVORABLE FOR TORNADOES AND SEVERE THUNDERSTORMS IN AND CLOSE TO THE WATCH AREA ... PERSONS IN THESE AREAS SHOULD BE ON THE LOOKOUT FOR THREATENING WEATHER CONDITIONS AND LISTEN FOR LATER STATEMENTS AND POSSIBLE WARNINGS.

B ... THIS TORNADO WATCH REPLACES TORNADO WATCH NUMBER 389. WATCH NUMBER 389 WILL NOT BE IN EFFECT AFTER 7PM CDT.

C ... TORNADOES AND A FEW SVR TSTMS WITH HAIL SFC AND ALF TO 3 IN. EXTRM TURBC AND SFC WND GUSTS TO 80 KT. A FEW CBS WITH MAX TOPS TO 650. MEAN WIND VECTOR 25030.

D ... TSTMS EXPCTD TO INTNSFY IN PVA AREA AHD OF STG VORT CNTR. UNSTBL AMS AND STG LO LVL WINDS ALSO FAVORABLE.

E ... OTR TSTMS .. CONT WW NR 391. UPDATE AC TO INCL FEW SVR TSTMS ERN AR BY MRNG.

..WILSON..

Examples of Convective SIGMET Bulletins

MKCC WST 302155
CONVECTIVE SIGMET 41C
OK AR TX
FROM 30N FSM TO 50SW LFK TO 60SE LPD
LN TSTMS 25 MI WIDE MOVG FROM 2825. MAX TOPS TO 500.

FCST TO 2355Z
LN WL MOV EWD 25 KT THRU 2355Z. TORNADOES ...HAIL TO 3 IN ... WIND GUSTS TO 70 KTS PSBL.°

MKCC WST 300655
CONVECTIVE SIGMET 10C
KS OK TX
FROM 50N ICT TO 40E GAG TO 30E AMA TO 30SSW MAF
LN TSTMS 20 MI WIDE MOVG FROM 2715. MAX TOPS TO 420.
1-3/4 IN HAIL RPRTD TWO LCTNS IN TX PAST HR.

FSCT TO 0855Z
LN WL CONT MOVG EWD 15 KT THRU 0855Z. HAIL TO 1-3/4 IN.
WIND GUSTS TO 65 KT PSBL.

3.3.5 Weather Service Offices (WSOs) and Weather Service Forecast Offices (WSFOs).

3.3.5.1 WSFOs and WSOs release to the public information contained only in sections A and B of watches. However, to help the public visualize which areas are affected by watches, designated offices prepare redefining statements (areal outlines) for those parts of their States within each public severe weather watch. They also may discontinue watches for those portions of their areas no longer threatened.

3.3.5.2 WSFOs and WSOs with county warning responsibilities are responsible for warning the general public. Severe weather warnings are based on reports of actual or suspected severe weather in or near an Office's area of responsibility. Each warning is identified as either a Tornado Warning or a Severe Thunderstorm Warning. When radar evidence is sufficient in the judgement of the responsible official to identify a dangerous storm, warnings are issued immediately.

3.3.5.3 Offices issue frequent statements to keep the public informed of weather developments during a severe weather watch.

3.3.6 Satellite Field Service Stations (SFSS). The SFSSs receive and analyze satellite pictures in near real time and assist NSSFC, WSFOs, and WSOs in applying these data to their severe storm forecasting and warning programs.

3.4 U. S. Air Force (USAF) Warning Procedures.

3.4.1 General. The Air Force Global Weather Central (AFGWC) provides, by means of USAF communications system, warnings for Military installations for:

a. Tornadoes;

b. Thunderstorms;

c. Strong surface winds of 35 knots (65 km/h) or more that are not associated with thunderstorms;

d. Heavy rain or snow (2 inches (50 mm) or more in a 12-hour period);

e. Freezing precipitation.

The criteria for severe thunderstorm warnings are the same as those of the NWS.

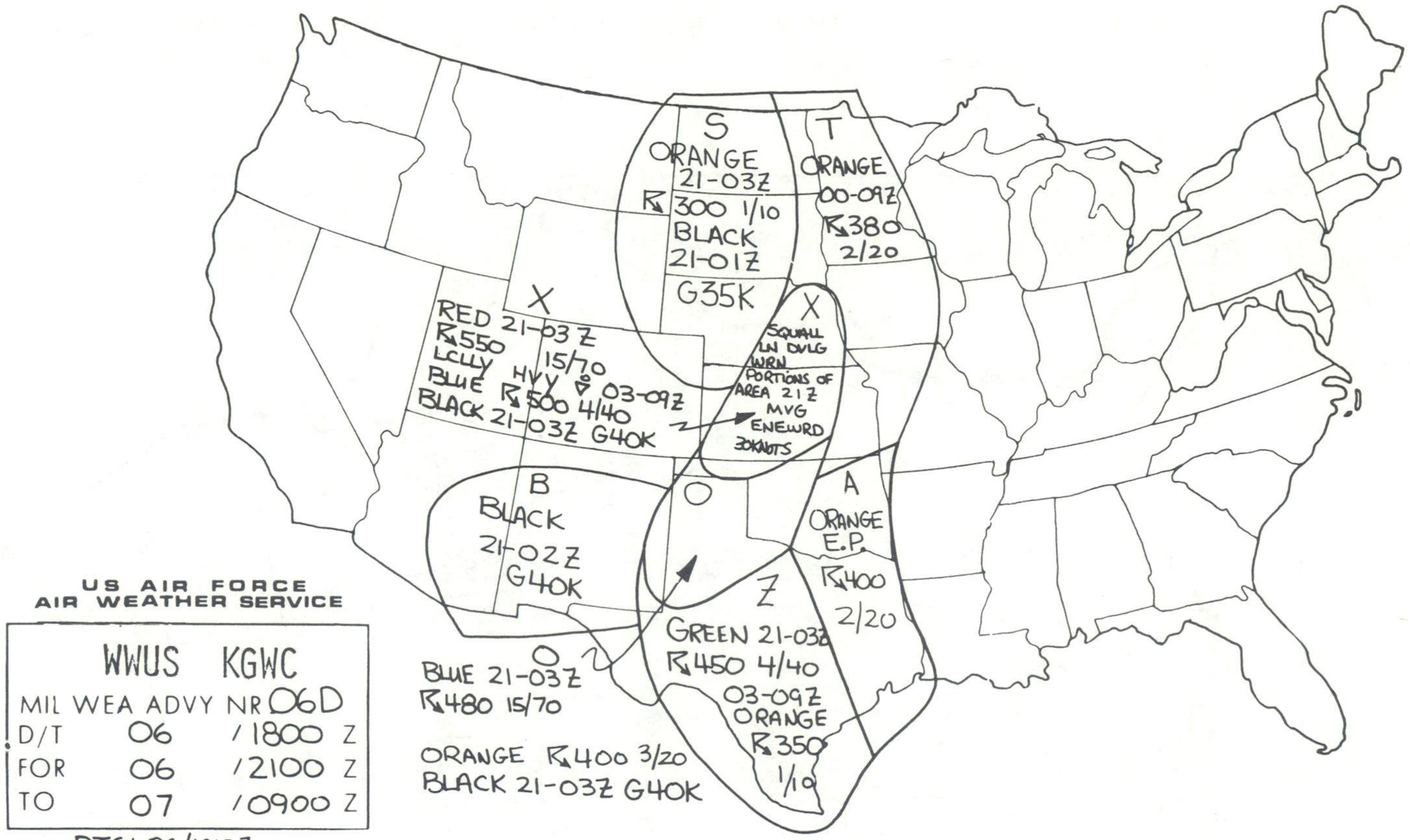


FIGURE 3-1. Example of Graphic Military Weather Advisory

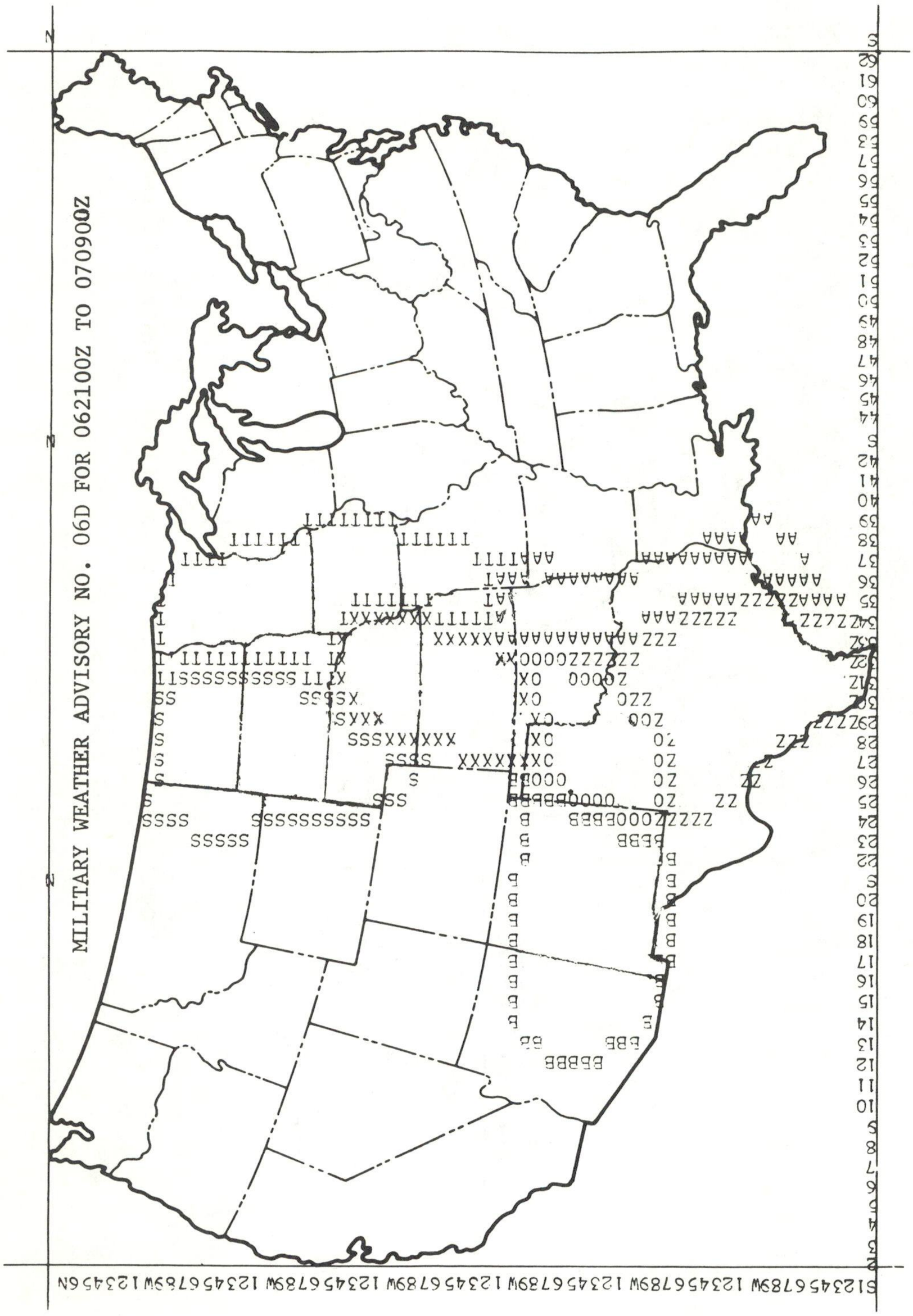


FIGURE 3-2. Example of Graphic Teletype Portion of a Military Weather Advisory

3.4.2 Military Weather Advisories (MWA). AFGWC issues both graphic (Figure 3-1) and teletypewriter (Figure 3-2) Military Weather Advisories (MWAs) and Military Weather Advisory Further Outlooks (FO). Military Weather Advisories are issued four times daily, valid for 12-hour periods beginning at 0300Z plus every 6 hours. Further Outlooks are issued twice daily valid for 12-hour periods beyond the 0900Z and 2100Z MWAs. Each product gives the area where any of the weather elements listed in Table 3-1 are expected to occur during the valid period.

Table 3-1

Military Weather Advisory (MWA) Weather Elements

COLOR	WEATHER ELEMENT(S)
RED	Tornado
BLUE	Severe Thunderstorm
GREEN	Moderate Thunderstorm o Winds between 35 and 49 knots (65-90 km/h) inclusive or o Hail greater than or equal to 1/2 inch (10 mm) but less than 3/4 inch (20 mm) in diameter
ORANGE	Thunderstorm with winds less than 35 knots (65 km/h) and hail less than 1/2 inch (10 mm) in diameter
BLACK	Surface winds greater than or equal to 35 knots (65 km/h) not associated with a thunderstorm
PURPLE	Heavy rains greater than or equal to 2 inches (50 mm) in 12 hours
HATCHED	Heavy snow greater than or equal to 2 inches (50 mm) in
BROWN	Freezing Precipitation

3.4.2.1 Purpose and Use. The Military Weather Advisories are designed to provide basic guidance to both the field forecaster and to the point warning forecasters at AFGWC. These Advisories are issued at fixed times; preparation time is limited by data availability and presentation format. Advisories may cover fairly large areas as in the case of thunderstorms, snow, and strong gradient winds, but the areas of more severe weather--such as tornadoes and severe thunderstorms--are usually more limited in time and space.

3.4.2.2 Amendment. Advisories are amended when an unforecast criterion is observed and expected to continue or when an advisory no longer adequately describes the severity or valid times of a forecast criterion.

3.4.2.3 Geographical Interpretation. A clear plastic overlay containing a scaled outline of the conterminous States, placed on the tele- typewriter message containing the Military Weather Advisory, will provide geographical orientation.

3.4.3 AFGWC Point Warnings. AFGWC Point Warnings are issued in plain language (see example below) for the same phenomena as Advisories. While Advisories provide general guidance to all military forecasters in terms of large and intermediate scale synoptic developments, AFGWC Point Warnings are issued for and to specify locations in the smallest scale of space and time consistent with the availability of data and the state-of-the-art. An effort is made to tailor the size of the points to the requirements of the using agency. The locations for which AFGWC has warning responsibility are listed in Volume III, Air Weather Service Pamphlet 105-52; the number of installations is approximately 500. Approximately 50 percent of these locations are U. S. Air Force, 45 percent are U. S. Army, and 5 percent are U. S. Navy. In addition to active military installations, AFGWC Point Warnings are issued for National Guard units, arsenals, ammunition plants, and other civilian activities under contract to the Department of Defense (DOD). AFGWC Point Warnings are issued for specific locations as the situation warrants in contract to Advisories which are issued at scheduled intervals for fixed valid periods. AFGWC Point Warnings can be amended, extended, or cancelled as necessary.

AFGWC Point Weather Warnings:

a. Provide specific warning to an installation where a forecaster is not assigned;

b. Alert a responsible individual at locations with a limited forecast service;

c. Alert and guide the field forecaster who has final responsi- bility for warning the agency supported.

EXAMPLE OF MILITARY POINT WARNING

0 032010Z
WWXX WWXX WWXX 3 KGWC 032010Z
TX 18-19

THUNDERSTORMS WITH 1-1/2 INCH HAIL AND SW GUSTS TO 65 KNOTS
VALID 032200Z TO 040200Z TORNADO VALID 032200Z TO 040100Z
OK 7-8

THUNDERSTORMS WITH NO HAIL AND SW GUSTS TO LESS THAN 35 KNOTS
EXPECTED BETWEEN 032200Z AND 040400Z.

3.4.4 Local Air Weather Service (AWS) Unit Warning. At those locations where an Air Weather Service forecaster is on duty, the forecaster has final responsibility for warning those agencies being supported. The criteria and lead time for such local warnings are established locally based on customer needs.

3.5 Distribution of Watches, Warnings, and Severe Weather Reports by Flight Service Stations.

This Plan does not provide for the distribution of severe weather information by FSSs. However, these stations occasionally receive requests for such information or are given a severe weather report by an observer. Such information or requests will be referred to the WSO associated with the FSS receiving the information. That WSO will issue the warning or pass the information to the WSO which has the warning responsibility for the county in which the requestor or phenomenon is located. The Federal Aviation Administration, Air Traffic Service, FSS Procedures Branch (ATT-360), and the National Weather Service will include, with their agency directives, the communication methods for assuring that these requests and reports reach the appropriate WSO.

4. COMMUNICATIONS

4.1 National Weather Service Systems.

4.1.1 Automation of Field Operations and Services (AFOS). AFOS is a modern automated communications system that permits data, forecasts, warnings, and other meteorological products to be distributed faster than conventional teletypewriter or facsimile. The communications system for the contiguous United States consists of two types of circuits: Regional Distribution Circuits (RDCs) and State Distribution Circuits (SDCs). Minicomputers transmit data between most offices on dedicated telephone circuits. Each message transmitted is automatically assigned a transmission priority ranging from one (highest) to five (lowest). Warning messages and watches have the highest priorities.

4.1.2 Radar Report (RAREP) and Warning Coordination Circuit (RAWARC). The National Weather Service internal teletypewriter system is a landline teletypewriter network consisting of five circuits, which terminate at the National Severe Storms Forecast Center in Kansas City and the Communications Control Section at Suitland, Maryland. The communications center at NSSFC is a systems monitor while the Communications Control Section (Communications Division) performs the computer relay functions for the system. Traffic on RAWARC is basically unscheduled and is handled according to a priority system, with severe weather information having the highest priority. The only regularly scheduled material entered on RAWARC is an hourly collection (H+35) of radar reports (SD). Special radar reports and other material authorized in the RAWARC manual can be transmitted at any time the circuits are not in use.

The NWS plans to phase out this system by March 1985, and incorporate the functions of RAWARC in AFOS.

4.1.3 NOAA Weather Wire Service (NWWS). The NWWS consists of local loops serving metropolitan areas and Statewide intrastate/interstate circuits. The purpose of NWWS is to transmit consumer-oriented forecasts, watches, weather warning, and meteorological data to the mass news media for broadcast to the public. Various specialized users also obtain drops on NWWS to meet their requirements.

Only WSFOs and WSOs (or certain other authorized offices) have direct entry on these circuits. The Weather Service Forecast Offices furnish broad-scale information, and local WSOs enter local information. Relays via AFOS are established as necessary to meet the requirements of the National Weather Service's Severe Local Storms Warning Service and of subscribers located along State or area borders. When urgent material such as a warning is transmitted, a prearranged bell signal is used to attract the attention of users to the transmission.

4.1.4 National Warning System (NAWAS). This is the Federal Emergency Management Agency (FEMA) operated hot line interstate telephone system which connects FEMA Warning Points, WSFOs, and WSOs, and WSMOs (Weather Service Meteorological Observatory) within each State and between States. Figure 4-1 gives the location of FEMA warning points.

NATIONAL WARNING SYSTEM

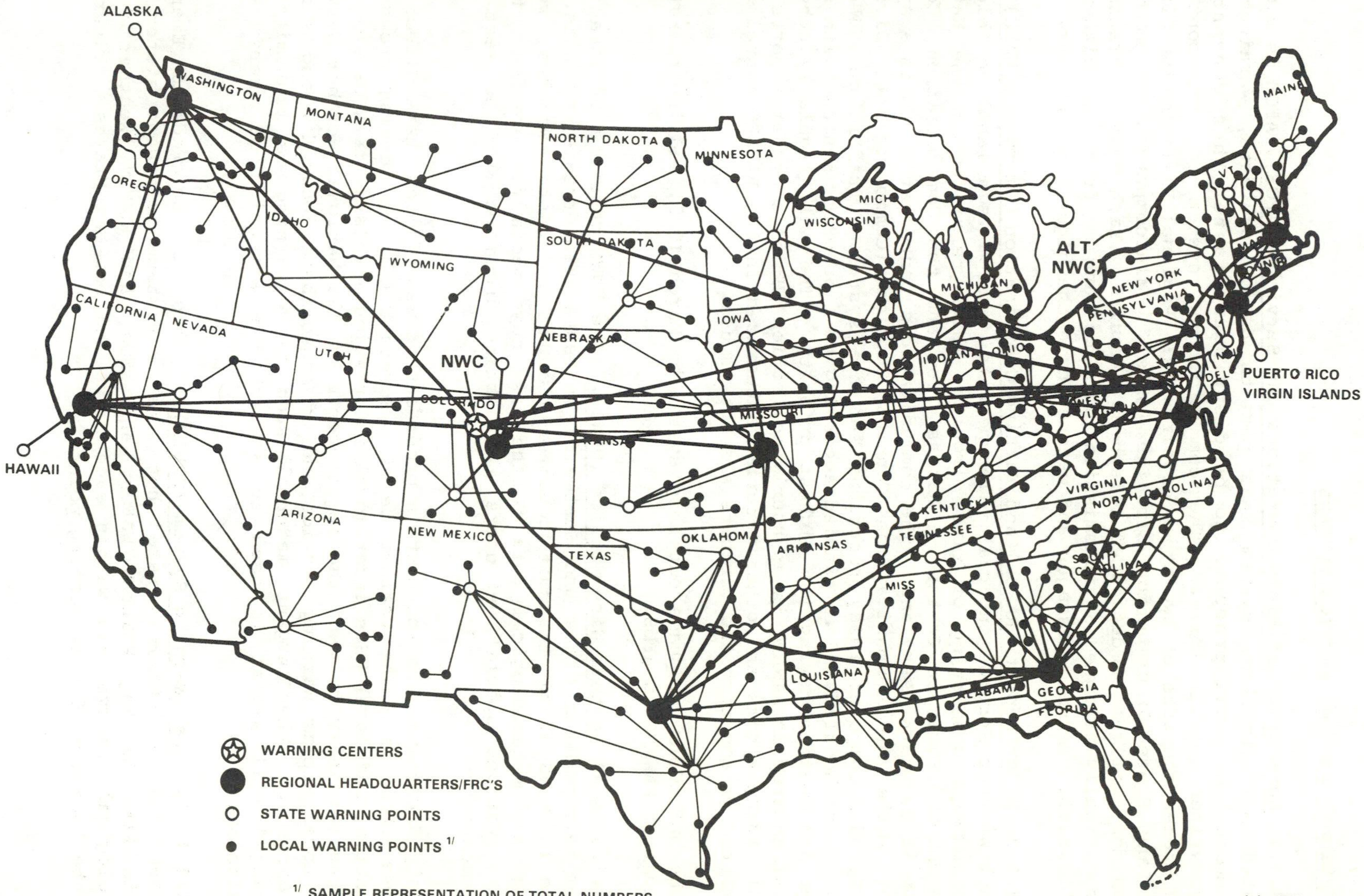


FIGURE 4-1. Federal Emergency Management Agency - NATIONAL WARNING SYSTEM.

4.1.5 Emergency Broadcast System (EBS). EBS activation is requested for all tornado warnings. Since EBS use is at the discretion of individual radio and television stations, arrangements for its use are made prior to the severe local storm season, unless such use is a continuing agreement. EBS activation is not requested for severe thunderstorm warnings.

4.1.6 NOAA Weather Radio. WSOs/WSFOs equipped with NOAA Weather Radio can transmit continuous weather warnings on one of following frequencies: 162.400, 162.425, 162.450, 162.475, 162.500, 162.525, and 162.550 MHz. These radio transmitters provide continuous weather information to an area of about 40-mile (65 km) radius. Local radio and TV stations can record and rebroadcast the material even though land lines in the area may be disrupted. These transmitters have a tone signal alert capability which can be used to activate specially designed receivers. Figure 4-2 shows locations of NOAA Weather Radio transmitters, and Appendix 3 lists the stations and their frequencies.

4.1.7 Miscellaneous. Other types of distribution methods are used, as appropriate, to make warnings available to other WSOs/WSFOs and to the public as rapidly as possible.

4.1.8 Distribution of Severe Weather Watch and Warning Bulletins. The distribution of Public Severe Weather Watch and Warning Bulletins is shown in Figure 4-3. The distribution of Aviation Severe Weather Watch Bulletins and In-Flight Weather Advisories is outlined in Figure 4-4.

4.2 U. S. Air Force Systems (USAF).

4.2.1 Within the conterminous United States, USAF radar weather observations are collected by means of the Continental U.S. (CONUS) Meteorological Data System (COMEDS). Collected reports are transmitted from the Carswell Automatic Digital Weather Switch (ADWS) to the Air Force Global Weather Central, the FAA Weather Message Switching Center (WMSC), and to the National Meteorological Center through computer-to-computer links. Severe radar reports are available to NSSFC/Radar Analysis and Development Unit in the bulletin that has the heading WOUS1 KAWN. Routine radar reports are transmitted from WMSC to NSSFC.

4.2.2 The COMEDS is divided into 20 geographic areas, with a single collecting and disseminating circuit covering each area (Figure 4-5).

4.2.3 The COMEDS is used to disseminate all Military Weather Advisories and Point Warnings issued by AFGWC.

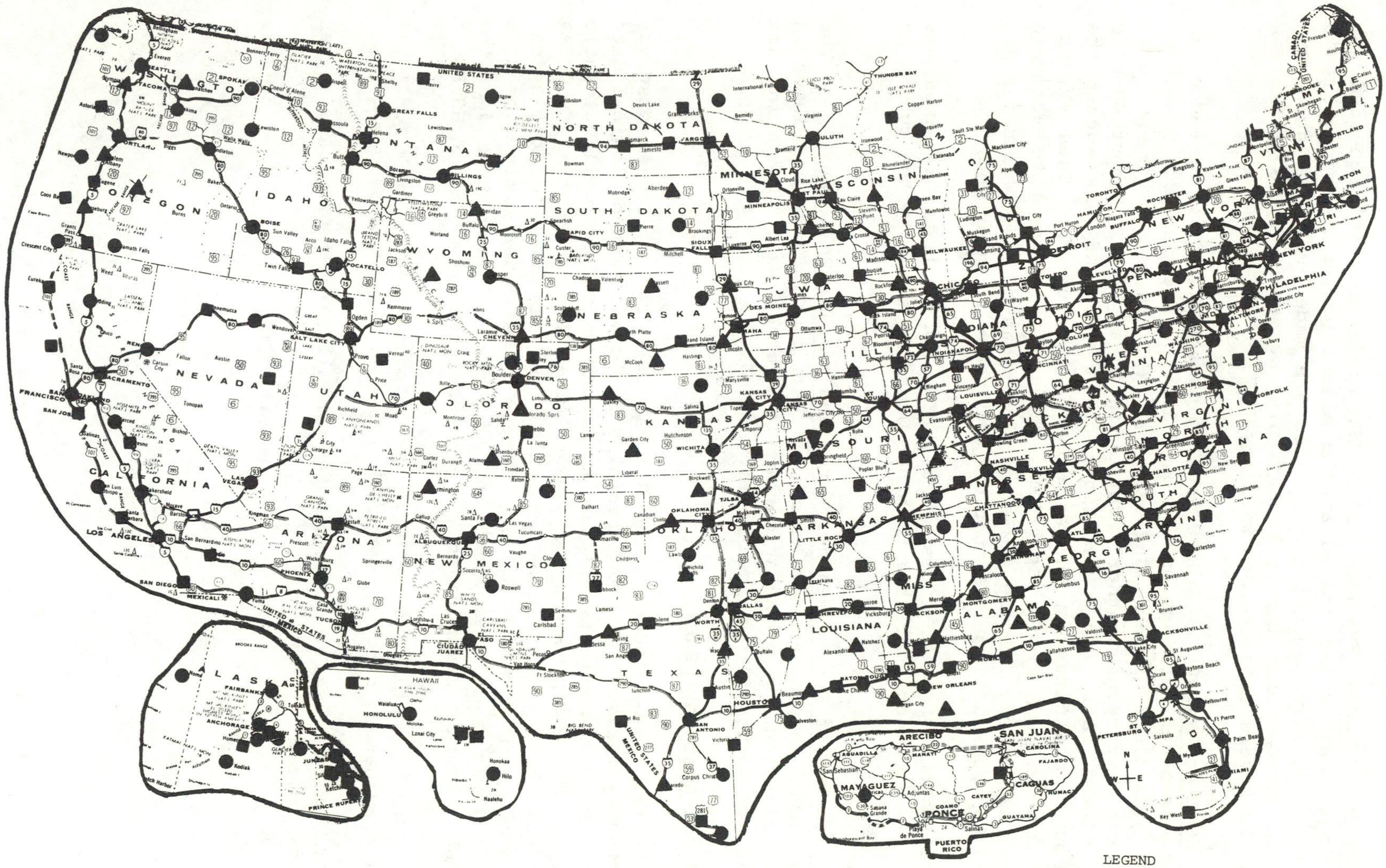


Figure 4-2. NOAA Weather Radio Network.

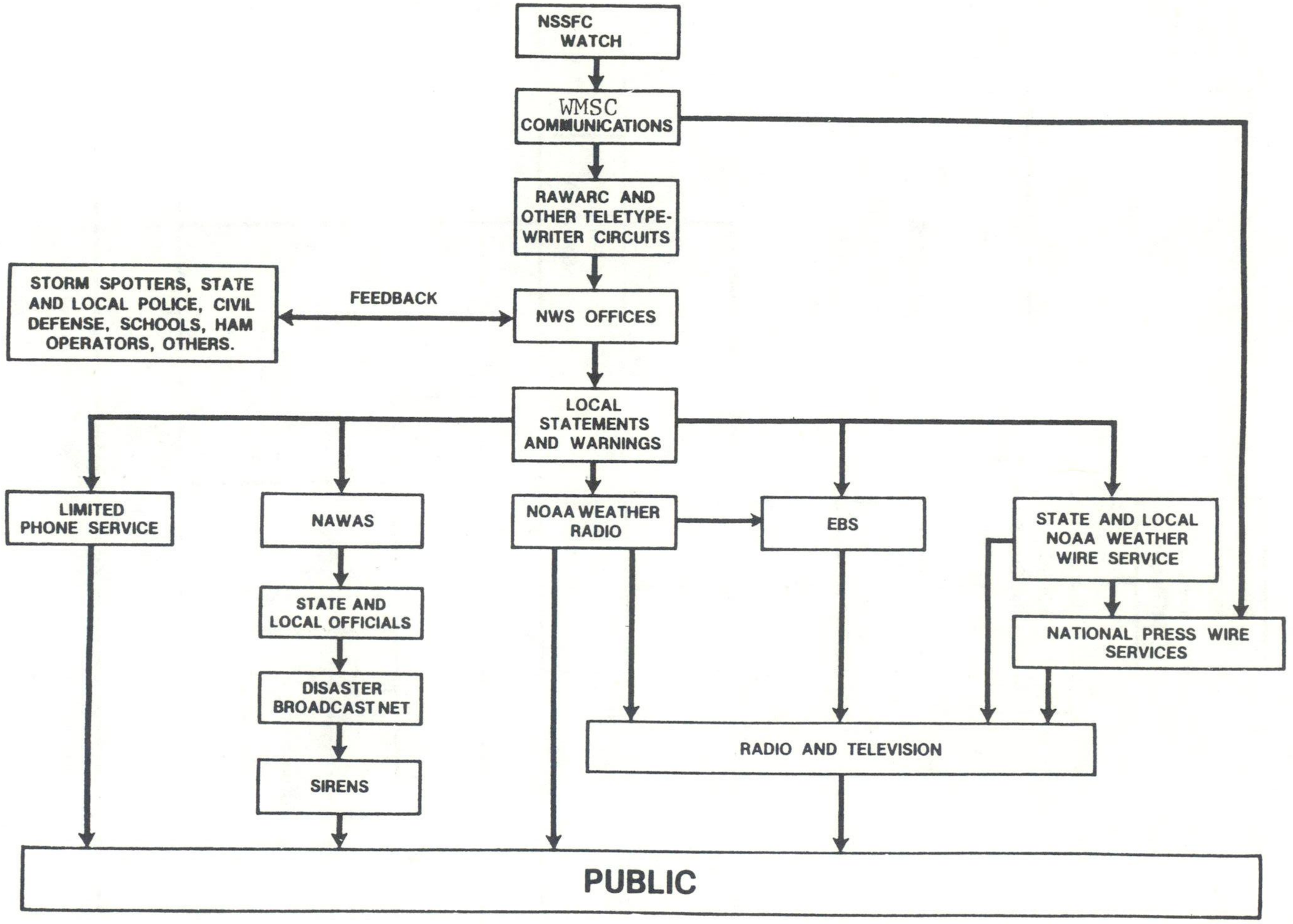


Figure 4-3. Distribution of Combined Severe Weather Watch and Warning Bulletins.

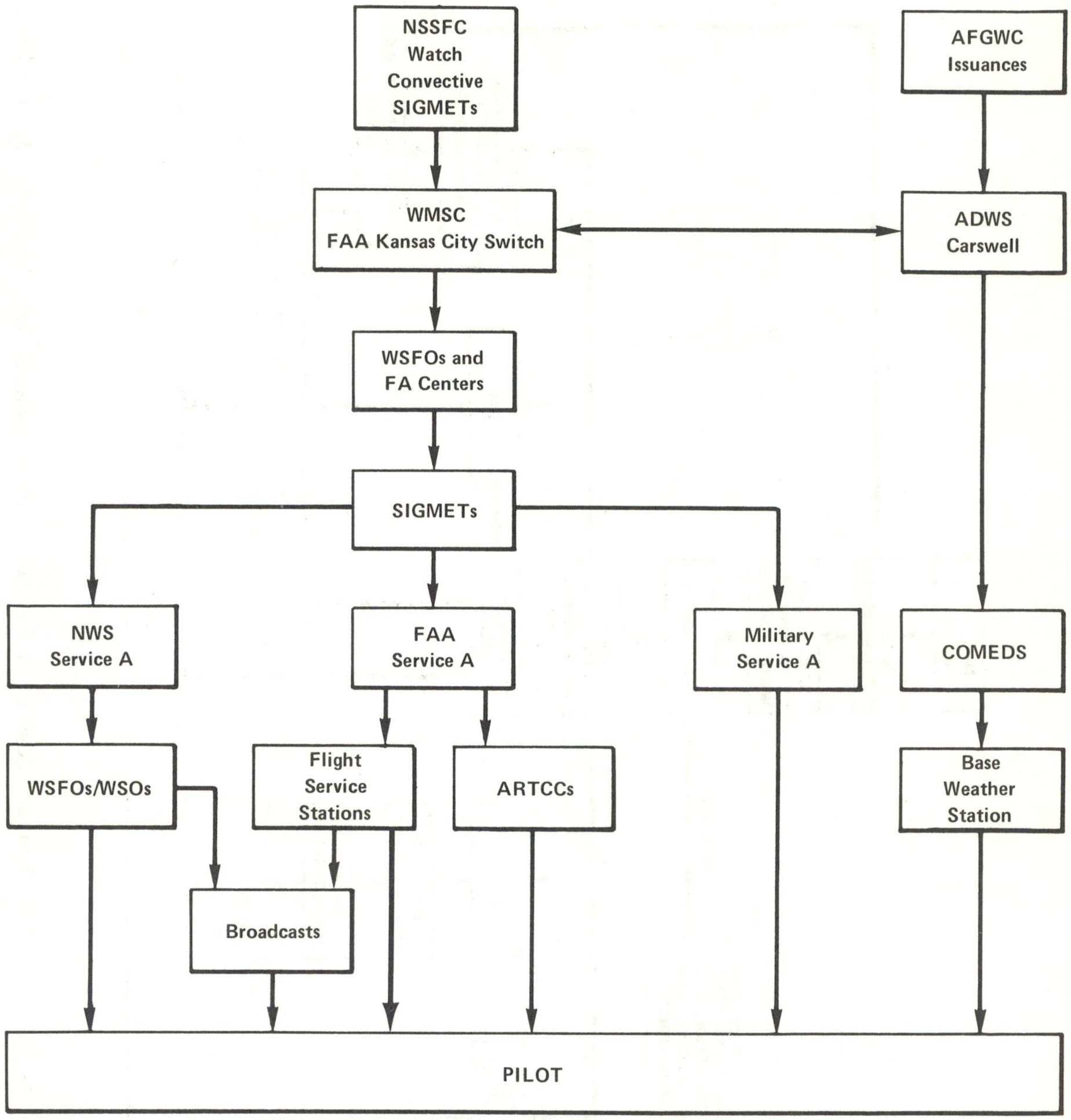


Figure 4-4. Distribution of Aviation Severe Weather Forecasts.

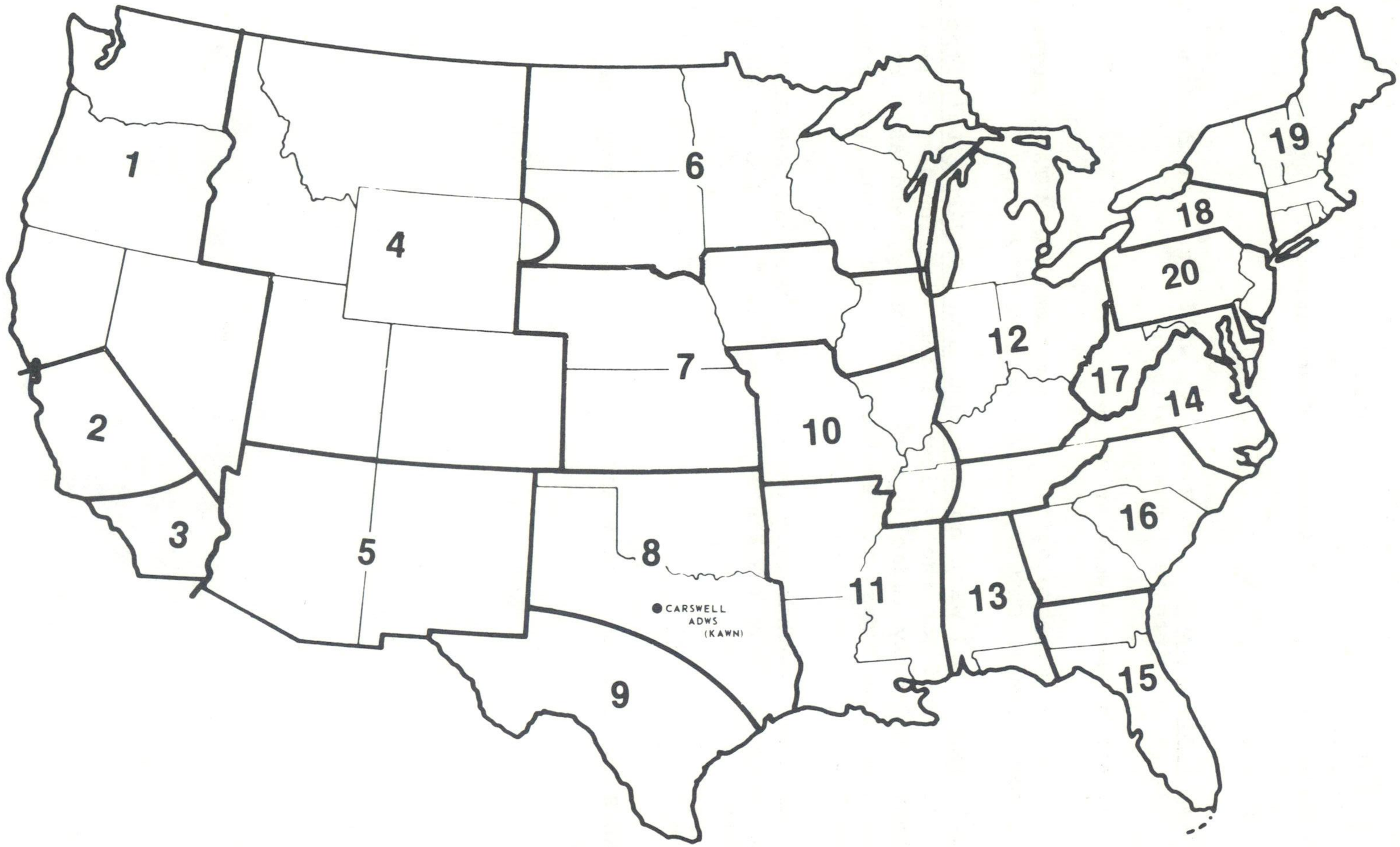


Figure 4-5. Geographical Areas of USAF CONUS Meteorological Data System.

4.3 Federal Aviation Administration (FAA) Systems.

4.3.1 Collection. Service "A" will be used for the collection and distribution of severe local storms information as follows:

a. Hourly and Special Aviation Observations;

b. PIREPs.

4.3.2 Distribution. Service "A" will be used for the distribution of severe local storms information as follows:

a. Aviation Severe Weather Watch;

b. Airmen's Meteorological Information (AIRMETs), Significant Meteorological Information (SIGMETs), and Convective SIGMETs.

4.3.3 RAREP and Warning Coordination (RAWARC) Teletypewriter System. RAWARC will be used for the collection and distribution of severe local storms information and hourly radar reports. Secondly, and as circuit time permits, RAWARC serves as a bypass to Service A, C. and O for more routine information when these circuits are busy.

The National Weather Service plans to phase out RAWARC by March 1985, and to discontinue the use of FAA's Services A, C, and O in NWS offices also by March 1985.

4.4 U. S. Navy.

COMEDS is used to collect and disseminate U. S. Navy weather reports.

5. OBSERVATIONS

5.1 Radar Observing and Reporting Plans.

5.1.1 Radar data, which are routinely used in the support of this Plan and in the preparation of National Severe Storms Forecast Center and Air Force Global Weather Central products, are available from radars of the U.S. Basic Weather Radar Network. This Network is composed of NWS radars, U.S. Air Force weather radars, and in the western United States, air route traffic control radars. The air route traffic control radars are remoted into the Air Route Traffic Control Centers (ARTCC) at Salt Lake City, UT; Palmdale, CA; Albuquerque, NM; and Auburn, WA. NWS local warning radars supplement the network radars. National Weather Service personnel at Palmdale, Albuquerque, and Auburn develop a composite of the radar data from radars remoted into these sites and transmit the data on the Radar Facsimile Circuit (RAFAX) to the National Weather Service Radar Unit at the Salt Lake City ARTCC. These data are then collated with the Salt Lake City radar data and transmitted on RAFAX to users throughout the West.

5.1.1.1 National Weather Service coded radar observations, including those from these four ARTCCs, are transmitted hourly on the Radar Report (RAREP) and Warning Coordination Circuits (RAWARC) at H+35. More frequent observations are taken and transmitted on RAWARC in severe weather situations. Hourly composites from ARTCCs are transmitted to a number of offices in the western intermountain region on the RAFAX circuit. Each ARTCC Radar Unit prepares a narrative summary of its composite and transmits the summary on RAWARC. These summaries and selected hourly radar observations are transmitted hourly on selected Service A circuits by the Modernized Weather Teletypewriter Communications System in Kansas City. The NWS plans to phase out RAWARC and to use AFOS in its place by March 1985.

5.1.1.2 At H+35, coded radar reports from the Air Weather Service (AWS) radar stations assigned to the U.S. Basic Weather Radar Network are forwarded to AFGWC from the Automated Digital Weather Switch (ADWS) at Carswell AFB by means of the data link. The NSSFC receives routine military radar weather observations from the ADWS through the FAA Weather Message Switching Center. Severe military RAREPs (those describing tornadoes, severe thunderstorms, or hail observations and carrying the bulletin heading WOUS) are obtained by dual means: (1) a drop on the COMEDS; and (2) through the FAA WMSC.

5.1.1.3 The National Weather Service, Air Force, and Navy operate a number of non-network radar facilities. Used primarily for local forecasting and warning and for immediate service to local agencies, these radars also provide selected information on severe storms. For example, all USAF weather radar facilities in the conterminous United States, whether or not they are assigned Network responsibilities, report radar-detected hailstorms, severe thunderstorms, and tornadoes on COMEDS and, when so requested, by telephone to the nearest WSFO or WSO.

5.1.2 The USAF air defense radar sites are capable of limited detection and interpretation of weather echoes. Appendix 1 lists the radar sites supporting each NORAD Region (NR). Operational commitments permitting, the radar sites within each region can provide limited supplementary weather data upon request. Contact by either AFGWC or NSSFC should be made by calling the appropriate AWS unit (see Appendix 1).

5.1.3 If a WSO needs radar data from a nearby military radar (network, air defense, or local use), such data can be obtained by local arrangements between the National Weather Service Meteorologist-in-Charge/Official-in-Charge and the AWS Detachment Commander or the Naval Oceanography Command Commanding Officer/ Officer-in-Charge of the activity operating the radar facility. Authorizations for such arrangements have been completed between the National Weather Service and the military agencies in prior agreements. These data will be supplied on a non-interference basis and should usually be limited to severe weather situations.

5.2 Rawinsonde-Observing Stations.

5.2.1 Network Stations. Rawinsonde observations are scheduled twice daily, 0000Z and 1200Z, at the 71 stations in the National Weather Service and Military Upper Air Network. These stations also take special observations whenever required and requested by the agency concerned.

Transponder capability is available at most stations to permit more accurate measurement of upper winds under strong wind conditions. Evaluated data from the routine soundings are transmitted over the Service C and COMEDS teletypewriter systems in the radiosonde code. Data from special soundings requested for potential or existing severe weather situations are transmitted by means of RAWARC and other appropriate communications circuits to NSSFC and AFGWC. Special soundings transmitted on RAWARC will use the standard upper air message heading to assure their relay to AFGWC.

5.2.2 Non-network Stations. The DOD takes unscheduled observations at a number of schools, at mobile locations, and at research, development, test, and evaluation facilities. However, because of the irregular scheduling of these observations, the military agencies concerned do not deem it advisable to include all of the observations in this Plan. Non-network upper air stations which might be sources of data are given in Table 5-1.

During the months of April, May, and June when the National Severe Storms Laboratory at Norman, Oklahoma, and other agencies are usually engaged in an intensive severe local storms data collection program in central Oklahoma, upper air soundings are taken at a number of locations in support of this program. However, these data are processed by computer and are not available for real-time use.

Table 5-1
Non-Network Upper Air Stations Which Might Be Sources of Data

STATION	OPERATED BY	TIME OF OBSERVATIONS	DISTRIBUTION	AGENCY CONTACT	WILL TAKE REQUESTED SPECIALS
Edwards AFB, CA	USAF	Unscheduled	COMEDS	Commander, Det. 21, 2nd Wea. Sq. AUTOVON 350-4318 COM 805-277-4318	Yes
Fort Benning, GA	USA	Unscheduled	COMEDS	Commander, Det. 10, 5th Wea. Sq. AUTOVON 835-7313 COM 404-545-7313	No
Fort Bragg, NC	USA	Unscheduled	COMEDS	Commander, Det. 3, 5th Wea. Sq. AUTOVON 236-3914 COM 919-396-3914	No
Fort Carson, CO	USA	Unscheduled	COMEDS	Commander, Det. 58, 5th Wea. Sq. AUTOVON 691-3651 COM 303-579-3620	No
Fort Hood, TX	USA	Unscheduled	COMEDS	Commander, Det. 14, 5th Wea. Sq. AUTOVON 737-9819 COM 817-532-9327	No
Fort Sill, OK	USA	Unscheduled	COMEDS	Commander, Det. 11, 5th Wea. Sq. AUTOVON 639-3200 COM 405-351-3200	No
Fort Polk, LA	USA	Unscheduled	COMEDS	Commander, Det. 31, 5th Wea. Sq. AUTOVON 863-2015 COM 318-537-2015	No
Fort Stewart, GA	USA	Unscheduled	COMEDS	Commander, Det 21, 5th Wea. Sq. AUTOVON 971-5432 COM 912-352-5207	No

Table 5-1 (continued)
Non-Network Upper Air Stations Which Might Be Sources of Data

STATION	OPERATED BY	TIME OF OBSERVATIONS	DISTRIBUTION	AGENCY CONTACT	WILL TAKE REQUESTED SPECIALS
Fort Riley, KS	USA	Unscheduled	COMEDS	Commander, Det 8, 5th Wea Sq. AUTOVON 856-3327 COM 913-239-3327	No
Fort Campbell, KY	USA	Unscheduled	COMEDS	Commander, Det 1, 5th Wea Sq. AUTOVON 635-2519 COM 502-798-2519	No
Fort Lewis, WA	USA	Unscheduled	COMEDS	Commander, Det 6, 5th Wea Sq. AUTOVON 357-5967 COM 206-967-5967	No
Eglin AFB, FL	USAF	Unscheduled	COMEDS	Commander, Det. 10, 2nd Wea. Sq. AUTOVON 872-5710 COM 904-882-5452	Yes
Marshall Space Flight Center, Huntsville, AL	NASA	Unscheduled, dependent upon operations	Local loop to WSO Huntsville AL then to RAWARC	Bob Turner FTS 453-3109	Yes
Navy Pacific Missile Test Center, Point Mugu, CA	USN	Monday-Friday, 1300Z, 1800Z, and 2300Z	COMEDS	Mr. Hickson or Mr. Lee AUTOVON 351-8748, COM 805-982-8748	Yes
Navy Pacific Missile Test Center, San Nicolas Island, CA	USN	Monday-Friday, 1800Z and 2300Z	COMEDS	Mr. Hickson or Mr. Lee, AUTOVON 351-8748, COM 805-982-8748	Yes
White Sands Missile Range, NM	USA	Unscheduled	COMEDS	Chief, Forecast Section White Sands Met Team AUTOVON 258-2605/1032	No

5.3 Surface Weather Observational Network.

To provide the basic weather data needed for the analyses performed by the National Meteorological Center, NSSFC, and AFGWC, all available surface data are used. The following stations provide data:

a. WSFOs/WSOs/WSMOs and Automatic Meteorological Observing Stations;

b. Federal Aviation Administration weather reporting stations--flight service stations, towers, and contract observer aviation weather reporting stations;

c. The DOD weather reporting stations.

These stations take observations and transmit coded observational data at regularly scheduled intervals. Transmissions are made hourly and even more frequently for aviation purposes, every 3 and 6 hours for synoptic map preparation, and daily for climatological purposes.

5.4 Pilot Reports (PIREPs).

a. The present FAA Instrument Flight Rules regulation (91.125, radio communications, section b) requires pilots to report, "(b) Any unforecast weather conditions encountered; and ....."

b. Pilots should report any weather condition they encounter which is hazardous to aviation.

c. FSSs, ARTCCs, and ATCTs accept, solicit and broadcast PIREPs. Additionally, ARTCCs and ATCTs pass PIREPs to FSSs for dissemination on the Service A teletypewriter circuit.

5.5 Severe Storm Surveillance by Meteorological Satellites.

5.5.1 Geostationary Operational Environmental Satellite (GOES). The GOES system consists of two operational spacecraft, GOES East at 75°W and GOES West at 135°W. Standby spacecraft with limited operational capabilities are positioned between 75°W and 135°W. The principal GOES products are half-hourly pictures with implanted grids automatically applied to all sectors. During daylight hours, approximately 1, 2, and 4 km resolution fixed standard sectors are produced. During the night (also available in daylight), the same geographical coverage standard sectors are produced with 7 km resolution infrared (IR). The IR data may be enhanced to emphasize various features. Floating sectors which are scheduled by the NWS Satellite Field Services Stations (SFSSs) are produced to augment the standard sector coverage support. All products are delivered in near real time to the National Environmental Satellite, Data and Information Service (NESDIS) Synoptic Analysis Branch (SAB), the NWS SFSSs and Weather Service Forecast Offices (WSFOs). (See GOES Operational Data Flow, Figure 5-1, and Satellite Data Availability, Table 5-2).

5.5.2 NOAA Polar-Orbiting Satellites. These satellites cross the U.S. twice daily near the equatorial crossing times as indicated in Table 5-2. Data are available via direct read-out (HRPT and APT) or central processing, AVHRR data are available on a limited basis through the GOES distribution system.

5.5.3 National Weather Service Satellite Field Services Stations (SFSS).

5.5.3.1 Support Concept. Under the NESDIS support concept, GOES imagery in support of the severe weather warning services is distributed by the Central Data Distribution Facility (CDDF) at Camp Springs, MD, to the SFSSs in Miami, San Francisco, Kansas City, Washington, Anchorage, Slidell, and Honolulu. The Kansas City SFSS is collocated with the National Severe Storms Forecast Center (NSSFC) and is responsible for satellite support to NSSFC and the central U.S. from Canada to Mexico. Each SFSS except Anchorage has floating sectors which can be centered over significant weather areas at 1, 2, and 4 km resolutions for visible data and the same geographical coverage in 7 km IR data. In addition, Kansas City uniquely receives data via the NESS Rapid Interval Scan Operation Plan (RISOP) which provides data over the severe storm area every fifteen (15) minutes.

5.5.3.2 Station Contact. NWS satellite meteorologists can be contacted as follows:

Miami	Between 0630-1630 EDST and 2000-0400 EDST at 305-350-4310 and 4460	(FTS 350-4310)
San Francisco	24 h/day at 415-876-9122/23	(FTS 470-9122/23)
Washington	24 h/day at 301-763-8425	(FTS 763-8425)
Kansas City	24 h/day at 816-374-2102	(FTS 758-2102)
Honolulu	24 h/day at 808-836-2776 San Francisco FTS 556-0220, HNL 836-2776	(FTS Operator)
Anchorage	24 h/day at 907-271-3473 Seattle FTS 399-0150, ANC 271-3173	(FTS Operator)
Slidell	24 h/day at 504-649-5130	(FTS 682-2807)

Table 5-2
Satellite and Satellite Data Availability for Severe Local Storms Season

SATELLITE	TYPE OF DATA	LOCAL TIME	REMARKS
GOES East - 75.0°W GOES West - 135.0°W 4 Spacecraft (standby) limited operational capability	VISSR	Every 30 min. (24 h/day) (Limited scan for short- interval viewing available)	1. 1, 2 and 4 km resolution visible standard sectors covering western U.S., midwest, and eastern U.S. (daylight). 2. 7 km resolution equivalent IR geographic standard sectors for the entire U.S. (night). 3. Equivalent IR-enhanced imagery. 4. Floating sectors at 1, 2 and 4 km resolution (visible) (equivalent IR 9 km). 5. Full disc IR (day and night). 6. Movie loops. 7. Wind analysis. 8. Cloud top heights.
NOAA-7	AVHRR GAC and LAC (recorded) HRPT and APT (direct) TOVS	1430/0230	
NOAA-8	AVHRR GAC and LAC (recorded) HRPT and APT (direct) TOVS	0740/1940	1. Sea-surface temperature analysis. 2. Moisture analysis. 3. Soundings.

GAC - Global Area Coverage (recorded reduced resolution for central processing
LAC - Local Area Coverage (recorded high-resolution data, limited amount)
TOVS - TIROS Operational Vertical Sounder
HRPT - High Resolution Picture Transmission
APT - Automated Picture Transmission (4 km)
AVHRR - Advanced Very High Resolution Radiometer
VISSR - Visible Infrared Spin Scan Radiometer
LF - Light Fine [Visual Scanning Radiometer 0.3 nmi (0.6 km)]
TF - Thermal Fine [Infrared Scanning Radiometer 0.3 nmi (0.6 km)]
LS - Light Smooth [Visual Scanning Radiometer 1.5 nm (2.8 km)]
TS - Thermal Smooth [Infrared Scanning Radiometer 1.5 nmi (2.8 km)]

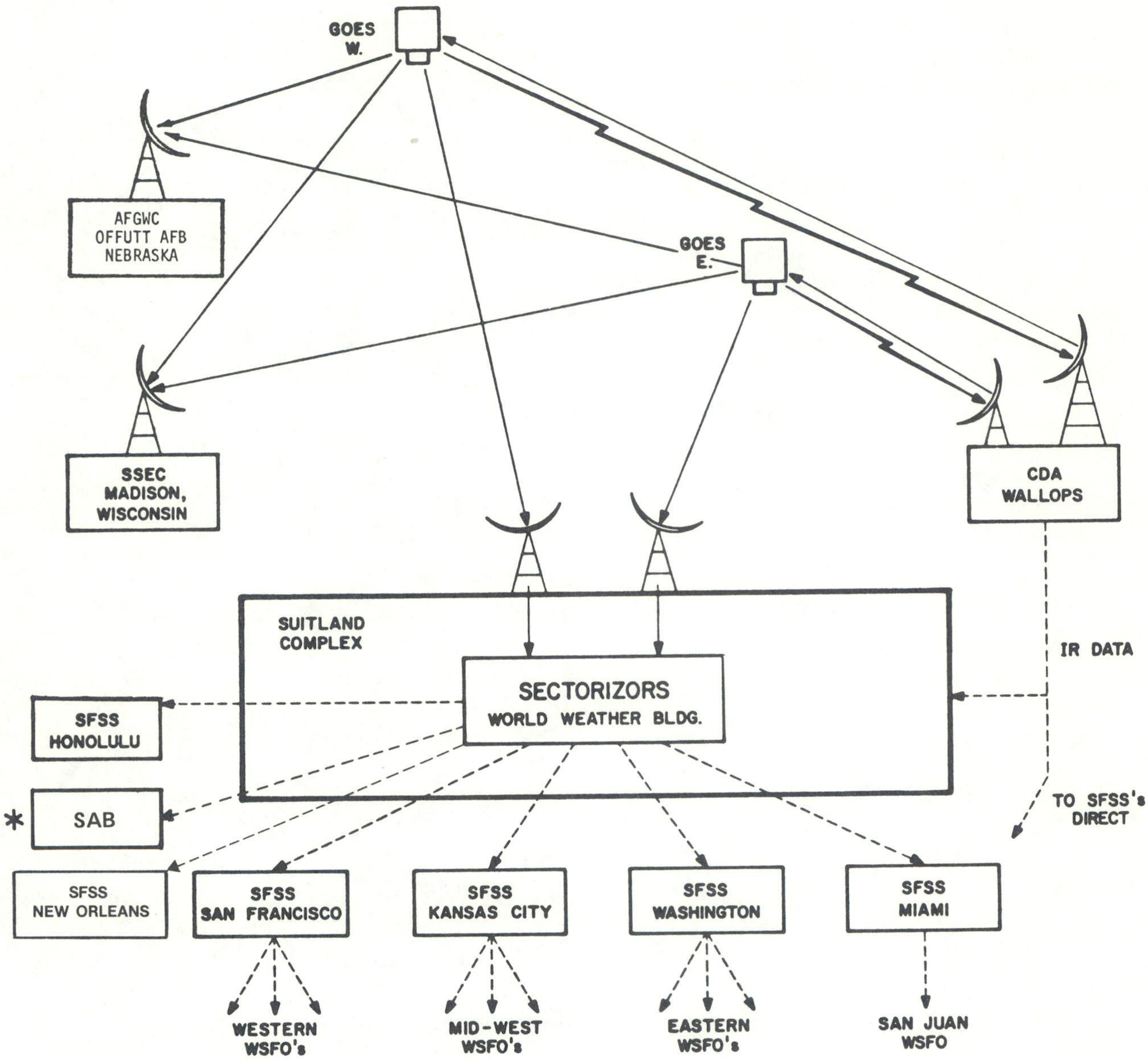
5.5.4 DOD Defense Meteorological Satellite Program (DMSP). This is a DOD-managed system to collect and process meteorological data from spaceborne sensors. These data are processed by the AFGWC and are available for timely application to severe weather forecasting. DMSP data are currently archived by NOAA/NESDIS at the University of Colorado and are available for use in severe weather research and development.

5.6 Severe Local Storm Actions of Nonmeteorological Agencies and Individuals.

The National Weather Service uses observations of severe local storms, particularly tornadoes, from many nonmeteorological agencies and personnel such as: utility companies, State Highway Patrols, local police departments, road maintenance patrols, citizen spotters (network), cooperative National Weather Service climatological observers, Citizen Band radio groups, local Civil Defense organizations, radio and television station mobile units, city employees (for example, the Chicago Sanitary District), the FAA, and individual citizens.

Reports are received by various means and are not uniform at each WSO. The means include Citizen Band or Civil Defense radio facilities with a transceiver often located in the WSO and operated by local cooperators, police radio, direct telephone lines involving unlisted numbers, the National Warning System (NAWAS), State Highway Patrols, teletypewriter circuits by means of telephone or a teletypewriter on statewide NOAA Weather Wire Service (NWSS) circuits, and Service A teletypewriter circuits.

Reports are disseminated to mass news disseminators, to other WSOs, and to safety agencies by NWS circuits (first priority, except for a more expedient means in some local areas), RAWARC, NAWAS, telephones (hotlines and commercial), and Civil Defense radio facilities. The "fan-out" principle is used wherever practical.



* NOTE: Anchorage SFSS is in the GOES Operational Data Flow but primarily uses the NOAA Polar-Orbiting Satellite data.

Figure 5-1. GOES Operational Data Flow.

6. PUBLICITY

The Military Weather Advisories and Point Warnings of the Air Force Global Weather Central (AFGWC) are designed for specialized military users and shall not be released to the public. News media releases that concern the cooperative efforts in severe storms activities of the Department of Defense and NOAA weather services and of other agencies should reflect the joint nature of these efforts by giving due credit to participating agencies. Copies of these releases should be forwarded to:

Environmental Services Division
OJCS
Washington, D.C. 20301

Director of Operations and Readiness
Airspace and Air Traffic Service Division
USAF/XOORF
Washington, D. C. 20330

Assistant Chief of Staff for Intelligence
Department of the Army
Attention: DAMI-ISP
Washington, D. C. 20310

Commander, Naval Oceanography Command
NSTL, Mississippi 39520

Headquarters, Air Weather Service (AWS/CS)
Scott Air Force Base, Illinois 62225

NOAA Public Affairs Office
6010 Executive Boulevard
Rockville, Maryland 20852

Commandant, United States Marine Corps
Headquarters, United States Marine Corps
Code ASL-44
Washington, D. C. 20380

APPENDIX A

NORAD REGION (NR) JOINT USE AND MILITARY ONLY RADAR SITES

The supporting AWS units of each of the listed NORAD Regions (NR) can obtain appropriate operational permission, contact military/civilian controllers at the NR radar sites within each region's area of responsibility, and obtain limited radar weather data.

NR	AREA	AWS UNIT	TELEPHONE NUMBERS	RADAR SITE
20	SE US	Det 9, 12 WS Tyndall AFB, FL	AUTOVON 970-2856 COM 904-283-2856	Grand Bay, AL Cross City, FL Cudjoe Key, FL Ft. Lonesome, FL Key West, FL Patrick AFB, FL Richmond, FL Tyndall AFB, FL Whitehouse, FL Lake Charles, LA Slidell, LA Ft. Fisher, NC Jedburg, SC Ellington AFB, TX Oilton, TX Oceana, VA
21	NE US	Det 8, 26 WS Griffis AFB, NY	AUTOVON 587-3444 COM 315-330-3444	N. Truro AFS, MA Buck Harbor, ME Empire, MI Calumet AFS, MI Port Austin AFS, MI Nashwauk, MN Gibbsboro AFS, NY Dansville, NY Remsen (Utica), NY Riverhead (Suffolk), NY The Plains, VA
25	NW US	Det 11, 17 WS McChord AFB, WA	AUTOVON 976-3434 COM 206-984-3434	Crescent City, CA Kalispell, MT Malmstron AFB, MT Finley AFS, ND Watford City, ND Keno, OR Salem, OR Makah AFS, WA Mica Peak, WA
26	SW US	Det 7, 9 WS March AFB, CA	AUTOVON 947-2463 COM 714-655-2463	Phoenix, AZ Mill Valley AFS, CA Mt Laguna AFS, CA Paso Robles, CA Point Arena AFS, CA San Pedro, CA Silver City, NM El Paso, TX Odessa, TX Sonora, TX

APPENDIX B

RECOMMENDED LETTER OF AGREEMENT
BETWEEN LOCAL UNITS OF NWS AND USAF

FROM: DET X, X VV, _____, AFB

SUBJECT: Letter of Agreement (LOA) - Notification of Severe Convective Weather

TO: (Appropriate NWS Office)

1. Introduction.

a. Purpose. To establish responsibilities and procedures for (Appropriate NWS office) to notify (Det X, X WW or military installation) when severe convective weather is expected to affect (military installation or site) and the supporting AWS detactment, Det X, X WW, is not staffed by a forecaster or the detachment's radar is inoperative.

b. Severe convective weather is defined as thunderstorms with winds of 50 knots (25 m/s) or more, hail 3/4 inch (20 mm) in diameter or larger, or tornadoes.

c. This LOA supersedes LOA dated _____ which should be destroyed.

2. Specific Terms of the Agreement.

a. Det X, X WW, will:

(1) Notify (appropriate NWS office) when Det X is not staffed by a forecaster. Normal forecaster duty hours are as follows:

(Describe normal forecaster duty hours)

(2) Notify (appropriate NWS office) when Det X's radar is inoperative except for normal preventive maintenance. Additionally, Det X will notify (appropriate NWS office) when their radar becomes operational again.

(3) Provide (appropriate NWS office) a single point of contact for notification. Telephone number for this point of contact is XXX-XXXX. Det X will inform (Appropriate NWS office) of changes in this point of contact or telephone number.

b. The (appropriate NWS office) will:

(1) Notify (appropriate military installation) by calling (single point of contact/telephone number) whenever a severe local storm warning is issued for the area including (military installation or site), when Det X, X WW is not staffed by a forecaster or Det X's radar is inoperative.

(2) Provide notification by telephone. This notification will be made only after dissemination commitments are completed and only when doing so will not impact public warning operations.

(3) Provide notification by telephone call; however, if line is busy one additional call will be made.

(4) Notify Det X, X WW when their radar is inoperative except for normal maintenance.

c. Detachment X and (appropriate NWS office) will, as workload permits, pass to each other by phone, local severe weather information of mutual benefit to both agencies. Such information would include, but not limited to, reported hail, damaging winds, tornadoes, or radar observations indicating severe thunderstorms or tornadoes.

_____
Signature
Meteorologist in Charge
or Official in Charge

Date _____

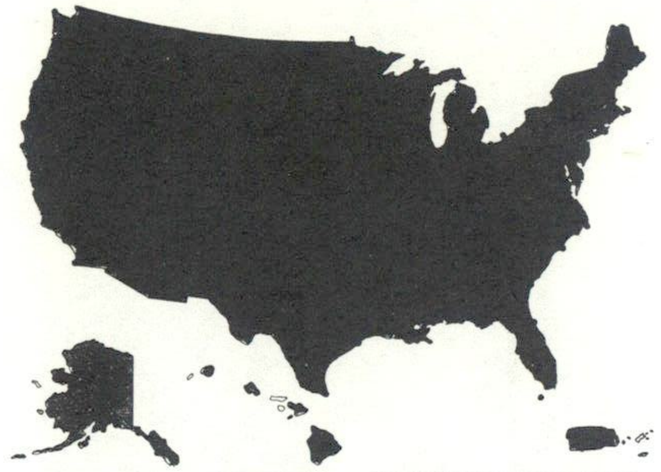
_____
Signature
Detachment Commander

Date _____

NOAA WEATHER RADIO NETWORK

Legend—Frequencies are identified as follows:
(1)—162.550 MHz
(2)—162.400 MHz
(3)—162.475 MHz
(4)—162.425 MHz
(5)—162.450 MHz
(6)—162.500 MHz
(7)—162.525 MHz

1983-12-01



Location	Frequency
Alabama	
Anniston	3
Birmingham	1
*Columbia	4
Demopolis	3
Dozier	1
Florence	3
Huntsville	2
Louisville	3
Mobile	1
Montgomery	2
Tuscaloosa	2
Alaska	
Anchorage	1
Cordova	1
Fairbanks	1
Homer	2
Juneau	1
Ketchikan	1
Kodiak	1
Nome	1
Petersburg	1
Seward	1
Sitka	2
Valdez	1
Wrangell	2
Yakutat	1
Arizona	
Flagstaff	2
Phoenix	1
Tucson	2
Yuma	1
Arkansas	
Fayetteville	3
Fort Smith	2
Gurdon	3
Jonesboro	1
Little Rock	1
Mountain View	2
Star City	2
Texarkana	1
California	
Bakersfield (P)	1
Coachella (P)	2
Eureka	2
Fresno	2
Los Angeles	1

Location	Frequency
California *continued*	
Merced	1
Monterey	2
Point Arena	2
Redding (P)	1
Sacramento	2
San Diego	2
San Francisco	1
San Luis Obispo	1
Santa Barbara	2
Colorado	
Alamosa (P)	3
Colorado Springs	3
Denver	1
Grand Junction	1
Greeley	2
Longmont	1
Pueblo	2
Sterling	2
Connecticut	
Hartford	3
Meriden	2
New London	1
Delaware	
Lewes	1
District of Columbia	
Washington, D.C.	1
Florida	
*Clewiston	2
Daytona Beach	2
Fort Myers	3
Gainesville	3
Jacksonville	1
Key West	2
Melbourne	1
Miami	1
Orlando	3
Panama City	1
Pensacola	2
Tallahassee	2
Tampa	1
West Palm Beach	3
Georgia	
Athens	2
Atlanta	1
Augusta	1

Location	Frequency
Georgia *continued*	
*Baxley	7
Chatsworth	2
Columbus	2
Macon	3
Pelham	1
Savannah	2
*Valdosta	6
Waycross	3
Hawaii	
Hilo	1
Honolulu	1
Kokee	2
Mt. Haleakala	2
Waimanalo (R)	2
Idaho	
Boise	1
Lewiston (P)	1
Pocatello	1
Twin Falls	2
Illinois	
Champaign	1
Chicago	1
Marion	4
Moline	1
Peoria	3
Rockford	3
Springfield	2
Indiana	
*Bloomington	5
Evansville	1
Fort Wayne	1
Indianapolis	1
Lafayette	3
South Bend	2
Terre Haute	2
Iowa	
Cedar Rapids	3
Des Moines	1
Dubuque (P)	2
Sioux City	3
Waterloo	1
Kansas	
Chanute	2
Colby	3
Concordia	1
Dodge City	3
Ellsworth	2

Location	Frequency
Kansas *continued*	
Topeka	3
Wichita	1
Kentucky	
Ashland	1
Bowling Green	2
Covington	1
Elizabethtown (R)	2
Hazard	3
Lexington	2
Louisville	3
Mayfield	3
Pikeville (R)	2
Somerset	1
Louisiana	
Alexandria	3
Baton Rouge	2
Buras	3
Lafayette	1
Lake Charles	2
Monroe	1
Morgan City	3
New Orleans	1
Shreveport	2
Maine	
*Caribou	7
*Dresden	3
Ellsworth	2
Portland	1
Maryland	
Baltimore	2
Hagerstown	3
Salisbury	3
Massachusetts	
Boston	3
Hyannis	1
Worcester	1
Michigan	
Alpena	1
Detroit	1
Flint	2
Grand Rapids	1
Houghton	2
Marquette	1
Onondaga	2
Sault Sainte Marie	1
Traverse City	2

Location	Frequency
Minnesota	
Detroit Lakes	3
Duluth	1
International Falls	1
Mankato	2
Minneapolis	1
Rochester	3
Saint Cloud (P)	3
Thief River Falls	1
Willmar (P)	2
Mississippi	
Ackerman	3
Booneville	1
Bude	1
*Columbia (R)	2
Gulfport	2
Hattiesburg	3
Inverness	1
Jackson	2
Meridian	1
Oxford	2
Missouri	
Columbia	2
Camdenton	1
Hannibal	3
Hermitage	5
Joplin/Carthage	1
Kansas City	1
St. Joseph	2
St. Louis	1
Sikeston	2
Springfield	2
Montana	
Billings	1
Butte	1
Glasgow	1
Great Falls	1
Havre (P)	2
Helena	2
Kalispell	1
Miles City	2
Missoula	2
Nebraska	
Bassett	3
Grand Island	2
Holdrege	3
Lincoln	3
Merriman	2
Norfolk	1
North Platte	1
Omaha	2
Scottsbluff	1
Nevada	
Elko	1
Ely	2
Las Vegas	1
Reno	1
Winnemucca	2
New Hampshire	
Concord	2
New Jersey	
Atlantic City	2
New Mexico	
Albuquerque	2
Clovis	3
Des Moines	1
Farmington	3
Hobbs	2
Las Cruces	2

Location	Frequency
New Mexico *continued*	
Ruidoso	1
Santa Fe	1
New York	
Albany	1
Binghamton	3
Buffalo	1
Elmira	1
Kingston	3
New York City	1
*Riverhead	3
Rochester	2
Syracuse	1
North Carolina	
Asheville	2
Cape Hatteras	3
Charlotte	3
Fayetteville	3
New Bern	2
Raleigh/Durham	1
Rocky Mount	3
Wilmington	1
Winston-Salem	2
North Dakota	
Bismarck	2
Dickinson	2
Fargo	2
Jamestown	2
Minot	2
Petersburg	2
Williston	2
Ohio	
Akron	2
Caldwell	3
Cleveland	1
Columbus	1
Dayton	3
Lima	2
*Moscow	4
Sandusky	2
Toledo	1
Oklahoma	
Clinton	3
Enid	3
Lawton	1
McAlester	3
Oklahoma City	2
Tulsa	1
Oregon	
Astoria	2
Brookings	1
Coos Bay	2
Eugene	2
Klamath Falls	1
Medford	2
Newport	1
Pendleton	2
Portland	1
Roseburg	3
Salem	3
Pennsylvania	
Allentown	2
Clearfield	1
Erie	2
Harrisburg	1
Johnstown	2
Philadelphia	3
Pittsburgh	1
State College	3
Wilkes-Barre	1
Williamsport	2

Location	Frequency
Puerto Rico	
Maricao	1
San Juan	2
Rhode Island	
Providence	2
South Carolina	
Beaufort	3
Charleston	1
Columbia	2
Florence	1
Greenville	1
Myrtle Beach	2
Sumter (R)	3
South Dakota	
Aberdeen	3
Huron	1
Pierre	2
Rapid City	1
Sioux Falls	2
Tennessee	
Bristol	1
Chattanooga	1
Cookeville	2
Jackson	1
Knoxville	3
Memphis	3
Nashville	1
Shelbyville	3
Waverly	2
Texas	
Abilene	2
Amarillo	1
Austin	2
Beaumont	3
Big Spring	3
Brownsville	1
Bryan	1
Corpus Christi	1
Dallas	2
Del Rio (P)	2
El Paso	3
Fort Worth	1
Galveston	1
Houston	2
Laredo	3
Lubbock	2
Lufkin	1
Midland	2

Location	Frequency
Texas *continued*	
Paris	1
Pharr	2
San Angelo	1
San Antonio	1
Sherman	3
Tyler	3
Victoria	2
Waco	3
Wichita Falls	3
Utah	
Logan	2
Cedar City	2
Vernal	2
Salt Lake City	1
Vermont	
Burlington	2
*Marlboro	4
Windsor	3
Heathsville	2
Lynchburg	2
Norfolk	1
Richmond	3
Roanoke	3
Washington	
Neah Bay	1
Olympia	3
Seattle	1
Spokane	2
Wenatchee	3
Yakima	1
West Virginia	
Beckley	6
Charleston	2
Clarksburg	1
Gilbert	7
Hinton	4
Romney	7
Spencer	6
Sutton	5
Wisconsin	
La Crosse (P)	1
Green Bay	1
Madison	1
Menomonie	2
Milwaukee	2
Wausau	3
Wyoming	
Casper	1
Cheyenne	3
Lander	3
Sheridan (P)	3

Notes:

1. Stations marked with an asterisk (*) are funded by private interest groups.

2. Stations marked (R) are low powered experimental repeater stations serving a very limited local area.

3. Stations marked (P) operate less than 24 hours/day; however, hours are extended when possible during severe weather.

4. Occasionally the frequency of an existing or planned station must be changed because of unexpected radio frequency interference with adjacent NOAA Weather Radio stations and/or with other government or commercial operators within the area.

APPENDIX D

ABBREVIATIONS AND ACRONYMS

AAT	Air Traffic Service (FAA)
AD	Air Division
ADWS	Automatic Digital Weather Switch
AFB	Air Force Base
AFGL	Air Force Geophysical Laboratory
AFGWC	Air force Global Weather Central
AFOS	Automation of Field Operations and Services
AFS	Air Force Station
AIRMET	Airmen's Meteorological Information
AM	Amplitude Modulation
ANGB	Air National Guard Base
APT	Automatic Picture Transmission
ARTCC	Air Route Traffic Control Center
ATCT	Air Traffic Control Tower
AWS	Air Weather Service
AW	Aviation Tornado Watch
AVHRR	Advanced Very High Resolution Radiometer
CDDF	Central Data Distribution Facility
CONUS	Continental United States
COMEDS	CONUS Meteorological Data System
DMSP	Defense Meteorological Satellite Program
DOD	Department of Defense
EBS	Emergency Broadcast System
EDIS	Environmental Data and Information Service
FAA	Federal Aviation Administration
FCMSSR	Federal Committee for Meteorological Services and Supporting Research
FCM	Federal Coordinator for Meteorology
FEMA	Federal Emergency Management Agency
FM	Frequency Modulation
FO	Military Weather Advisory Future Outlooks
FSS	Flight Service Station
FTS	Federal Telecommunications Service
GAC	Global Area Coverage 4 km Resolution
GMT	Greenwich Mean Time
GOES	Geostationary Operational Environmental Satellite
HRPT	High Resolution Picture Transmission
IAP	International Airport
ICMSSR	Interdepartmental Committee for Meteorological Services and Supporting Research
IR	Infrared

KCRT	Keyboard Cathode Ray Tube
LAC	Local Area Coverage 1.1 km resolution
LF	Light Fine Video Data (1/3 nmi (0.6 km))
LOA	Letter of Agreement
LS	Light Smooth Video Data (1.5 - 2.0 nmi (2.8 - 3.7 km))
LVL	Level
MDR	Manually Digitized Radar
METWATCH	Meteorological Watch
MIC	Maximum Instantaneous Coverage
MKC	Kansas City
MWA	Military Weather Advisory
NAFAX	National Facsimile Network
NASA	National Aeronautics and Space Administration
NAWAS	National Warning System
NESDIS	National Environmental Satellite, Data and Information Service
NHC	National Hurricane Center
NMC	National Meteorological Center
NOAA	National Oceanic and Atmospheric Administration
NR	NORAD Region
NRC	Nuclear Regulatory Commission
NSSFC	National Severe Storms Forecast Center
NSSL	National Severe Storms Laboratory
NWS	National Weather Service
NWWS	NOAA Weather Wire Service
OJCS	Office Joint Chiefs of Staff
PATWAS	Pilots Automatic Telephone Weather Advisory Service
PIBAL	Pilot Balloon
PIREP	Pilot Report
R&D	Research and Development
RAREP	Radar Report
RAWARC	Radar Report and Warning Coordination Circuit
RAWIN	Rawinsonde
SAB	Synoptic Analysis Branch
SC/BS	Subcommittee for Basic Services
SD	Circuit Heading for Radar Reports
SFSS	Satellite Field Service Station
SIGRAD	Significant Radar Message
SIGMET	Significant Meteorological Information
SMS	Synchronous Meteorological Satellite
SR	Stored Data
SRC	State Relay Center
TAA	Total Area Affected
TF	Thermal Fine Data (1/3 nmi (0.6 km))
TIROS	Television Infrared Observation Satellite
TOVS	TIROS Operational Vertical Sounders
TS	Thermal Smooth Data (1.5 - 2.0 nm (2.8 - 3.7 km))
TWEB	Transcribed Weather Broadcast

USA	United States Army
USAF	United States Air Force
USN	United States Navy
VHRR	Very High Resolution Radiometer
VIP	Video Integrated Processor
VISSR	Visible Infrared Spin Scan Radiometer
VOR	VHF Omni-Directional Radio Range
WIBIS	Severe Weather Watch Will Be Issued
WMSC	Weather Message Switching Center
WSFO	Weather Service Forecast Office
WSMO	Weather Service Meteorological Observatory
WSO	Weather Service Office
WSOM	Weather Service Operations Manual

APPENDIX E

METRIC CONVERSION

This appendix presents in capsular form a description of the International System of Units (SI) metric system and selected standard conversion factors commonly used in meteorology and hydrology. The American National Standard Institute/IEEE Standard 268-1982 Metric Practice has been approved for use by the Department of Defense, other Federal agencies, and by many industries. Users are encouraged to acquire and use the ANSI/IEEE 268-1982 Standard Metric Practice to ensure consistent conversion and implementation.

The first part of this appendix is the Federal Register Notice of February 26, 1982, titled: "Metric System of Measurement; Interpretation and Modification of the International System of Units for the United States." The table herein is a list of selected conversion factors by classification excerpted from the ANSI/IEEE Standard. Finally, the figure shows the relationships of SI units with names. It shows graphically how the 19 SI derived units with special names listed in Table 2 of the Federal Register Notice are derived in a coherent manner from the base and supplementary units. A description of the chart precedes the figure.

The Interdepartmental Committee for Meteorological Services and Supporting Research (ICMSSR) has adopted the kilopascal for use in the U. S. except for aeronautical operations where inches of mercury or hectopascal may be used as appropriate. Termination of the use of the unit bar should begin to be phased in immediately to facilitate conversion to meet the official termination date for the bar of 31 December 1985; however, retrofitting existing systems or modifying existing specifications for new systems is not required.

National Bureau of Standards

Metric System of Measurement; Interpretation and Modification of the International System of Units for the United States

Section 3 of Pub. L. 94–168, the Metric Conversion Act of 1975, declares that the policy of the United States shall be to coordinate and plan the increasing use of the metric system in the United States. Section 403 of Pub. L. 93–380, the Education Amendments of 1974, states the policy of the United States to encourage educational agencies and institutions to prepare students to use the metric system of measurement as part of the regular education program. Under both these acts, the "metric system of measurement" is defined as the International System of Units as established by the General Conference on Weights and Measures in 1960 and interpreted or modified for the United States by the Secretary of Commerce (sec. 4(4), Pub. L. 94–168; sec. 403(a)(3), Pub. L. 93–380). The Secretary has delegated his authority under these subsections to the Director of the National Bureau of Standards.

In implementation of this authority, tables and associated materials were published in the **Federal Register** of October 26, 1977 (42 FR 56513–56514), setting forth the interpretation and modification of the International System of Units (hereinafter "SI") for the United States.

In accordance with recent decisions of the International Committee for Weights and Measures of the General Conference on Weights and Measures, and to refine the earlier interpretation and modification, it is deemed appropriate to amend that interpretation and modification, as published in the above-cited **Federal Register** notice of October 26, 1977. To assist interested parties and encourage the proper use of SI, the entire interpretation and modification, as hereby amended, is republished. Accordingly, this notice supersedes the notice of October 26, 1977.

The amendments consist of the inclusion in table 2 of the sievert, a special name for the SI derived unit of dose equivalent, the inclusion in table 6 of the electronvolt and the unified atomic mass unit, and the inclusion in table 7 of the rem, a unit of dose equivalent. The unit "standard atmosphere" is no longer included in table 7. The amendments are indicated by a dagger symbol (†).

The SI is constructed from seven base units for independent quantities plus two supplementary units for plane angle and solid angle, listed in table 1.

TABLE 1.—SI BASE AND SUPPLEMENTARY UNITS

Quantity	Name	Symbol
SI base units:		
length	meter	m
mass [1]	kilogram	kg
time	second	s
electric current	ampere	A
thermodynamic temperature.	kelvin	K
amount of substance	mole	mol
luminous intensity	candela	cd
SI supplementary units:		
plane angle	radian	rad
solid angle	steradian	sr

[1] "Weight" in common parlance is often used to mean "mass."

Units for all other quantities are derived from these nine units. In table 2 are listed 19 SI derived units with special names which were derived from the base and supplementary units in a coherent manner, which means, in brief, that they are expressed as products and quotients of the nine base and supplementary units without numerical factors.

TABLE 2.—SI DERIVED UNITS WITH SPECIAL NAMES

Quantity	SI unit		
	Name	Symbol	Expression in terms of other units
frequency	hertz	Hz	s^{-1}
force	newton	N	$kg \cdot m/s^2$
pressure, stress	pascal	Pa	N/m^2
energy, work, quantity of heat.	joule	J	N·m
power, radiant flux	watt	W	J/s
electric charge, quantity of electricity.	coulomb	C	A·s
electric potential, potential difference, electromotive force.	volt	V	W/A
capacitance	farad	F	C/V
electric resistance	ohm	Ω	V/A
conductance	siemens	S	A/V
magnetic flux	weber	Wb	V·s
magnetic flux density	tesla	T	Wb/m^2
inductance	henry	H	Wb/A
luminous flux	lumen	lm	cd·sr
illuminance	lux	lx	lm/m^2
Celsius temperature [1]	degree Celsius.	°C	K
activity (of a radionuclide).	becquerel	Bq	s^{-1}
absorbed dose, specific energy imparted, kerma, absorbed dose index.	gray	Gy	J/kg
†dose equivalent, dose equivalent index.	sievert	Sv	J/kg

[1] In addition to the thermodynamic temperature (symbol T) expressed in kelvins (see table 1), use is also made of Celsius temperature (symbol t) defined by the equation

$$t = T - T_o$$

where $T_o = 273.15$ K by definition. The unit "degree Celsius" is equal to the unit "kelvin," but "degree Celsius" is a special name in place of "kelvin" for expressing Celsius temperature. A temperature interval or a Celsius temperature difference can be expressed in degrees Celsius as well as in kelvins.

All other SI derived units, such as those in tables 3 and 4, are similarly derived in a coherent manner from the 28 base, supplementary, and special-name SI units.

TABLE 3.—EXAMPLES OF SI DERIVED UNITS EXPRESSED IN TERMS OF BASE UNITS

Quantity	SI unit	Unit symbol
area	square meter	m^2
volume	cubic meter	m^3
speed, velocity	meter per second	m/s
acceleration	meter per second squared.	m/s^2
wave number	1 per meter	m^{-1}
density, mass density	kilogram per cubic meter.	kg/m^3
specific volume	cubic meter per kilogram.	m^3/kg
current density	ampere per square meter.	A/m^2
magnetic field strength	ampere per meter	A/m
concentration (of amount of substance).	mole per cubic meter	mol/m^3
luminance	candela per square meter.	cd/m^2

TABLE 4.—EXAMPLES OF SI DERIVED UNITS EXPRESSED BY MEANS OF SPECIAL NAMES

Quantity	Name	Unit symbol
dynamic viscosity	pascal second	Pa·s
moment of force	newton meter	N·m
surface tension	newton per meter	N/m
heat flux density, irradiance.	watt per square meter.	W/m^2
heat capacity, entropy.	joule per kelvin	J/K
specific heat capacity, specific entropy.	joule per kilogram kelvin.	J/(kg·K)
specific energy	joule per kilogram	J/kg
thermal conductivity	watt per meter kelvin	W/(m·K)
energy density	joule per cubic meter	J/m^3
electric field strength	volt per meter	V/m
electric charge density.	coulomb per cubic meter.	C/m^3
electric flux density	coulomb per square meter.	C/m^2
permittivity	farad per meter	F/m
permeability	henry per meter	H/m
molar energy	joule per mole	J/mol
molar entropy, molar heat capacity.	joule per mole kelvin	J/(mol·K)
exposure (x and γ rays).	coulomb per kilogram	C/kg
absorbed dose rate	gray per second	Gy/s

For use with the SI units there is a set of 16 prefixes (see table 5) to form multiples and submultiples of these units. It is important to note that the kilogram is the only SI unit with a prefix. Because double prefixes are not to be used, the prefixes of table 5, in the case of mass, are to be used with gram (symbol g) and not with kilogram (symbol kg).

TABLE 5.—SI PREFIXES

Factor	Prefix	Symbol
10^{18}	exa	E
10^{15}	peta	P
10^{12}	tera	T
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{2}	hecto	h
10^{1}	deka	da
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p
10^{-15}	femto	f
10^{-18}	atto	a

Certain units that are not part of the SI are used so widely that it is impractical to abandon them. The units that are accepted for continued use in the United States with the International System are listed in table 6.

TABLE 6.—UNITS IN USE WITH THE INTERNATIONAL SYSTEM

Name	Symbol	Value in SI unit
minute (time)	min	1 min = 60 s
hour	h	1 h = 60 min = 3 600 s
day	d	1 d = 24 h = 86 400 s
degree (angle)	°	$1° = (\pi/180)$ rad
minute (angle)	′	$1′ = (1/60)° = (\pi/10\,800)$ rad
second (angle)	″	$1″ = (1/60)′ = (\pi/648\,000)$ rad
liter	L*	$1 L = 1 dm^3 = 10^{-3} m^3$
metric ton	t	$1 t = 10^3$ kg
hectare (land area)	ha	$1 ha = 10^4 m^2$
†electronvolt	eV	$1 eV = 1.602 \times 10^{-19}$ J, approximately**
†unified atomic mass unit.	u	$1 u = 1.660\ 57 \times 10^{-27}$ kg, approximately**

* Both L and l are international symbols for liter. Because "l" can easily be confused with the numeral "1" the symbol "L" is recommended for United States use.

** The values of these units in terms of SI units are obtained experimentally.

In those cases where their usage is already well established, the use, for a limited time, of the units in table 7 is accepted, subject to future review.

TABLE 7.—UNITS IN USE TEMPORARILY WITH THE INTERNATIONAL SYSTEM

nautical mile	angstrom	curie
knot	barn	roentgen
	bar	rad [2]
	gal [1]	†rem [3]

[1] Unit of acceleration.
[2] Unit of absorbed dose.
[3] Unit of dose equivalent.

Metric units, symbols, and terms that are not in accordance with the foregoing Interpretation and Modification are no longer accepted for continued use in the United States with the International System of Units. Accordingly, the following units and terms listed in the table of metric units in section 2 of the Act of July 28, 1866 that legalized the metric system of weights and measures in the United States are no longer accepted for use in the United States:

myriameter
stere
millier or tonneau
quintal
myriagram
kilo (for kilogram)

For more information regarding the International System of Units, contact Dr. David T. Goldman, National Measurement Laboratory, National Bureau of Standards, U.S. Department of Commerce, Washington, D.C. 20234, telephone (301) 921–3304.

Dated: February 2, 1982.

Ernest Ambler,

Director.

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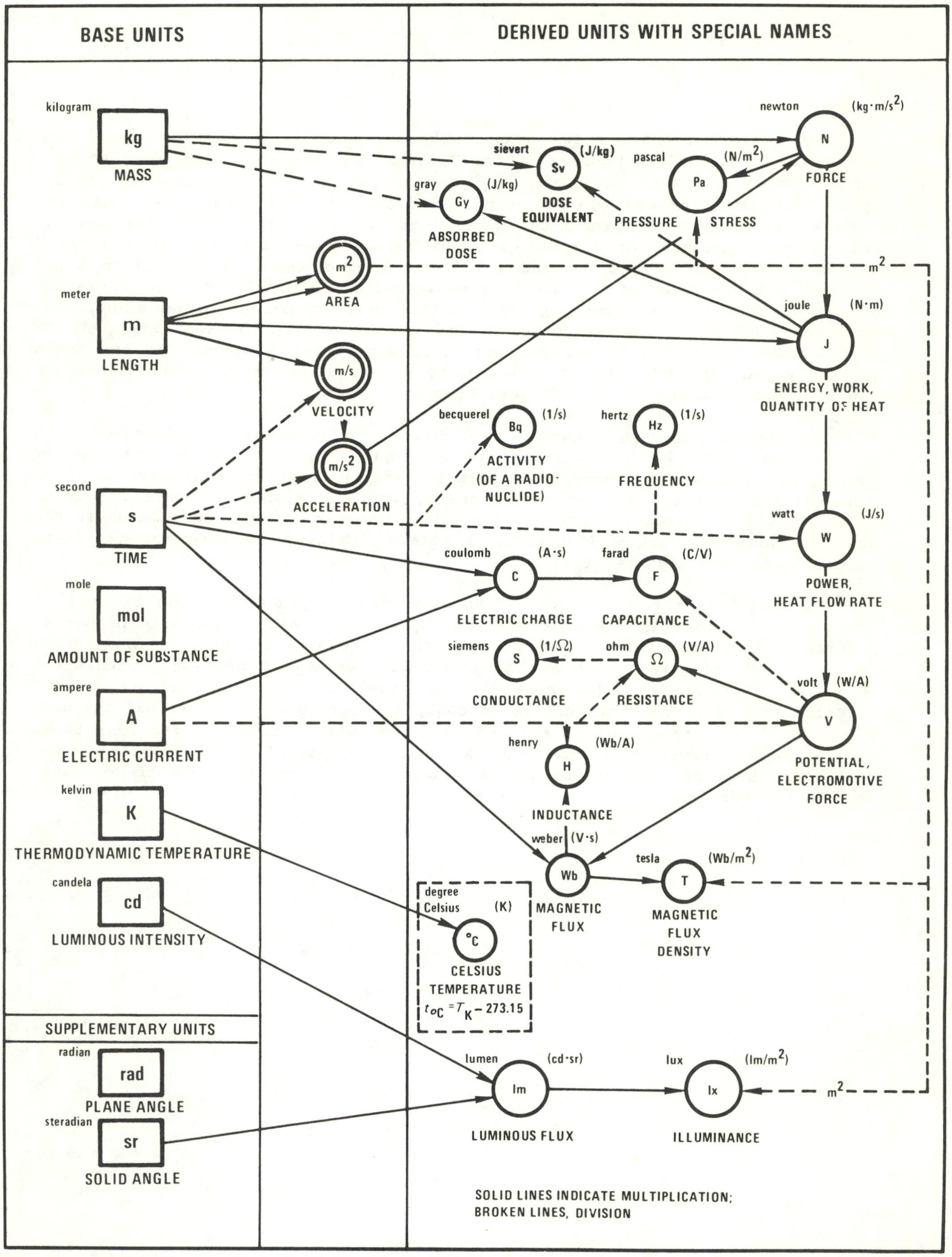
BILLING CODE 3510–13–M

The following chart shows graphically how the 19 SI derived units with special names listed in Table 2 of the Federal Register Notice are derived in a coherent manner from the base and supplementary units. In the first column the symbols of the base and supplementary units are shown in rectangles, with the name of the unit shown toward the upper left of the rectangle and the name of the quantity (measurable attribute) shown below the rectangle. In the third column the symbols of the derived units with special names are shown in solid circles, with the name of the quantity shown below the circle, and an expression of the derived unit in terms of other units shown toward the upper right. In the second column are shown those derived units without special names that are used in the derivation of the derived units with special names. In the chart the derivation of each unit is indicated by arrows bringing in numerator factors (solid lines) and denominator factors (broken lines).

The degree Celsius, shown on the chart in a broken-line rectangle, is a special name for the kelvin, for use in expressing Celsius temperatures or temperature intervals. Where it is used to express temperature intervals, it is equal to the kelvin, as shown on the chart, with the symbol K toward the upper right of the ^{o}C circle; where it is used to express Celsius temperatures, the equation below "CELSIUS TEMPERATURE" relates Celsius temperature (t_{oC}) to thermodynamic temperature (T_K).

As stated in the ANSI/IEEE 268 Standard Metric Practice, "The SI unit of pressure and stress is the pascal (newton per square meter) and with proper SI prefixes is applicable to all such measurements. Old metric gravitational units for pressure and stress such as kilogram-force per square centimeter shall not be used. Widespread use has been made of other non-SI units such as bar and torr for pressure, but this use is strongly discouraged. The millibar has been widely used by meteorologists for communication within their profession; there is now some attempt to introduce the name hectopascal as a substitute for millibar. However, the kilopascal should be used in presenting meteorological data to the public."

RELATIONSHIPS OF SI UNITS WITH NAMES



SELECTED STANDARD CONVERSION FACTORS

Factors with an * are exact

Unit	=	SI Standard Unit
ACCELERATION		
1 ft/s^2	=	3.048 000*E-01 m/s^2
standard acceleration of free fall	=	9.806 650*E+00 m/s^2
ANGLE		
1 degree	=	1.745 329 E-02 rad
AREA		
1 acre	=	4.046 873 E+03 m^2
1 ft	=	9.290 304*E-02 m^2
1 hectare	=	1.000 000*E+04 m^2
1 in	=	6.451 600*E-04 m^2
BENDING MOMENT OR TORQUE		
1 dyne.cm	=	1.000 000*E-07 N.m
1 lbf.ft	=	1.355 818 E+00 N.m
ELECTRICITY AND MAGNETISM		
1 ampere hour	=	3.600 000*E+03 C
1 EMU of capacitance	=	1.000 000*E+09 F
1 EMU of current	=	1.000 000*E+01 A
1 EMU of electric potential	=	1.000 000*E-08 V
1 EMU of inductance	=	1.000 000*E-09 H
1 EMU of resistance	=	1.000 000*E-09 Ω
1 ESU of capacitance	=	1.112 650 E-12 F
1 ESU of current	=	3.335 641 E-10 A
1 ESU of electric potential	=	2.997 925 E+02 V
1 ESU of inductance	=	8.987 554 E+11 H
1 ESU of resistance	=	8.987 554 E+11 Ω
ENERGY (Includes WORK)		
1 British thermal unit (International Table)	=	1.055 056 E+03 J
1 British thermal unit (thermochemical)	=	1.054 350 E+03 J
1 calorie (International Table)	=	4.186 800*E+00 J
1 calorie (thermochemical)	=	4.184 000*E+00 J
1 electronvolt	=	1.602 19 E-19 J
1 erg	=	1.000 000*E-07 J
1 kW.h	=	3.600 000*E+06 J
1 therm	=	1.054 804*E+08 J

ENERGY PER UNIT AREA TIME

1 Btu (International Table)/(ft^2.h)	=	3.154 591 E+00 W/m^2
1 erg/(cm^2.s)	=	1.000 000*E-03 W/m^2

FLOW (See MASS PER UNIT TIME or VOLUME PER UNIT TIME)

FORCE

1 dyne	=	1.000 000*E-05 N
1 kilogram-force	=	9.806 650*E+00 N
1 pound-force (lbf)	=	4.448 222 E+00 N

FORCE PER UNIT AREA (See PRESSURE)

FORCE PER UNIT LENGTH

1 lbf/ft	=	1.459 390 E+01 N/m

HEAT

1 Btu (International Table).ft/(h.ft^2.$^\circ$F) (thermal conductivity)	=	1.730 735 E+00 W/(m.K)
1 Btu (thermochemical).ft/(h.ft^2.$^\circ$F) (thermal conductivity)	=	1.729 577 E+00 W/(m.K)
1 Btu (International Table)/lb	=	2.326 000*E+03 J/kg
1 cal (thermochemical)/(cm.s.$^\circ$C)	=	4.184 000*E+02 W/(m.K)
1 cal (thermochemical)/s	=	4.184 000*E+00 W
1 ft^2/h (thermal diffusivity)	=	2.580 640*E-05 m^2/s

LENGTH

1 angstrom	=	1.000 000*E-10 m
1 astronomical unit	=	1.495 979 E+11 m
1 foot	=	3.048 000*E-01 m
1 inch	=	2.540 000*E-02 m
1 micron	=	1.000 000*E-06 m
1 mile (nautical)	=	1.852 000*E+03 m
1 mile (statute)	=	1.609 344*E+03 m

LIGHT

1 footcandle	=	1.076 391 E+01 1x
1 lambert	=	3.183 099 E+03 cd/m^2
1 lumen per ft^2	=	1.076 391 E+01 1m/m^2

MASS

1 gram	=	1.000 000*E-03 kg
1 pound (avoirdupois)	=	4.535 923 7*E-01 kg
1 tonne	=	1.000 000*E+03 kg

MASS PER UNIT TIME (Includes FLOW)

1 lb/min	=	7.559 873 E-03 kg/s

MASS PER UNIT VOLUME (Includes DENSITY and MASS CONCENTRATION)

1 g/cm^3	=	1.000 000*E+03 kg/m^3
1 lb/ft^3	=	1.601 846 E+01 kg/m^3

POWER

1 Btu (International Table)/h	=	2.930 711 E-01 W
1 Btu (thermochemical)/h	=	2.928 751 E+01 W
1 cal (thermochemical)/s	=	4.184 000*E+00 W
1 erg/s	=	1.000 000*E-07 W
1 horsepower (electric)	=	7.460 000*E+02 W
1 ton of refrigeration (12 000 Btu/h)	=	3.517 E+03 W

PRESSURE OR STRESS (FORCE PER UNIT AREA)

1 atmosphere (standard)	=	1.013 250*E+05 Pa
1 inch of mercury (60^oF)	=	3.376 85 E+03 Pa
1 millibar	=	1.000 000*E+02 Pa
1 psi	=	6.894 757 E+03 Pa

RADIOLOGY

1 rem (dose equivalent)	=	1.000 000*E-02 Sv
1 roentgen	=	2.58 E-04 C/kg

TEMPERATURE

Celsius Temperature	=	$(t_{oF}-32)/1.8$
Fahrenheit Temperature	=	$1.8t_{oC}+32$
Kelvin Temperature	=	$t_{oC}+273.15$

TIME

1 day (mean solar)	=	8.640 000*E+04 s
1 day (sidereal)	=	8.616 409 E+04 s
1 year (sidereal)	=	3.155 815 E+07 s
1 year (tropical)	=	3.155 693 E+07 s

1 VELOCITY (Includes SPEED)

1 ft/min	=	5.080 000*E-03 m/s
1 knot (international)	=	5.144 444 E-01 m/s
1 mi/h (international)	=	4.470 400*E-01 m/s
1 mi/h (international)	=	1.609 344*E+00 km/h

VISCOSITY

1 poise	=	1.000 000*E-01 Pa.s
1 lb/ft.s	=	1.488 164 E+00 Pa.s

VOLUME (Includes CAPACITY)

1 acre-foot	=	1.233 5 E+03 m^3
1 barrel (oil, 42 gal)	=	1.589 873 E-01 m^3
1 in^3	=	1.638 7064*E-05 m^3
1 L (liter)	=	1.000 000*E-03 m^3

VOLUME PER UNIT TIME (Includes FLOW)

1 ft^3/min	=	4.71A19 474 E-04 m^3/s

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