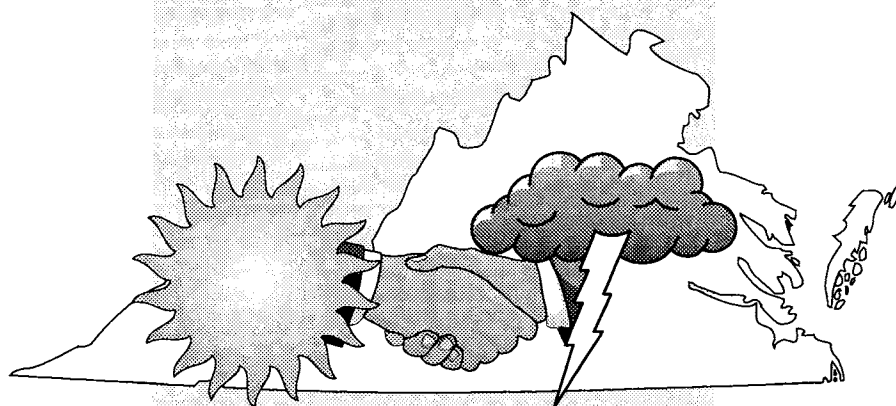


FINAL REPORT

ASSESSMENT OF OPPORTUNITIES FOR ENHANCED COOPERATION IN ACQUIRING AND DISSEMINATING WEATHER DATA AMONG SELECTED VIRGINIA GOVERNMENT AGENCIES



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Abstract Accurate and timely information regarding impending weather conditions is important to several public agencies in Virginia. Potential problems including flooding, heavy snowfall, and damaging winds necessitate planning and pre-event deployment by many units of Virginia agencies. The acquisition and dissemination of weather reports and forecasts can be costly. Notwithstanding the associated costs, concern for public safety compels government to obtain the information it needs. This project inventories the weather collection and acquisition practices of selected Virginia executive branch agencies that demonstrated a need for weather-related information. This included gathering information relevant to the sources, uses, and costs of their weather-related information and exploring the feasibility of sharing data and costs.				

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(The opinions, findings, and conclusions expressed in this report are those of the authors and not necessarily those of the sponsoring agencies.)

Virginia Transportation Research Council
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ABSTRACT

Accurate and timely information regarding impending weather conditions is important to several public agencies in Virginia. Potential problems including flooding, heavy snowfall, and damaging winds necessitate planning and pre-event deployment by many units of Virginia agencies. The acquisition and dissemination of weather reports and forecasts can be costly. Notwithstanding the associated costs, concern for public safety compels government to obtain the information it needs.

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INTRODUCTION

Public safety is an overarching responsibility of government at any level, and warning the public and preparing for mitigating weather-related hazards are governmental duties few would challenge. Recent severe weather conditions in Virginia highlighted the importance of disseminating accurate and prompt weather information. Areas along the Blue Ridge Mountains in central Virginia were inundated by torrential rainfall from thunderstorms in late June 1995. One of the most devastated areas, the upper Rapidan River basin in Madison County, received more than 6 inches of rain per hour for 4 hours, totaling more than 30 inches of rainfall in 24 hours. The deluge triggered landslides and flooding throughout Madison and Greene counties, resulting in loss of life and property. The cooperation of numerous local, state, and federal agencies was required to minimize loss of life, restore utilities, and repair transportation systems.

The summer flooding was followed by one of the snowiest and coldest winters in recent memory. Areas of Virginia received more than 40 inches of snowfall for the 1995-96 winter season, with some regions receiving more than half their total from a single storm. The combination of persisting cold temperatures and high winds led to snowdrifts more than 9 feet tall in some localities. Subsequent heavy rains caused rapid melting of the snow, which resulted in widespread flooding in the western regions of Virginia. Government agencies coordinated efforts in removing snow from transportation systems, evacuating citizens from snowbound and/or inundated areas, and restoring utilities.

These events underscored the need for accurate and timely weather forecasts and reports of current conditions. They are essential for deploying snow removal equipment, evacuating citizens from flood-prone areas, and assessing the magnitude of resource allocation for mitigating weather-related emergencies. Although numerous government agencies rely on weather reports for their daily operations, no uniformity exists in weather data acquisition and distribution. Agencies individually acquire and share weather data based on their individual needs.

This diversity in the modes of weather data acquisition, use, and dissemination highlights some concerns. One is that government agencies in the same region with similar weather data needs may be separately purchasing information, whereas collaborative efforts could result in financial savings and increased quality and quantity of weather data. Better weather data that are more readily available also serve to increase public safety. Accidents and hazards can be avoided if the public is notified about weather conditions as soon as they are assessed. For these reasons, the Virginia Department of Motor Vehicles' (DMV) Traffic Safety Services and the Virginia Department of Transportation's (VDOT) Traffic Engineering Division jointly requested a study of the sources of weather data and possible opportunities for sharing weather data.

PURPOSE AND SCOPE

The purpose of this study was to delineate the current weather information needs of Virginia government agencies, identify their sources of data acquisition, and examine the possibilities of weather data sharing among agencies. The scope included selected agencies in the Virginia state government executive branch that demonstrated a need for weather information.

METHODOLOGY

Step 1: Identify National Sources of Weather Data

The National Weather Service (NWS) is a major repository for weather information. Documentation concerning the NWS data and their availability and information on weather data collected by Virginia state agencies were reviewed.

Step 2: Identify Weather Information Users

The researchers made telephone calls to the offices of the eight Virginia cabinet secretaries to determine if other agencies had weather data needs. Table 1 shows the agencies that were determined to have such needs.

Step 3: Determine Sources, Uses, Distribution, and Cost of Weather Information

The researchers conducted a telephone survey (shown in Appendix A) to document the origins, uses, and sharing of weather information for each agency identified in Step 1. First, all pertinent information related to weather data acquisition and distribution was gathered. Then,

Table 1. Virginia Agencies That Require Weather-Related Data

Secretary of Transportation Department of Transportation Department of Aviation Department of Motor Vehicles Department of Rail & Public Transportation Virginia Port Authority Secretary of Commerce and Trade Department of Agriculture & Consumer Services Department of Mines, Minerals & Energy Department of Forestry Virginia Resources Authority Virginia Agricultural Development Authority	Secretary of Public Safety Department of State Police Department of Emergency Services Secretary of Natural Resources Department of Game & Inland Fisheries Department of Conservation & Recreation Department of Environmental Quality Marine Resources Commission Chesapeake Bay Local Assistance Department University of Virginia State Climatology Office
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basic cost data were requested. Some agencies, such as VDOT, required additional surveys for each district to document weather data sources and uses.

Step 4: Evaluate Survey Responses

Data collected from the agencies were compiled and analyzed for trends. One goal of the research was to identify methods that could potentially reduce duplication of effort and at the same time upgrade the quality and timeliness of weather information. The researchers sought to achieve this goal by identifying agencies that had similar weather data needs and identifying methods of weather data sharing.

RESULTS

Sources of Weather Data

National Oceanic and Atmospheric Administration/National Weather Service Data

There are two primary sources of weather data: (1) data that originate with the NWS or its parent agency, the National Oceanic and Atmospheric Administration (NOAA), and (2) extremely limited weather data collected in Virginia for specific purposes, such as flight weather data and surface temperature. Although a number of private vendors of weather information exist, almost all reformat NWS data to meet their customers' needs.

NWS provides a collection of data services to users through a package entitled Family of Services (FOS) to meet specific and unique individual and corporate needs:

1. *Public Product Service (PPS)* distributes weather watches, warnings, and various hydrological, agricultural, and miscellaneous forecast and products
2. *Domestic Data Service (DDS)* includes basic observations and various aviation and marine products
3. *International Data Service (IDS)* carries worldwide surface and upper air observations
4. *High Resolution Service (HRS)* carries global model-derived forecasts and analysis
5. *Digital Facsimile Service (DIFAX)* carries weather analysis and prognosis products related primarily to aviation
6. *AFOS Graphics Service* carries all charts associated with weather information, including model guidance charts, national radar summaries, manually prepared analyses and forecast charts for surface and aloft, and climatological charts.

Specific services provided by FOS include:

1. Warnings and forecasts for severe weather and general forecasts (for short-term conditions out to 1-year projections) are provided to the public.
2. Warnings and forecasts are provided to the marine and aviation communities to support safe travel.
3. Critical information and forecasts are provided to emergency managers and local decision makers to support evacuations and other safety measures in response to toxic spills, wild fires, and technological hazards.
4. High-quality data and weather information are made available to the private sector and weather information providers to support the needs of the broadcast media and the technical needs of specific companies and individuals.
5. NWS provides dial-in access to a wide range of climate data.
6. Recordings provide weather services including public forecasts, marine forecasts, tropical weather, current conditions, and extended forecasts; 100 of the 300 announcement systems have ring-through facilities to connect the caller directly to NWS personnel to obtain more information.

The products provided through FOS are listed in Appendix B. Ordinarily, fees for becoming a direct user of FOS include a one-time connection fee of \$2,500 and an annual maintenance fee of \$7,000 for DDS. However, in discussions with Julie Chapman-Hayes, Program Manager for FOS, fees are often waived for state agencies if proper justification is

provided as to why the agency needs the information. Thus, it is likely that the complete FOS could be made available to the state for free.

NOAA also provides several products. These include the NOAA Weather Wire Service (NWWS), the primary communications facility for disseminating NWS forecasts, warnings, and other information to the media and emergency management agencies. NWWS is a satellite communications system, owned by GTE Communications, that transmits NWS products from NWS offices to users. More than 58 major NWS forecasting offices throughout the United States provide weather information that is transmitted to GTE's master facility in Mt. View, California, which is then rebroadcast via satellite to more than 1,500 users. The users then have access to the nearly 6,400 products transmitted daily.

The NOAA Weather Radio also provides audio broadcasts of weather information. NWS field offices collect and broadcast data through a national network of VHF-FM radio transmitter sites throughout the United States and its territories. The audio information is also broadcast on cable television weather channels. A future network expansion will increase coverage to 95 percent of the U.S. population.

A new system is being developed for NWS by AAI Systems Management as part of its modernization program. The Automated Surface Observing System (ASOS) consists of a large complement of sophisticated weather sensors that will more reliably measure weather data such as wind speed and direction, temperature, dew point, visibility, cloud height, rainfall, and type and intensity of precipitation. Information from these new sensors will provide aviation personnel and weather forecasters the tools to predict the weather quickly and accurately.

There are four primary methods of accessing NWS data:

1. *Buy data directly from NWS.*
2. *Contract with 1 of the 15 commercial and private vendors that purchase the data directly from NWS.* These vendors package and resell the data based on individual customer's needs. These companies are the main contacts between agencies or individuals who have weather needs and NWS, and their names and addresses are listed in Appendix C.
3. *Contract with one of the vendors that buys NWS data from 1 of the 15 vendors buying the data directly from NWS.* Nearly 300 smaller private companies and individuals purchase weather data from the one of the major commercial subscribers and tailor and resell the information based on individual client needs. Eight private Virginia companies that are certified by the consulting meteorologist program are available to supply weather data, and an additional 21 exist in states bordering Virginia. The names and addresses of these companies are listed in Appendixes D and E, respectively.

4. *Access free NWS data from the Internet or The Weather Channel.* Numerous universities, colleges, and private companies have weather service provider home pages on the Internet. The list shown in Appendix F was obtained by searches conducted on the Internet. Appendix G lists more than 30 addresses of industry-tested Internet sites that provide a variety of weather information, including current weather conditions, forecasts, weather maps, and tropical weather updates.

Weather Data Collected by State Agencies

For VDOT, quantifying the weather conditions at or near the roadway surface is equally as or more important than quantifying atmospheric weather conditions. Moisture that falls through the atmosphere as rain may change to ice upon contact with a slightly cooler road surface that may be only a few degrees lower than the surrounding air. This phenomenon illustrates the need for both ground and atmospheric weather data throughout Virginia to assess subtle changes and variations in weather and road conditions.

VDOT recognized the need to monitor the weather of both the roadway and the atmosphere and implemented a statewide weather monitoring system—the Surface Condition Analyzer System (SCAN). Forty road weather information system (RWIS) stations are located throughout the state, the majority at bridges. Each station measures meteorological data and has several sensors embedded in the roadway, above the ground surface, and below the ground surface. The sensors measure meteorological conditions, including air temperature, relative humidity, precipitation, wind speed and direction, surface temperature, surface moisture conditions, and subsurface temperature. All 40 RWIS stations were purchased from the private vendor, SSI, and, thus, belong to the state. However, the vendor owns the software needed to retrieve and format data from the stations. Thus, this vendor is responsible for maintaining and repairing the monitoring equipment, providing VDOT with collected instrument data, and supplying weather forecasts for the next 24 hours on a minimum twice-daily basis. These data are specific to pavement surface conditions and are integral to VDOT's responsibility to clear road surfaces and issue warnings to individuals and other agencies about hazardous roadways, especially during the winter months. This type of weather data may not be immediately useful to other agencies.

In addition to RWIS, some weather data are electronically collected at airports for use in flight planning. By combining weather data collected from AWOS III computerized briefing terminals at Virginia airports with the 40 RWIS stations, state agencies potentially have a number of weather sites that provide instantaneous weather conditions. Although these data may be too specific for users in other agencies, additional study of these state sources should be conducted.

Assessment of Weather-Related Needs of Agencies

All agencies chosen for the study were contacted concerning their weather-related needs. Table 2 shows which agencies require weather data for their operations. The survey identified 12

Table 2. State Agency Requirements for Weather Information

Agency	Requires Weather Information?	Level of Urgency
Chesapeake Bay Local Assistance Department	No	-
Department of Agriculture & Consumer Service	Yes	Long term
Department of Aviation	Yes	Immediate
Department of Conservation & Recreation	Yes	Hourly-to-daily
Department of Emergency Services	Yes	Immediate
Department of Environmental Quality	Yes	Hourly-to-daily
Department of Forestry	Yes	Hourly-to-daily
Department of Game & Inland Fisheries	No	-
Department of Mines, Minerals & Energy	Yes	Long term
Department of Motor Vehicles	No	-
Department of Rail & Public Transportation	No	-
Department of State Police	Yes	Immediate
VDOT (all districts/central office)	Yes	Immediate
Marine Resources Commission	Yes	Immediate
Virginia Agricultural Development Authority	No	-
Virginia Port Authority	Yes	Immediate
Virginia Resources Authority	No	-
State Climatology Office	Yes	Long term

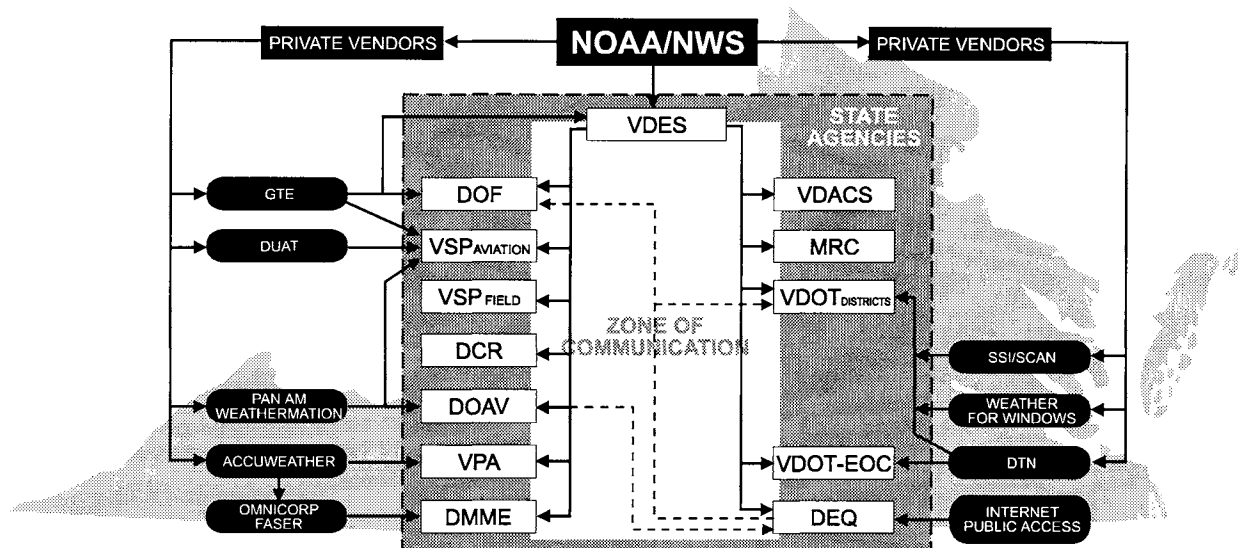
Source: Telephone surveys, August 1996 and June 1997.

of the 18 agencies that require weather data. In terms of urgency, agencies were said to have an immediate need if they needed updates at least every 15 to 60 minutes; an hourly-to-daily need if they needed updates within 1 to 23 hours, and a long-term need if they needed data on a daily, weekly, or monthly basis.

A summary of weather needs, sources, and dissemination by agencies requiring weather data is provided in Appendix H.

DISCUSSION

This study of the uses of weather data in Virginia identified three levels of expediency: instantaneous, hourly to daily, and long term/archival. The study also found that state agencies combine free NWS data provided through television, radio, or emergency bulletins with NWS data purchased from vendors who have repackaged the information in a format that meets each agency's needs. As shown in Figure 1, multiple vendors are under contract to different state agencies to provide data. Some agencies have contracts with more than one vendor. However, the figure shows that only three agencies regularly share current (nonarchival) weather data with other state agencies. The Department of Emergency Services (VDES) shares data with all other agencies; the Department of Environmental Quality (DEQ) sends the daily ozone level reports to the Department of Forestry (DOF) and VDOT, so that burning and operating internal combustion engines can be minimized; and DEQ accesses Pan Am Weatheration through the Department



DOF	Department of Forestry	VDACS	Department of Agriculture & Consumer Services
VSP _{AVIATION}	Department of State Police - Aviation	DEQ	Department of Environmental Quality
VSP _{FIELD}	Department of State Police - Field	VDES	Department of Emergency Services
DOAV	Department of Aviation	MRC	Marine Resources Commission
DMME	Department of Mines, Minerals & Energy	VDOT _{DISTRICTS}	Virginia Department of Transportation - Districts
VPA	Virginia Port Authority	VDOT-EOC	Virginia Department of Transportation - Emergency Operations Center
DCR	Department of Conservation & Recreation		

Figure 1. Sources of Weather Data for State Agencies and Their Data Sharing

of Aviation (DOAV). It may be that the needs of the various agencies are so different that only different vendors can adequately meet them. However, it is also possible that the state is paying many vendors for similar information that could be provided, without cost, directly from NWS.

More detailed coordination of agency-based weather contracting is needed to minimize costs to the state while meeting all agency needs. A multiagency weather data oversight group could be formed to coordinate these activities. It may be possible that free NWS data could be reformatted to meet each agency's needs by a central group, such as the Department of Information Technology or the State Climatology Office, to avoid contracting with multiple vendors. If this is not possible, it may be that contracting with a single vendor (or minimum number of vendors) could minimize duplication of effort. It may even be possible that media sources of weather information, such as The Weather Channel, could meet many of Virginia's needs.

In addition, the advancement of Internet technology may minimize the need for contracting with private vendors for daily or long-term weather data. An agency can access several Internet Web sites that provide near real-time data (15-minute delay). Local and regional forecasts, complete with Doppler radar imagery, are free to subscribers. A discussion with the weather director of one television station revealed that their daily forecasts are almost solely

based on data gathered from the Internet. This observation may indicate trends to come in weather data acquisition by both the public and private sector. Virginia might be better served by installing more Internet access sites in an agency in lieu of contracting with a private vendor for weather needs.

The U.S. Department of Transportation is studying the feasibility of implementing a Surface Transportation Weather Information System (STWIS) as part of the Intelligent Transportation System (ITS) initiative. This study for the Federal Highway Administration is in the early stages and is evaluating the potential for a federally coordinated program to advance a system that satisfies the weather data needs of surface transportation users and operators. Rather than implement a specific federal standard or program, STWIS will involve federal coordination of system development and sponsorship of research and development within the existing ITS framework. Agencies involved in deploying STWIS will include federal agencies, state departments of transportation, transit authorities, local transportation agencies, and private firms marketing weather systems and services. STWIS will expand the scope of RWIS, with the goal of providing a broad group of surface transportation decision makers a shared, open system for acquiring relevant weather information. Virginia could include information on STWIS in their planning for weather data acquisition and dissemination.

FINDINGS AND CONCLUSIONS

- Virtually all weather information originates from NWS. Private vendors purchase and tailor weather data and resell the product based on individual client needs.
- Most state agencies combine media-based sources of weather information (such as The Weather Channel or emergency bulletins) with data provided by vendors who repackage NWS data to meet their weather-related needs.
- NWS data are usually free to governmental agencies that apply and have a justifiable need for the information.
- Some state agencies require specific weather data that focus, for instance, on pavement surface conditions during inclement weather (VDOT) or conditions in the upper atmosphere (DOAV). These additional needs are being met through the collection of original data by the agencies.
- Two agencies expressed dissatisfaction with the accuracy and immediacy of their current sources of weather information and a desire to obtain data that better suited their needs, and many of them felt there was a need for enhanced cooperation and sharing of weather data acquisition and dissemination. One agency, the State Office of Climatology, expressed an interest in becoming the central reformatting and distribution point for weather data for state agencies.

- Numerous Internet sites supply weather data, and some are updated as often as every 15 minutes.
- Virginia governmental agencies can improve and enhance their acquisition and dissemination of necessary weather information, reduce costs, and improve data accuracy by pooling existing resources and reducing duplication of services.
- Improved coordination and cooperation could facilitate enhanced information sharing.

RECOMMENDATIONS

1. Form an oversight group to evaluate in detail (1) all agency needs for weather data, (2) all services provided by commercial vendors, and (3) the services provided by NWS. The lead agency for this effort should have both a working knowledge of weather data availability and the computer expertise to reformat weather information to meet individual agency needs. A plan that maximizes the accuracy, utility, and timeliness of weather data and minimizes the cost of data acquisition, repackaging, and duplication of effort should then be developed to meet agency needs.
2. Consider using the Internet and media-based weather services, such as The Weather Channel, to meet agency needs.

SURVEY QUESTIONNAIRE

WEATHER RELATED INFORMATION SURVEY: PHASE ONE

Date: _____ Time: _____ Researcher: _____

Organization: _____

Contact person and phone number: _____

1. Does your agency have needs for weather-related information? (circle one)
yes no (end survey)

2. What are your agency's uses of weather data?

3. How does your agency obtain weather data?

4. How timely does your agency's weather data need to be?

5. What type of weather information is your agency collecting?

6. What other agencies use the weather data that your agency collects?

WEATHER RELATED INFORMATION SURVEY: PHASE TWO

Date: _____ Time: _____ Researcher: _____

Organization: _____

Contact person and phone number: _____

1. What is the annual cost of your agency's weather data acquisition?

2. How is this financed?

3. Is your agency's weather related data obtained through competitive bids or through sole-source contracts?

APPENDIX B

NATIONAL WEATHER SERVICE FAMILY OF SERVICES DATA

The National Weather Service Family of Services

A. BACKGROUND - Since 1983, the National Weather Service (NWS) has made substantial changes in the way it makes environmental data available to external users. Following implementation of the Automation of Field Operations and Services (AFOS), traditional teletypewriter services have been almost entirely phased out. Consistent with that part of the NWS mission dealing with making environmental information available to the public sector, it became necessary to establish alternative means of making information available.

B. FAMILY OF SERVICES - External user access to near real-time weather and flood data and information is now available on a family of medium speed communication services accessed in the Washington area. The family is divided into six services: (1) the Public Product Service, (2) the Domestic Data Service, (3) the International Data Service, (4) the High Resolution Data Service, (5) the Digital Facsimile Service, and (6) the AFOS Graphics. All products appearing on the data services are identified by abbreviated headings that conform to World Meteorological Organization standards and procedures.

NOTE: NWS Warnings and Advisories are *disseminated* immediately on the NOAA Weather Wire Service and the NOAA Weather Radio. These are the primary sources for the general public, and other *external* users. NWS Warnings and Advisories then are relayed on the NWS Family of Services as appropriate.

C. SERVICES AVAILABLE

Note: The transmission speed of FOS circuits may be increased as deemed necessary and advisable by NWS, and as approved by the majority of the subscribers to each service, to provide adequate throughput of the information carried on each circuit.

1. PUBLIC PRODUCT SERVICE (PPS)

The PPS provides users with forecasts and warnings in an easily read, plain language format.

(a) Communications Parameters: 9600 bits per second transmission speed, asynchronous mode, character-oriented (ASCII).

(b) Contents: Watches and Warnings
Coastal Flood Warnings
Flash Flood Watches
Civil Emergency Messages

- Flood Warnings
- Gale Warnings
- Marine/Aviation Tropical Cyclone Advisories
- Marine Subtropical Storm Advisories
- Non-Precipitation Watches, Warnings and Advisories
- Public Severe Weather
- Public Subtropical Advisories
- Public Tropical Cyclone Advisories
- Severe Local Storm Watches and Area outline
- Severe Local Storm Watch Cancellation Messages
- Severe Thunderstorm and Special Marine Warnings
- Severe Thunderstorm Warnings
- Special Marine Warnings
- Special Weather Statements
- State Weather Roundups
- Subtropical Storm Advisories
- Tornado and Special Marine Warnings
- Tornado Warnings
- Tropical Cyclone Position Estimates
- Tropical Cyclone Updates
- Tropical Depression Discussions
- Tsunami Watches and Warnings
- Winter Weather Watches, Warnings and Advisories
- Hydrologic Products
- Flash Flood Statements
- Flood Potential Outlooks
- Flood Statements
- Hydrometeorological Discussions
- National Flood *Summaries*
- River Recreation Statements
- River Statements
- River *Summaries*
- Water Supply Outlook

Agricultural Products

- Agricultural Forecasts

Agricultural Weather Advisories

- Fruit Frost Forecasts
- Special Agricultural Weather Forecasts
- Unscheduled Agricultural Products
- 30-Day Agricultural Weather Outlooks

Miscellaneous Forecasts and Products

- Air Quality Indices

Air Stagnation Advisories
Average Monthly Weather Outlooks
Average Seasonal Weather Outlooks
Climatological Monthly Means
Coastal Waters Forecasts
Daily Climatological Reports
Earthquake Information Reports
Fire Danger Statements
Great Lakes Forecasts
Hurricane Local Statements
Lakeshore Warning Statements
Local Forecasts
Local Storm Reports
Marine Weather Statements
Narrative Radar Summaries
National Holiday Weather Forecasts
National Weather Summaries
Nearshore Marine Forecasts
Other Marine Products
Post-storm Hurricane Reports
Public Information Statements
Recreation Reports
Record Reports
Regional Weather *Summaries*
Road Condition Reports
Severe Weather Outlooks
Severe Weather Statements
Severe Weather and Statistical Summaries
Smoke Management
Weather Forecasts
Snow Avalanche Bulletins
Special Tropical Disturbance Statements
State Forecasts
State Max/Min Temperature and Precipitation Tables
State Weather Summaries
Temperature and Precipitation Tables
Travelers Forecasts
Travelers Forecast Tables
Tropical Weather Discussions
Tropical Weather outlooks
Tropical Weather *Summaries*
Zone Forecasts
 3- to 5-Day Extended Forecasts
 6- to 10-Day Outlooks

2. DOMESTIC DATA SERVICE (DDS)

The DDS provides users with coded observations, reports, forecasts, and analyses.

(a) Communications Parameters: 9600 bits per second transmission speed, asynchronous mode, character-oriented (ASCII).

(b) Contents:

- Basic Weather Products
- Radar Observations
- Rawinsonde Observations
- Surface Synoptic Observations

Aviation Products

- AIRMET's
- Aviation Area Forecasts
- Center Weather Advisories
- Convective SIGMET's
- FD Winds Aloft Forecasts
- Meteorological Impact Statements
- Offshore Aviation Area Forecasts
- PIRAL Observations
- Pilot Reports
- SIGNET's
- Surface Aviation Observations
- Hourly Observations
- Terminal Forecasts
- Transcribed Weather Broadcasts
- Urgent Pilot Reports
- Wind and Temperature Forecasts

Marine Products

- Buoy Reports
- Great Lakes Ship Weather Observations
- High Seas Forecasts
- Marine Guidance Products
- Ocean Front Analyses
- Oceanographic Data
- Offshore Forecasts
- Ship Weather Observations
- Spectral Wave Data
- Tide Reports

Miscellaneous Forecasts and Products

- Aircraft Reconnaissance Reports
- Coast Guard Surface Reports
- Coded City Forecasts
- Coded Analyses and Forecasts
- Daily Dispersion Outlooks
- Fire Weather Forecasts
- FOUS Freezing Levels and Relative Humidity Guidance
- FOUS Trajectory Forecasts
- FOUS Relative Humidity and Temperature Guidance
- Hydrometeorological Data Reports
- International Crop Reports
- Low Level Soundings
- Miscellaneous Surface Observations
- Prognostic Map Discussion
- Quantitative Precipitation Forecasts
- Rocketsonde Data
- Satellite Interpretation Messages
- Satellite Tropical Disturbance *Summaries*
- Special Dispersion Statements
- State Forecast Discussions
- Upper Wind Fallout Forecasts
- Watch Status Reports
- Weekly Data for Agriculture

3. INTERNATIONAL DATA SERVICE (IDS)

The IDS provides users with worldwide coded observations, reports, and forecasts.

(a) Communications Parameters: 9600 bits per second transmission speed, asynchronous mode, character-oriented (ASCII).

(b) Contents

- Aircraft Reconnaissance Reports
- AIREP's
- Average Monthly Weather Outlooks
- Average Seasonal Weather Outlooks
- Buoy Reports
- Climatological Monthly Means
- Marine Guidance Products
- Marine/Aviation Tropical Cyclone Advisories
- Oceanographic Data
- Ocean Front Analyses
- Offshore Forecasts

- PIBAL Observations
- Prognostic Reasoning Product
- Public Tropical Cyclone Advisories Rawinsonde Observations
- Rocketsonde Data
- Satellite Interpretation Messages
- Satellite Tropical Disturbance Summaries
- Satellite Position and Intensity Reports
- SIGMET's
- Special Tropical Disturbance Statements
- Spectral Wave Data
- Surface Synoptic Observations
- Hourly Observations
- Temperature and Precipitation Tables
- Terminal Forecasts
- Tropical Cyclone Discussions
- Tropical Cyclone Position Estimates
- Tropical Cyclone Updates
- Tropical Depression Discussions
- Tropical Weather Discussions
- Tropical Weather Outlooks and *Summaries*
- Tsunami Watches and Warnings
- Weekly Data for Agriculture
- Weekly Weather and Crop Reports
- Wind and Temperature Bulletins (18- and 24-hour)
- 30-Day Agricultural Weather Outlooks
- Tropical Disturbance Summaries

4. HIGH RESOLUTION DATA SERVICE (HRS)

The HRS provides users with global model-derived forecasts and analyses, most of which are in the gridded binary (GRIB) format. The HRS, formerly the Direct Connect Service (added to the FOS offerings on October 1, 1986), is different from the other services in that subscribers connect directly to a port in the NWS Telecommunications Gateway computer facility. NWS guarantees that this service will be available for a minimum of 2 years.

- (a) Communication Parameters:
 - 56,000 bits per second
 - X.25 transmission protocol
 - NWSTG is the DCE
 - Packet size is 256 data characters
 - Packet Window is 7
 - Link Window is 7
 - Use Permanent Virtual Circuit
 - Logical Channel Number is 1
 - Immediate Packet Response is recommended

(b) Contents: Analyses and forecasts derived from the Nested Grid Model (NGM) and the global spectral models for the mandatory levels at latitude and longitude grid points. Fields include surface pressure, winds, heights, temperatures, moisture, tropopause height, maximum winds (NW), and NW pressure level. Forecast periods include 06, 12, 18, 24, 30, 36, 42, 48, and 60 hours. Extended range forecasts out to 168 hours (seven days) are included for surface pressure and 500mb heights. Forecasts prepared by the European Centre for Medium-Range Forecasts (in the WMO Grid format) are also included. These forecasts of sea level pressure and 500mb height are based on 12Z analyses and are for 24, 48, 72, 84, 96, 120 hours. This service also carries the Gridded Eta Model Data as well as the 1.25 by 1.25 High Resolution Aviation Data.

5. DIGITAL FACSIMILE SERVICE (DIFAX)

DIFAX joined the FOS offerings on October 1, 1986.

(a) Communications Parameters: 4800 bits per second, 720 scans per minute, V.29 transmission protocol, synchronous mode, simplex digital sign

(b) Contents: About 300 facsimile charts are disseminated every day. These include analyses, prognoses, and observed data, plus international aviation charts and agricultural products.

6. THE AFOS GRAPHIC SERVICE (AGS)

AGS joined the FOS offerings on December 1, 1989.

(a) Communications Parameters: 4800 bits per second transmission speed, asynchronous mode and 9600 bits per second transmission speed, synchronous mode between modems.

(b) Contents: About 368 charts are disseminated. This includes model guidance charts, national radar *summaries*, objective forecasts, manually prepared analyses and forecast charts for surface and aloft, and climatological charts.

D. AVAILABILITY - External users may choose to be a direct subscriber to one or more of the Family of Services from the Washington, D.C., rate center of AT&T Communications. Direct subscribers are responsible for the communications cost of their direct connection. As an alternative, external users may choose to have their needs satisfied by contracting with one of the weather information service companies that are already connected to the Family of Services. A list of the current subscribers to the Family of Services is available on request.

E. USER FES - The FOS system is intended to be operated on a cost-recovery basis, hence NWS imposes user charges in the form of one-time connection fees and annual maintenance fees to recover FOS costs to the government for operating this system. FOS costs are reviewed annually and fees are adjusted accordingly. Annual maintenance charges are due to the NWS each year by

October 1 and cover a one-year period from October 1 through September 30 of the following year. Subscribers are notified annually of the fees due for the coming year. A list of current user fees is available on request.

APPENDIX C

COMMERCIAL COMPANIES THAT SUBSCRIBE TO THE NATIONAL WEATHER SERVICE FAMILY OF SERVICES

AccuWeather, Inc
619 West College Avenue
State College, PA 16801
PHONE: 814/237-0837 FAX: 814/238-1339

Alden Electronics
40 Washington Street
Westboro, MA 01581
PHONE: 1-800/225-9492 ext. 2464

American West Airlines
4000 E. Sky Harbor Boulevard
Phoenix, AZ 85034
PHONE: 602/693-3978

Associated Press
1825 K Street, NW, Suite 710
Washington, DC 20006
PHONE: 202/736-1179

CompuServe, Inc.
5000 Arlington Centre Boulevard
Columbus, OH 43220
PHONE: 614/538-4414

GTE Federal Systems
Room 13115000 Conference Center Drive
Chantilly, VA 22021
PHONE: 703/818-5854

Global Weather Dynamics, Inc.
2400 Garden Road
Monterey, CA 93940
PHONE: 408/49-4500

Harris Corporation
Government Informational System Division
P.O. Box 98000, Mail Stop W3/7753
Melbourne, FL 32935
PHONE: 407/984-5788

Kavouras, Inc.
11400 Rupp Drive
Burnsville, MN 55337
PHONE: 612/890-0609

Reuters American Inc.
1333 H Street, NW, Suite 400
Washington, DC 20005
PHONE: 202/898-8419

UNISYS Corporation
P.O. Box 1226
221 Gale Lane
Kenneth Square, PA 19348
PHONE: 610/444-2433

United Press International
1400 I Street, NW
Washington, DC 20005
PHONE: 202/898-8259

Universal Weather & Aviation, Inc.
8787 Tallyho Road
Houston, TX 77061
PHONE: 713/944-1622 ext 390

Weathernews Inc.
680 West Maude Avenue, Suite 3
Sunnyvale, CA 94086
PHONE: 408/245-3600

WSI Corporation
4 Federal Street
Billerica, MA 01821
PHONE: 508/670-5000

APPENDIX D

COMMERCIAL COMPANIES IN VIRGINIA THAT PURCHASE THE FOS FROM THE FIFTEEN COMMERCIAL SUBSCRIBERS*

Radian Corporation Suite
2502455 Horsepen Road
Herndon, VA 22071
PHONE: 703/713-1500 FAX: 703/713-1512

Mentor Technologies
6018 Sherborn Lane
Springfield, VA 22152
PHONE: 301/794-0280 FAX: 301/794-0288

GTE Federal Systems
Room 13115000 Conference Center Drive
Chantilly, VA 22021
PHONE: 703/818-5854

Simpson Weather Associates, Inc.
809 East Jefferson Street
Charlottesville, VA 22902
PHONE: 804/979-3571 FAX: 804/979-5599

Sullivan Environmental Consulting, Inc.
Suite 200
1900 Elkin Street
Alexandria, VA 22308
PHONE: 703/780-4580 FAX: 703/780-4586

Satellite Image Data Processing and Analysis Environmental Applications
5505 Seminary Road, Suite 315N
Falls Church, VA 22041
PHONE: 703/671-8831

Home Engineering and Environmental Services
4501 Ford Avenue, Suite 1100
Alexandria, VA 22302
PHONE: 703/379-5600 FAX: 703/379-5609

Hydex Corporation
2203 Lydia Place
Vienna, VA 22181
PHONE: 703/281-6284 FAX: 703/281-6284

* Source: The National Weather Service's Home Page.

APPENDIX E

COMMERCIAL COMPANIES IN STATES BORDERING VIRGINIA THAT PURCHASE THE FOS FROM THE FIFTEEN COMMERCIAL SUBSCRIBERS*

Bechtel Corporation
9801 Washingtonian Boulevard
Gaithersburg, MD 20878
PHONE: 301/417-3144 FAX: 301/670-0297

Roscoe R. Braham, Jr. (CCM), Professor
P.O. Box 1068
Cary, NC 27512
PHONE: 919/380-1352

Capitol Weather Consultants
3809 Clarks Lane, Suite 007
Baltimore, MD 21215
PHONE: 410/764-6080

Climatological Consulting Corporation
150 Shope Creek Road
Asheville, NC 28805-9795
PHONE: 704/298-4237 FAX: 704/298-4280

Commercial Weather Services Association
655 Fifteenth Street, Suite 310
Washington, DC 20005
PHONE: 202/546-6993

Crutcher Consultant
35 Westall Avenue
Asheville, NC 28804
PHONE: 704/253-2539

Duke Power CompanyMGO3C1
13339 Hagers Ferry Road
Huntersville, NC 28078-7929
PHONE: 704/875-5940 FAX: 704/875-5493

Earth Satellite Corporation
6011 Executive Boulevard, Suite 400
Rockville, MD 20852
PHONE: 301/231-0660 FAX: 301/231-5020

Rudolf J. Engelmann (CCM)
Global Atmospheric Response
11701 Karen Drive
Potomac, MD 20854
PHONE: 301/299-8784 FAX: 301/299-8784

Edward S. Epstein (CCM)
8216 Inverness Hollow Terrace
Potomac, MD 20854
PHONE: 301/299-2259 FAX: 301/299-7805

L. Ray Hoxit (CCM)
P.O. Box 140
Lake Toxaway, NC 28747
PHONE: 704/884-7979 FAX: 704/884-7979

Thomas F. Malone (CCM)
North Carolina State University
Department M.E.A.S.
Box 8208
Raleigh, NC 27695-8208
PHONE: 919/515-5117 FAX: 919/515-7908

Frank V. Melewicz (CCM)
6703 McCahill Terrace
Laurel, MD 20707
PHONE: 301/498-2380

MESO, Inc.
1005 Capability Drive, Suite 224
Raleigh, NC 27606
PHONE: 919/515-8605 FAX: 919/515-8605

Meteorological Applications
12926 Allerton Lane
Silver Spring, MD 20904
PHONE: 301/384-1875

National Academy of Engineering
2101 Constitution Avenue, NW
Washington, DC 20418
PHONE: 202/334-3200

Ted Palma (CCM)
6340 Quadrangle Drive, Suite 200
Chapel Hill, NC 27514
PHONE: 919/419-7546 FAX: 919/419-7501

Roemer Weather, Inc.
12628 Waterman Drive
Raleigh, NC 27614
PHONE: 919/870-5657 FAX: 919/870-6429

Simpson Weather Associates, Inc.
No. S-803
540 N Street, SW
Washington, DC 20024
PHONE: 202/479-0052

Trinity Consultants, Inc.
P.O. Box 2099
Chapel Hill, NC 27515-2099
PHONE: 919/967-0325 FAX: 919/967-0325

Dean A. Wilson & Associates
103 Overview Lane
Cary, NC 27511
PHONE: 919/467-4883

* Source: The National Weather Service's Home Page.

APPENDIX F

COLLEGE AND UNIVERSITY INTERNET SITES PROVIDING WEATHER INFORMATION

Complete Internet Addresses can be found at the Web Site:

<http://cirrus.spri.umich.edu/wxnet/servers.html>

University of Alabama - Huntsville Weather Homepage
University of Alaska - Fairbanks Institute of Marine Science and Atmospheric Sciences Group
Auburn University, Alabama Agricultural Weather Information Service
Alden Electronics
University of British Columbia Geography Department
University of California, Davis Atmospheric Science Department
University of California, Los Angeles Department of Atmospheric Sciences
University of California, San Diego Climate Research Division and Scripps Institution of Oceanography
University of Chicago Department of the Geophysical Sciences
University of Colorado Program in Atmospheric and Oceanic Sciences
Colorado State University Department of Atmospheric Science and Cooperative Institute for Research in the Atmosphere
Cornell University Northeast Regional Climate Center Creighton University Department of Atmospheric Sciences
Cooperative Program for Operational Meteorology, Education and Training (COMET)
Dalhousie University Atmospheric Science
Desert Research Institute Western Regional Climate Center
Drexel University Department of Physics and Atmospheric Science
College of DuPage NEXLAB Homepage
Florida State University Department of Meteorology and Florida Explores and Cooperative Institute for Tropical Meteorology
Georgia Institute of Technology School of Earth and Atmospheric Sciences
University of Georgia Department of Geography's Georgia Skies
University of Hawaii Weather Server, Satellite Oceanography Laboratory, and Ocean Atlas of Hawaii
University of Illinois The Daily Planet and the UIUC-CoVis Geosciences Web Server
Indiana University's Department of Geography's Climate and Meteorology Program
University of Iowa Center for Global and Regional Environmental Research
Iowa State's Department of Physics and Astronomy Atmospheric Physics Group and I.S.U. Atmospheric Science
University of Kansas Atmospheric Science Program
Louisiana State University Southern Regional Climate Center and Earth Scan Lab
Lyndon State College, Vermont Department of Meteorology
University of Maryland Department of Meteorology

Massachusetts Institute of Technology Center for Meteorology and Physical Oceanography
 and Weather Radar Lab
 McGill University WeatherPage
 University of Miami Rosenstiel School of Marine and Atmospheric Science
 University of Michigan Department of Atmospheric, Oceanic, and Space Sciences. Also home
 of Weather Underground and the WeatherNet server
 Michigan State University Department of Geography and Current Weather Maps/Movies
 Millersville University, Pennsylvania Department of Earth Sciences
 University of Missouri - Columbia Atmospheric Science Homepage
 National Center for Atmospheric Research (NCAR) Climate and Global Dynamics Division
 National Oceanic and Atmospheric Administration (NOAA) Climate Diagnostics Center
 Naval Postgraduate School Departments of Meteorology and Oceanography
 University of North Carolina - Asheville Atmospheric Sciences Department
 University of North Carolina-Charlotte Department of Geography and Earth Sciences Weather
 Server
 North Carolina State University Department of Marine, Earth, and Atmospheric Science
 and the Department of Meteorology Weather Server
 Northeast Louisiana University Department of Geosciences
 Northern Illinois University Meteorology Program's Weather Center
 Ohio State University Atmospheric Science Program Homepage and Their Current Weather
 Menu
 University of Oklahoma College of Geosciences and Oklahoma Weather Roundup
 Oregon State University's Oregon Climate Service
 Pennsylvania State University Department of Meteorology, and Greg Forbes' NIDS-Based
 Quick-Look Case Summary of a July 19, 1996 tornado outbreak
 Plymouth State College, New Hampshire Weather Center
 Purdue University WXP-The Weather Processor
 University of Rhode Island Graduate School of Oceanography
 Rutgers University Environmental Sciences Department and its New Jersey Weather page
 San Francisco State University's California Regional Weather Information
 South Dakota School of Mines and Technology Institute of Atmospheric Sciences, Department
 of Meteorology, and Local Weather Information
 SUNY Albany Department of Earth and Atmospheric Sciences
 SUNY Brockport Department of Earth Science
 SUNY Oswego Meteorology Homepage
 Texas A&M Department of Meteorology
 Texas Tech Atmospheric Science Group
 University of Utah Department of Meteorology
 Unidata NSF Geosciences Example Integrated Earth Information Server
 Utah State University College of Natural Resources
 Valparaiso University Department of Geography and Meteorology
 University of Washington Department of Atmospheric Sciences
 University of Wisconsin-Madison SSEC Home Page, the SSEC Visualization Project,
 the Home Page for the UW-NMS Model, SSEC's directory to its
 Real-Time Data, including color composites of real-time satellite images, and

Cooperative Institute for Meteorological Satellite Studies, an excellent source for sounder data

University of Wisconsin - Milwaukee Atmospheric Science Club

University of Wyoming Atmospheric Science Department and the Wyoming Weather Web

Yale University Department of Geology and Geophysics

APPENDIX G

INDUSTRY-BASED INTERNET SITES PROVIDING WEATHER DATA

AccuWeather
<http://accuwx.com>

Aerospace & Marine International Corporation
<http://www.amiwx.com>

Agricultural Weather Information Service (AWIS), Inc.
<http://www.awis.com>

Alden Electronics
<http://www.alden.com>

American Weather Concepts, Inc.
<http://www.amerwxcncpt.com>

American Weather Enterprises
<http://www.fcinet.com/amweather>

Armchair Sailor
<http://www.yachtworld.com/armchair>

Automated Weather Source
<http://aws.com/>

Baja Weather Service
<http://www.smartville.com/baja-weather>

Baron Services
<http://www.baronservices.com>

BBsea Ltd.
<http://www.ravenet.com/bbseam>

Cable News Network (CNN)
<http://www.cnn.com/WEATHER/index.html>

Climatological Consulting Corporation
<http://www.ccc-weather.com>

Climatronics Corporation
<http://www.climatronics.com>

Commercial Weather Services Association
<http://www.io.com/weather/CWSA>

Compu-Weather, Inc.
<http://www.compu-weather.com/cwi/>

DTN Weather Center
<http://www.dtn.com/ag/wxcenter/index.htm>

Earth Satellite Corporation (EarthSat)
<http://www.earthsat.com>

EarthWatch Communications, Inc.
<http://www.earthwatch.com>

Environmental Dynamics Research, Inc.
<http://www.edrinc.com>

Ed Roy, Ltd.
<http://www.edroy.com>

FleetWeather, Inc.
<http://www.fleetweather.com>

Fox Weather Service
<http://www.foxweather.com>

Freese-Notis
<http://www.weather.net>

General Oceanics, Inc.
<http://www.business1.com/genocean>

Global Atmospheric, Inc.
<http://www.gds.com>

Global Weather Dynamics, Inc.
<http://www.rothnet.com/gwdi/gwdi.html>

Harris Corporation
<http://www.hisd.harris.com/products/weather>

Henz Meteorological Services (HMS)
<http://www.hmsweather.com>

Jenifer Clark's Gulfstream
<http://www.erols.com/gulfstrm>

Kavouras, Inc.
<http://www.kavouras.com>

MAR, Inc.
<http://www.marinc.com>

Micro Forecasts, Inc.
<http://www.gorge.net/windsight/default.htm>

Northwest WeatherNet, Inc.
<http://www.nw-weather.net>

Oceanweather, Inc.
<http://www.oceanweather.com>

Ocean Strategies
<http://www.agate.com/oceanstr>

OMNI Weather, Inc.
<http://www.mcs.net/omniwx>

PC Weather Products, Inc.
<http://www.pcwp.com>

Roemer Weather
<http://www.investaweather.com/investaweather/rwx.html>

Roffer's Ocean Fishing Forecasting Service, Inc.
<http://www.roffs.com>

SkyWalker Data Systems
<http://www.skywin.com>

The Tornado Project
<http://www.tornadoproject.com>

Tropical Weather Services
<http://www.tropicalweather.com>

Universal Weather & Aviation, Inc.
<http://www.univ-wea.com>

USA Today
<http://www.usatoday.com/weather/wfront.htm>

Weather Access, Inc.
<http://www.wxaccess.com>

WeatherBank, Inc.
<http://www.thor.net/wxbank>

The Weather Center
<http://www.nwlink.com/wxwatch>

The Weather Channel
<http://www.weather.com>

Weather Consulting
<http://www.mindspring.com/ppmeteo/Pauls.html>

WeatherLabs, Inc.
<http://www.weatherlabs.com>

WeatherNews International
<http://www.wni.com>

Weather Research Center
<http://www.phoenix.net/wrc/wrc.htm>

Weather Scratch Meteorological Services
<http://www.wxscratch.com>

Weather Services Corporation
<http://www.wx.com>

The Wind Hot Line
<http://www.tiac.net/users/wind>

WSI Corporation
<http://sysu1.wsicorp.com>

Weather Research Associates
<http://www.ime.net/mailhot/wx.html>

The WeatherStore
<http://www.weatherstore.com>

WELS Research Corporation
<http://www.weatherpro.com>

Widespread Weather Services Inc.
<http://www.io.com/weather>

Zephyrus Electronics, Ltd.
<http://www.big-z.com>

* Source: The National Weather Service's Home Page.

General Weather Information

INTELLICAST: Washington D.C. Radar
<http://www.intellicast.com/weather/dca/radar>

Welcome to AccuWeather
<http://www.accuweather.com/>

Travelers Forecast
<http://netcast.noaa.gov/cgi-bin/page?pg=travelers>

National Weather Service
<http://www.nws.noaa.gov/>

Virginia Carolina Forecasts and Observations
<http://twister.sbs.ohio-state.edu/virginia.html>

Storm Prediction Center
<http://www.nssl.uoknor.edu/~spc/#Forecasts>

Virginia State Climatology Office Home Page
<http://faraday.clas.Virginia.EDU:80/~climate>

EarthWatch Communications, Inc.
<http://www.earthwatch.com>

METR 475 Lab Home Page
<http://www.met.tamu.edu/class/Metr475/Lab475.html>

The Weather Resource
<http://www.buffnet.net/~glf>

Purdue Weather Processor
<http://wxp.atms.purdue.edu>

The Weather Visualizer- University of Illinois
<http://covis.atmos.uiuc.edu/covis/visualizer>

An Online Guide to Meteorology
<http://covis.atmos.uiuc.edu/guide/guide.html>

Interactive Weather Information Network
<http://iwin.nws.noaa.gov/iwin/graphicsversion/main.html>

National Weather Service

<http://www.nws.noaa.gov/index.htm>

PSC Weather Center

<http://vortex.plymouth.edu>

The Best of the Rest--Links to Weather/Climate Data and Images

<http://www.ncdc.noaa.gov/weathers.html#WEATHER>

PSC Weather Center Tropical Weather Menu

<http://vortex.plymouth.edu/tropical.html>

Interactive Weather Browser

<http://rs560.cl.msu.edu/weather/interactive.html>

INTELLICAST: USA Weather

<http://www.intellicast.com/weather/usa>

FSL homepage

<http://www.fsl.noaa.gov>

Texas A&M Current Weather Page

<http://www.met.tamu.edu:80/personnel/students/weather/current.html>

The Weather Channel

<http://www.weather.com>

WeatherNet

<http://cirrus.sprl.umich.edu/wxnet/index.html>

Tropical Weather

JHU/APL Atlantic Hurricane Track Maps

<http://fermi.jhuapl.edu/hurr/index.html>

John's Hurricane Page

<http://www.dibbs.net/~jadjkins/storm.htm>

Rob Lightbown's Tropical Weather Page

<http://maine.maine.edu/~rlight51/weather.html>

National Hurricane Center - PRODUCTS

http://www.nhc.noaa.gov/products_index.html

WeatherNet: Tropical Weather Products

<http://cirrus.sprl.umich.edu/wxnet/tropical.html>

Tropical Cyclone Page

<http://www.nhc.noaa.gov/products.html>

Weather Maps

NWS Field Office Fax Charts

<http://tgs5.nws.noaa.gov/fax/nwsfax.shtml>

The Latest Weather

<http://covis.atmos.uiuc.edu/java/weather0.4/Weather.html>

CRAS Regional Forecast Products

<http://oldthunder.ssec.wisc.edu/model/daily/regional.html#east>

Virginia Data

<http://iwin.nws.noaa.gov/iwin/va/va.html>

GTS RMTN-IV Charts

<http://www.nws.noaa.gov/internl.htm>

Other Local Weather Information

<http://www.nhc.noaa.gov/maps.html>

Current Weather Maps/Movies

<http://rs560.cl.msu.edu/weather>

Weather Maps

<http://cirrus.sprl.umich.edu/wxnet/maps.html>

NCEP -- 6-10 Day Outlook Discussion

<gopher://geograf1.sbs.ohio-state.edu.:70/0/nmc/FEUS40.KWBC>

NCEP -- National Discussion

<gopher://geograf1.sbs.ohio-state.edu.:70/0/nmc/FXUS01.KWBC>

NCEP -- Extended Discussion

<gopher://geograf1.sbs.ohio-state.edu.:70/0/nmc/FXUS02.KWBC>

Station Forecasts

http://covis.atmos.uiuc.edu/covis/visualizer/fcst_stn.html

ORGANISED WEATHER LINKS: RADAR IMAGES

http://www.comet.net/weather/cgi-bin/owl_menubarsm.map?84,42

ORGANISED WEATHER LINKS: CHARLOTTESVILLE, VIRGINIA FORECASTS

http://www.comet.net/weather/forecasts/owl_cville_forecast.html

APPENDIX H

AGENCIES REQUIRING WEATHER DATA

Department of Agriculture & Consumer Service (VDACS)

Contact: Jim Lawson, Deputy State Statistician

Weather data used by VDACS for analyzing current and future crop conditions are received from the NOAA National Climatic Center in Asheville, North Carolina, via monthly reports. Since forecasts examine weather conditions on a daily or weekly basis, instantaneous weather data are not needed. Monthly weather summaries would be useful. The NWS office in Wakefield had published such a report, but when it stopped disseminating this information, VDACS tried to use a weather system called CIRRUS (Climatic Interactive Rapid Retrieval User System) supplied by the Southeast Regional Climatic Center of NOAA in Columbia, South Carolina, to fill this need.

In the past, VDACS put out a report each Monday that summarized the previous week's weather (temperature, precipitation, and narrative) using data from CIRRUS. However, CIRRUS did not sufficiently meet VDACS' needs in providing complete and timely weather information for this weekly report. Less than 100 percent of the weather stations used by CIRRUS reported the data on a timely enough basis, and in those instances, CIRRUS used guesstimates based on the surrounding weather stations' data for the missing information. This problem prompted VDACS to drop this service and discontinue publishing the weekly report. VDACS needs data for the growing degree-day index, an indicator of the growth potential of field crops, with which they feel the State Climatology Office might be able to help them.

VDACS' only source of weather information is *Climatological Data Virginia* publications printed by the National Climatic Center. The subscription price is \$40 a year, which is financed through a federal/state cooperative agreement between the U.S. Department of Agriculture (USDA) and VDACS. Weather information is disseminated by VDACS through published reports, including an annual Weather Crop Report, which incorporates the monthly publications received from NOAA. Weather data are not disseminated to other state agencies.

Department of Aviation (DOAV)

Contact: James Bland, Manager of Airport Services Division

Weather information is crucial in the execution of safe flight given its impact on aircraft accidents and airport capacity. DOAV distributes weather information to pilots for flight planning and to airports for pilot advisories. Additionally, DOAV's Division of Flight Operations operates aircraft for transporting state officials and must use weather information for its flight planning.

DOAV requires specific types of weather data such as aviation forecasts that are in a specified format called a Metar. The agency requires both instantaneous and daily weather reports. Thus, DOAV uses vendors that provide these types of products by reformatting NWS data. The agency also receives its weather information from a private contractor, Pan Am Weather Services.

DOAV has been assisting local airports in acquiring pilot briefing systems since 1987. At that time, DOAV evaluated the market and chose the Pan Am Weatheration system as the industry standard in Virginia based on three criteria: (1) the equipment used satellite communication, which is more cost-effective than land lines; (2) it is the most user-friendly of all the systems; and (3) it is available to the home user. Currently, sources such as Data Transmission Network Corporation (DTN) used by other agencies would not meet this third need. Information the Pan Am service provides includes text, graphics of radar imagery, terminal forecasts, and surface observations through a computer terminal.

The current cost of Pan Am Weatheration is \$275/month. This includes hardware, software, upgrades, enhancements, service, and maintenance. Although weather information collected at airports is currently not disseminated outside the aviation industry, the agency has volunteered access to its weather data. They have helped fund about 25 other Weatheration sites throughout Virginia for use by the pilot community and home users. Agencies such as DEQ have accessed these sites. Although each airport sponsor (owner) pays for the installation, DOAV reimburses the sponsor for this cost. The subsequent maintenance of Weatheration, including the monthly service charge, is the airport sponsor's responsibility.

Since 1987, DOAV has been a partner with several airports and the Federal Aviation Administration (FAA) in providing Automated Weather Observation Systems (AWOS III) data collection equipment at 27 airports in Virginia. NWS is also installing approximately 15 Automated Surface Observation Systems (ASOS), which provide weather collection for both aviation and nonaviation users. These automated systems collect weather information continuously. DOAV installed ku-band satellite equipment (called Z-link) at airports to upload the AWOS/ASOS data into a national network called NADIN (National Aerospace Data Integrated Network). FAA, NWS, and private vendors can acquire the information from this network. The collected information is accessible via VHF radio to pilots in flight and through the FAA Flight Service Stations, NWS, or private vendors, such as Pan Am Weatheration, DTN, or WSI.

Department of Conservation & Recreation (DCR)

Contacts: Lee Bess, Director of Logistics, State Parks Division

Joe Haugh, Director, Dam Safety Division

DCR relies on updated weather data to alert employees of potential hazardous conditions. The State Parks and Dam Safety Divisions are the more frequent users of weather information.

The Dam Safety Division does not use weather data directly. They are instrumental in ensuring that each dam owner has an emergency action plan, part of which involves weather monitoring. However, it is the dam owner's responsibility to monitor the weather and implement the emergency plan. The division also receives technical reports published by NWS, usually concerning rainfall frequencies, but these tend to be for archival and analytical purposes. When hurricanes or floods are predicted, VDES may alert the division, which may then provide technical assistance to VDES. However, most of the time, emergencies happen so quickly that the Dam Safety Division is less involved during the actual emergency.

The State Parks Division generally receives weather information concerning weather emergencies, particularly hurricanes. In event of an emergency, alerts are faxed from VDES. In addition, the division can participate in conference calls with NWS that VDES puts through to all relevant agencies. During weather emergencies, the division may contact VDES as many as 8 times a day. Weather information is then sent to park personnel in the 37 state parks. The division feels that weather information would be useful for construction purposes and in times when they need to warn people or get them out of the park; however, they do not currently receive the weather information necessary to accomplish these purposes.

Department of Environmental Quality (DEQ)

Contact: Dan Salkovitz, Senior Environmental Engineer

DEQ primarily uses weather data for forecasting air pollution transport and concentration. Usage is almost every day, particularly when ozone levels are as high as they are in the summer. DEQ issues ozone forecasts to the local media, the American Lung Association, Richmond Ride Finders, VDOT, DOF, and the Hampton Roads Planning District Commission. They issue these forecasts from mid-May to September every weekday and as needed on weekends. The reports serve a public health purpose in that ozone affects the eyes and throat, and the reports are helpful in notifying people with respiratory ailments. The forecasts are also useful for taking preventative action to keep ozone levels down, such as through ride sharing and carpooling on days when high levels are expected. DOF uses the ozone report to determine acceptable days to conduct prescribed burning. Additionally, repeated high ozone levels may ultimately affect the choice of a business to build or expand in an area.

The Internet is increasingly being used by DEQ to access real-time satellite imagery and atmospheric data by linking to sites such as the U.S. Geological Survey's Water Resources Web Home Page and other Web sites. Currently, this is accessed through a personal account, but eventually DEQ plans on obtaining greater access to the Internet. DEQ also receives information from Pan Am's Weatheration, which is supplied free of charge by DOAV. Finally, DEQ subscribes to archive data from the National Climatic Data Center for a fee of \$220/year.

Department of Emergency Services (VDES)

**Contact: Fred Vincent, Chief, Telecommunications Branch
Vic Buisset, Communications Supervisor**

VDES provides weather information, alerts, advisories, watches, and warnings for all state and local governments and state agencies in Virginia via fax or through the Virginia Criminal Information Network (VCIN). VCIN is a secure, disaster-proof network with a terminal in each locality in Virginia. VDES also activates the Emergency Alert System if necessary during severe weather warnings. Another way they disseminate essential information is through conference calls. In certain situations, they contact the NWS offices and the National Hurricane Center for information and set up a conference call with the state agencies that have responsibility under emergency situations, coastal jurisdictions (if a hurricane is involved) or whichever jurisdictions will be affected by the weather situation, and the three NWS offices. Thus, the localities are able to talk directly to the NWS offices and ask specific questions. VDES also maintains a Web page that has press releases, state situation reports, and links to various other sites on the Internet, but the information displayed may not be current. VDES does not feel the Internet is a viable link for them to issue real-time emergency information.

Weather data are received from several sources. NWS provides the bulk of the weather information through a GTE satellite receiver located in the State Emergency Operations Center. Telephone contact is also used for NWS information. Updates are at least hourly but could occur more frequently depending on the weather situation. VDES automatically receives any information NWS issues for Virginia. In addition to the GTE satellite receiver, the Internet is used for radar imagery to the extent it is available. VDES receives the satellite service and equipment from NWS free of charge.

Department of Forestry (DOF)

Contact: George Nelson, Office Service Specialist

DOF relies on weather reports for determining the level of danger of forest fires, which is used in fire readiness planning and fire prevention. Additional functions they perform that require weather information include prescribed burning and aerial spray programs. NWS provides reports four times a day via a GTE satellite and usually includes state and subregional forecasts. Fire weather forecasts, which include information such as humidity and wind direction and strength for each region of Virginia, along with regional and statewide forecasts, are received from the NWS office in Sterling, Virginia. The extreme Southwest Virginia forecast is received from the Charleston, West Virginia, office. These data are disseminated to personnel in two state forests, three forestry centers, and the six regional forestry offices, and from there to county foresters. Weather information is disseminated to military bases, state agencies, the U.S. Forest Service, the National Park Service, the National Forests, and others. Forecast expediency required is on the order of several hours rather than minutes.

The cost for the satellite service and equipment, which is supplied by GTE, is \$400 to \$500 per year after an initial startup cost. The agency expressed satisfaction with the information

provided by the satellite service and have developed ways to supplement it, if necessary, from the Internet. However, current Internet access has been erratic. In general, accessibility to the Internet sites is getting better. DOF also gets the ozone report every day from DEQ. This report is important in determining when it is permissible to conduct prescribed burns. This agency also receives severe weather information from VDES. DOF is further working with VDOT's Emergency Operations Center (EOC) to gain access to weather data VDOT collects.

Department of Mines, Minerals & Energy (DMME)

Contact: Ken Jurman, Agency Management Analyst

The Energy Division of DMME uses weather information that ties into a particular software program, FASER, which is used to track regional and statewide energy usage. State government agencies located in state-owned buildings use this software to measure their energy consumption and cost, and then the information is reported to the division on a quarterly basis. The division stores this information and plans on using it for future analysis of state energy consumption.

FASER is an energy accounting program that requires many inputs; one variable is heating and cooling degree-day data. For a useful comparison of energy consumption between different years, temperature variations need to be taken into account. Omnicomp, the company that created FASER, receives degree-day information from the private vendor Accuweather, which receives its data from NWS. The Energy Division has a contract under which Omnicomp customizes the weather data for the particular region, formats the data to work with FASER, and ships the FASER-formatted disks to 83 locations in Virginia every month. In total, 63 agencies participate in this program, although some receive multiple disks because they have facilities in more than one region/location. Omnicomp also tracks other information, such as utility rate information, which is also included on the disks. This service costs DMME approximately \$7,000 a year. This cost is financed from oil overcharge funds, which are restitution funds that arose from the oil overcharges during the 1970's energy crisis.

Department of State Police (VSP)

Contacts: Lt. Col. Gerald Massengill, Field Operations Division

First Sergeant Brian Gubesch and Trooper John Cook, Aviation Division

VSP uses weather information in its patrol operations and for aviation purposes.

General State Police Usage. Timely severe weather information is crucial for VSP's daily patrolling operations. A principal user of weather information in VSP is the Bureau of Field Operations, which is responsible for patrol operations. This weather information is supplied directly by VDES and is received over the VCIN in the form of a teletype message that advises of any storm or weather alert.

Aviation Division Usage. Another division of VSP that frequently uses weather information is the Aviation Division, whose 17 trooper pilots operate aircraft for search and

rescue, law enforcement, and Medivac services (MedFlight). Thus, weather data, particularly information about storm conditions, are required for flight planning. The Aviation Division secures weather information such as height of clouds, winds, temperature, and visibility via satellite through Pan Am Weatheration. They do not have direct contact with NWS but do receive NWS information through FAA, which distributes NWS reports. Additionally, they are planning on using the Internet as a supplemental source of weather information. Internet weather data would be most useful for planning scheduled flights; however, only a small portion of the division's flights are scheduled. This division primarily functions in rapid response to emergency situations. Given the need for immediate access to weather information to plan flights during these emergency situations, the Internet cannot be used as the primary source of information. The Internet is not as easily accessible as satellite weather systems, which are automatically and continually updated, and there are occasional difficulties connecting to the Internet.

The Aviation Division also accesses weather information through software provided by FAA called DUAT (Direct User Access Terminal). Two companies, GTE and Data Transformation Company (DTC), provide DUAT under contract to FAA at federal expense. Since the DTC and GTE products are different, access to certain information is sometimes available through only one of the providers. The Aviation Division is also evaluating two other weather services, DTN and WSI Corporation. An important factor that they will consider is timeliness. It is crucial for them to have up-to-date information that they can consult quickly for weather conditions such as thunderstorms if they receive a call to transport an injured person. Satellite services fulfill this need because they are updated automatically. Other considerations include cost, service, type of information, area of coverage, and technical aspects of the systems. The division pays \$295 per month for Pan Am Weatheration, although the initial one-time installation costs 8 years ago were \$7,000. This included one dedicated terminal and the software necessary for the division's three bases to access Pan Am Weatheration terminals. These costs are financed through VSP's safety fund for the Medivac/Medflight program.

Virginia Department of Transportation

EOC. All field activities of EOC depend on timely weather information. Data are accessed through multiple sources. NWS and VDES provide EOC with emergency weather updates. Also, they keep in telephone contact with NWS and, during emergencies, may participate in conference calls VDES initiates with NWS. Forecasts and Doppler radar imagery are accessed through The Weather Channel via cable television. Some field personnel also use the Internet. Just prior to this survey, weather information was also obtained via satellite using Weather for Windows and DTN. However, Weather for Windows usage has recently decreased and is used only as a backup in the event there are problems with DTN, since DTN provides everything that Weather for Windows does, but at a lower cost. There is a \$350 initial fee for DTN, plus a \$62 per month fee that provides unlimited usage for one terminal. The cost for Weather for Windows varied from \$400 per month during normal operations to \$1,000 per month or more during disaster operations. Included are such charges as per image downloading fees and long distance

costs. In addition, field personnel reported costs ranging from \$100 to \$600 per month for Weather for Windows.

EOC is hoping to eliminate Weather for Windows throughout the state and is sending out an RFP within the year to address weather programs. One thing they will be looking for is a contract with a 1-year renewable option because technology is changing so quickly. They want the flexibility to be able to choose to renew a vendor or solicit bids for new vendor in a year. Weather information is disseminated to other VDOT agencies, local law enforcement agencies, and the general public.

EOC also monitors statewide weather conditions through VDOT's SCAN, a series of road-embedded sensors provided by SSI that detect changing weather conditions. These sensors provide information concerning the surface temperature of pavement, rather than air temperature. Pavement temperatures may be higher or lower than surrounding air temperatures, and the relationship between air and surface temperature determines what form of roadway icing occurs, such as snow or freezing rain.

Districts. Weather data are used at all levels of VDOT field personnel, from district administrators to field resident engineers to area headquarters' superintendents, the level closest to the public. In the Northern Virginia District, all personnel, including the clerical staff, participate in some aspect of the snow removal operations, so they use weather information to anticipate when their snow removal shifts will begin.

As of January 1997, 45 VDOT residencies had access to SCAN, and 22 had connections to The Weather Channel. All receive updates from VDES. All districts have supplemented their weather information primarily through DTN. In fact, from the telephone survey of July 1997, there seemed a strong preference for DTN and less emphasis on other private vendors such as Weather for Windows or SCAN. Many districts had a DTN connection. One district was still using Weather for Windows but was waiting for a DTN hookup. Additionally, there is a pilot program being tested out of Richmond, in which DTN information would be broadcast over the network to VDOT district offices. The districts were also strongly influenced in their decision to use DTN by EOC. Frequently voiced as the advantages of DTN were cost (quoted as a \$300 to \$318 installation fee, plus a monthly fixed fee of about \$65), frequency of updates (every 15 minutes), and user-friendliness of the software (i.e., menu driven, easily learned). Very few districts receive weather news from NWS directly, and those that do receive it over radio scanners or over a telephone link, such as the NAWAS (National Washington Area Service), the cost for which does not come out of the district budget. Only a few districts were aware that DTN received some of its weather information from NWS. The Northern Virginia District has contracted the services of GTE's WeatherWire Service, which supplies hourly NWS updates via satellite. This information comes in text form. The initial installation fee was \$4,000, plus there is an annual fee of \$200.

Each district disseminates weather reports to local residencies as needed. General weather needs relate to severe weather situations, such as hurricanes, thunderstorms, and

flooding in the summer and snow or other freezing precipitation in the winter. Funding for weather data services generally comes from operating, maintenance, or snow removal budgets.

Marine Resources Commission (MRC)

Contact: G.W. Showalter, Chief, Engineering Surveying

MRC obtains weather data from NWS reports, which are broadcast over marine radio bands by GTE. Employees also monitor Channels 16 and 17 over their marine radios for information and obtain information from local radio station weather updates. The Internet is also used to a limited extent.

Specific departments that tend to be more frequent users of weather information include the Law Enforcement Group, the Operations Office, and Engineering Surveying. The Operations Office is the radio communications arm for the Law Enforcement Group, the Engineering Office, and other field personnel and is responsible for sending out emergency alerts. The activities of the Law Enforcement Group primarily take place on the water; thus, notification of boating weather conditions is important. Similarly, the Engineering Division conducts surveys on the water, and planning for these surveys is influenced by the tides, winds, and other weather conditions.

Virginia Port Authority (VPA)

Contact: Linda Ford, Director of Public Relations

VPA uses weather data for assessing potential severe weather in ocean ports. Notification of any type of weather that affects water conditions is important to them as inclement weather can affect shipping schedules and cause delays. VPA owns the land on which the ports are built, but a private company, Virginia International Terminals, runs the operations. Virginia International Terminals obtains weather information from the commercial vendor Accuweather by fax and then disseminates it to VPA. Additional weather information is accessed through the Internet. At the time of publication of this report, additional information was not available from this agency.

State Climatology Office

Contact: Jerry Stenger, Research Coordinator

The State Climatology Office collects archival data from past weather reports and makes the information available to the general public through publications and direct requests. They obtain their data through NWS networks accessed through telephone links, the NOAA Southeast Regional Climate Center through a computer link over the Internet, and the Internet in general. A password is required to access the Southeast Regional Climate Center service site on the Internet, but this account is provided from NWS' funding to regional climate centers. They also receive reports published by the National Climatic Center in Asheville, North Carolina.

The agency is occasionally requested to provide weather forecasts for the University of Virginia, which requires hourly weather information. However, most of its work involves archival data. The agency recently provided customized archival reports for DEQ, VDOT, VSP, VDACS, DOF, the Department of Health, county agencies, private companies such as engineering firms and film companies, and individuals. They also work with VDES to give them background information during severe weather conditions. The State Climatology Office is the sole source of archival weather data in Virginia and handles approximately 4,000 requests for weather information each year.