U.S. DEPARTMENT OF COMMERCE
Office of Inspector General

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

The Northeast River Forecast Center Is Well Managed, But Some Improvements Are Needed

Inspection Report No. IPE-17259/August 2005

PUBLIC RELEASE

Office of Inspections and Program Evaluations

TABLE OF CONTENTS

EXECUTIVE SUMMARY i

BACKGROUND 1

OBJECTIVES, SCOPE, AND METHODOLOGY 5

OBSERVATIONS AND CONCLUSIONS 6

I. Management and Oversight of the NERFC Are Adequate 6

A. A positive team environment exists at the NERFC 6

B. Regular oversight is performed by the Eastern Region Headquarters 7

II. Improvements in the RFC's Product Delivery, Outreach, and Verification Methodology are Needed 8

A. The use of Geographic Information System (GIS) should be expanded 8

B. NERFC needs to increase its outreach to meet the demand for new AHPS products and services 10

C. Advancements in RFC verification are needed to improve forecaster skill and river models 13

III. NERFC's External Partners Are Mostly Satisfied, But Some Additional WFO and NERFC Coordination Would Be Beneficial 17

A. Partners and customers are pleased with RFC products and services 17

B. Some additional coordination between NERFC and the WFOs would be beneficial 18

IV. Facility Maintenance Problems Need To Be Addressed 20

A. NWS should take the actions necessary to ensure facility repairs and maintenance are accomplished 20

B. Steps taken to address the presence of zinc whiskers should be documented 20

V. NERFC's Financial and Administrative Operations Are Generally Well Managed 23

A. Most financial and administrative operations are managed well with a few exceptions 23

B. NERFC should evaluate the need for its government vehicle 23

SUMMARY OF RECOMMENDATIONS 25

APPENDICES 26

A. River Forecast Verification Statistics

B. [redacted]

C. Agency Response to the OIG Draft Report

EXECUTIVE SUMMARY

Pursuant to the authority of the Inspector General Act of 1978, as amended, the Office of Inspector General conducted an inspection of the National Weather Service's (NWS') Northeast River Forecast Center (NERFC) in Taunton, Massachusetts. The purposes of our inspection were to assess the adequacy of the NERFC's programmatic and administrative operations, determine the effectiveness of management and NWS oversight of the NERFC, and assess how the NERFC coordinates its activities with federal, state, and local government agencies and other water management organizations. Our review lasted from December 14, 2004, through February 4, 2005, with an onsite visit from January 3-7, 2005.

NWS estimates that 90 percent of all natural disasters in the United States involve flooding. On average, over the past 20 years, flooding has annually claimed over 90 lives and caused damages in excess of $4.25 billion, according to the National Weather Service. The Northeast River Forecast Center (NERFC) is one of 13 NWS centers located throughout the United States responsible for conducting continuous hydrologic modeling of river basins. RFCs are responsible for issuing hydrometeorological forecasts and guidance to Weather Forecast Offices (WFO) and water management organizations to assist with their water resource responsibilities. Collocated with the Boston WFO, the NERFC is one of the smallest centers, with only eight WFOs in its watershed area. The NERFC covers Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, and most of New York.

WFOs cover smaller geographical areas, while RFCs service substantially larger river basin areas. WFOs are the primary source of NWS forecasts, watches, and warnings. RFCs support WFOs by providing flood and hydrologic forecast guidance. In addition, RFCs, as centers of hydrologic expertise in the NWS, continuously enhance local forecast models and are typically the primary point of contact for many water supply managers. The RFCs also support hydrologic users that require information integrated over basins larger than individual WFOs and/or more technically sophisticated hydrologic information. At the NERFC, approximately one-third of staff time was spent providing flood and hydrologic forecast guidance, while two-thirds was spent on hydrologic modeling and development work. During nonflood periods, the NERFC provides regularly scheduled daily, weekly, and seasonal hydrologic information, such as the short-term hydrologic forecast.[1] During periods of flooding, the RFCs issue guidance forecasts for the height of the flood crest, the time a river is expected to reach flood stage, the time to crest, and the time when the river is expected to recede below flood stage and back to normal levels. The WFOs, using RFC guidance and taking local knowledge into account, issue flood warning and watch products. The RFCs coordinate directly with water management agencies, such as the U.S. Army Corps of Engineers, and hydroelectric dam operators, to optimize reservoir flood control during major flood events.

The NERFC obtains information used to develop its forecasts from a variety of sources, such as stream gauges, radar, satellites, and ground-based automated sensors. In addition, the NWS modernization introduced the Advanced Weather Interactive Processing System, a powerful data

[1] See NWS Directive 10-912 for a list of official products – www.nws.noaa.gov/directives/010/pd01009012b.pdf; last accessed 2/18/05). RFCs may also develop customized products to meet local user needs.

processing system designed to improve weather forecasting, and an online suite of hydrologic forecast products called the Advanced Hydrologic Prediction Services, which is currently about 50 percent implemented at the NERFC. Additional products and services will evolve as technologies, such as geographic information systems, are put into operation.

Overall, we found NERFC to be a well-functioning office. Our specific observations are as follows:

Management and oversight of NERFC are adequate. Although relatively new, the hydrologist-in-charge addresses problems or issues that arise and, according to staff, has a presence on the floor—often volunteering for the less desirable evening, weekend, and midnight (when called for) shifts. In addition, our observations confirmed what NERFC staff told us—that the office works well as a team to issue the best possible river forecasts. We also found that staff from the NWS' Eastern Region Headquarters regularly visit and communicate with NERFC and conduct semiannual internal reviews. (See page 6.)

The use of Geographic Information System (GIS) should be expanded. The NERFC is not taking full advantage of new Geographic Information System (GIS) software that could make its products more useful to the public, WFOs, state and local agencies, and other water managers. GIS is a system for the management, analysis, and display of geographic knowledge, using a series of information sets such as geographic data sets, maps and data models. Using GIS could better meet customer needs, enhance NWS and user analysis, and improve forecast quality. It will allow users to, for example, not only see how high a river is at locations with stream gauges, but to actually see a map depicting local streets and how far the river might encroach into the area. It would also allow emergency managers and other organizations to take the flood forecast GIS data files and overlay them onto their own GIS data. Thus far, fragmented responsibility and the lack of a clear direction for GIS implementation appears to have hindered NWS' GIS efforts. (See page 8.)

NWS should be prepared to meet increased hydrology product demands and better document its plan for improving river forecast verification. The Advanced Hydrologic Prediction Services (AHPS) will enable NERFC and other RFCs to provide both more information and increasingly complex hydrologic information to its users. This is expected to increase the demand for more hydrology products and services and bring in new customers and partners—some with an understanding of hydrology, some without. While in recent years the RFCs only assisted WFOs, which have had primary responsibility for hydrologic outreach, with the implementation of AHPS and the introduction of new hydrologic products, the RFCs are now expected to do more outreach with water management agencies and others who use hydrologic data. In addition, a key issue to recognize and address in such outreach efforts is the importance of stream gauges to the NERFC mission, given the NERFC's dependence on USGS gauges, which provide essential information to AHPS. Although we do not have a specific recommendation regarding USGS gauges, the critical role they play in the NWS mission is important to note. Finally, to continuously improve RFC products and services, a verification system that identifies model errors and forecaster skill strengths and weaknesses needs to be developed and implemented. (See page 8.)

External partners are mostly satisfied, but some additional WFO and RFC coordination would be beneficial. RFCs work with a number of water resource organizations (federal, state, and private dam operators, canal commissions, state and local drought task forces) and emergency managers. We interviewed several of NERFC's external partners. They all reported that they are satisfied with NERFC products and work closely and are in frequent contact with both the NERFC and the local weather service office. NERFC is also working with NOAA's National Oceanic Service (NOS), providing data for its New York Harbor hydrodynamic model that forecasts water levels and current velocities. Eventually, NERFC intends to use NOS data for its Lower Hudson River forecasts.

NERFC regularly meets its deadlines for daily and weekly products transmitted to the WFOs, although more coordination between some WFO forecasters and NERFC may be needed during flood events. Although most WFO forecasters and NERFC staff reportedly work well together, NERFC staff stated that a small number of WFO forecasters do not properly coordinate with NERFC, as required in NWS Directive 10-921,[2] particularly during flood events when updated large-scale river forecasts are being issued. In summary, staff relations between NERFC and most of the 8 WFOs in its watershed area are generally good, but additional communication and coordination between the two offices would help ensure the public is receiving consistent, reliable information. (See page 17.)

Facility maintenance problems need to be addressed. Officials at NERFC informed us that the lack of maintenance on the Taunton facility has been a problem in the past, and is getting worse as the building ages. The building, constructed to NWS specifications, is covered by a 20-year lease with a private company that terminates in 2013. We identified a number of outstanding work orders. Since April 2004, 46 work orders have been submitted by the RFC to the leasing company for repairs and maintenance. Of these, only four were completed and 42 were not completed. Of the 42 that were not completed, 17 were reissued work orders and 25 were original work orders. Most of the work orders were for relatively minor external and internal facility maintenance repairs and landscape upkeep, but some safety issues are involved: for example, repairing a roof drain splash that presents a winter ice hazard on the sidewalk, replacing and fixing general wear and tear items such as door and window weather stripping and pavement cracks, and properly maintaining the landscape by removing dead trees. The lessor's compliance with the terms of the lease for the Taunton facility should be enforced.

Tiny conductive filaments of zinc (referred to as "zinc whiskers"), typically less than a few millimeters long and only a few thousandths of a millimeter in diameter, have reportedly been found to cause electrical shorts in computer equipment. NERFC and WFO have experienced more than $16,000 in equipment repairs, replacement, and related shipping costs at the Taunton facility since January 2000. An April 2004 air quality study confirmed the presence of zinc whiskers at the Taunton facility, and it is suspected that the whiskers caused the computer problems. Since the report was issued, NERFC facility staff devised some methods to minimize equipment failures. The measures taken to avoid costly equipment losses due to zinc whiskers

[2] NWS directive 10-921 Weather Forecast Office Hydrologic Operations, Section 3.1.2.b Large-scale forecast points (9/04/2003).

should be documented by NERFC and made available to other NWS facilities that may develop zinc whisker problems in the future. (See page 20.)

NERFC's financial and administrative operations are generally well managed. We found only minor problems when we looked at the NERFC's inventory of assets; time and attendance, cell phone, and travel records; timeliness of performance appraisals; and use of both government-issued purchase cards and the government-owned vehicle. There were some minor omissions on time and attendance forms and two leave requests and one overtime authorization that could not be accounted for. Limited mileage on the center's government vehicle suggests that it may be underutilized. NERFC should monitor its use, and, based on potential future staff requirements, evaluate the continuing need for a full-time government vehicle. (See page 23.)

On pages 25 and **Error! Bookmark not defined.**, we offer eight recommendations to address our concerns.

In its June 30, 2005, response to our draft report, NOAA fully concurred with the eight recommendations. NOAA provided a number of specific actions to be taken, with target implementation dates, that in most instances fulfill the intent of the recommendation.

A discussion of NOAA's response to each recommendation, including actions it intends to take, follows each relevant section in the report. NOAA's entire response to our draft report can be found in Appendix C.

BACKGROUND

The National Weather Service (NWS) estimates that 90 percent of all natural disasters in the United States involve flooding, which over the past 20 years, has annually claimed more than 90 lives and caused damages in excess of $4.25 billion. The mission of the Northeast River Forecast Center (NERFC) in Taunton, Massachusetts, one of 13 river forecast centers throughout the United States (see Figure 1) operated by NWS, is to help reduce such losses.

Each river forecast center (RFC) is located in a main watershed area for which it issues hydrometeorological forecasts and guidance to weather forecast offices (WFOs) and water management organizations, based on its continuous hydrologic modeling of river basins. NERFC is collocated with the Boston WFO. WFOs cover smaller geographical areas, issue forecasts, watches, and warnings to the public, and are operations oriented. RFCs cover substantially larger watershed areas, produce guidance forecasts and other products, and devote a third of staff time to operations and two-thirds to hydrologic modeling and development work. RFCs may also develop products to meet local user needs.

Figure 1: River Forecast Center Hydrologic Service Areas

Source: National Weather Service

NERFC opened in 1955 in Bloomfield, Connecticut. It moved to its present location in a GSA-leased facility in 1993 as part of NWS' modernization effort. The center's FY 2004 budget was $92,600, excluding staff salaries and facility rent. Staff includes a Hydrologist-in-Charge (HIC); a Development and Operations Hydrologist (DOH); 11 forecasters with backgrounds in hydrology, meteorology, and civil engineering; and a hydrologic technician who also performs office administrative duties. NWS' Eastern Region Headquarters in Bohemia, New York, has oversight responsibilities for the NERFC and NOAA's Eastern Administrative Support Center (EASC) in Norfolk, Virginia, provides NERFC with personnel and administrative services.

NERFC's hydrologic service area covers Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, and most of New York. NERFC issues forecasts for 150 locations in the watershed areas of the St. John's and Kennebec rivers, the Housatonic, Blackstone, and Charles rivers, the Merrimack River, Connecticut River, Hudson River, Finger Lakes region, Great Lakes region, and Lake Champlain region.

Geographically, NERFC is one of the smallest RFCs, providing hydrologic and hydrometeorological forecast and guidance products to eight WFOs located in Boston; Albany, Binghamton, Buffalo and New York City, New York; Caribou and Gray, Maine; and Burlington, Vermont. River level and flow forecasts are issued to the public by local WFOs. During nonflood periods, NERFC sends the WFOs regular daily, weekly, and seasonal hydrologic products, such as the short-term hydrologic forecast. RFCs provide forecasts, guidance, assimilated data fields, and data products using internal information processing systems to transmit and receive products to and from other NWS users. Selected RFC products of a contingency planning nature are not intended for distribution outside the NWS. Consequently, such products are not distributed over NWS-supported public dissemination pathways such as NOAA Weather Wire or posted on the Internet, but may be made available through secured mechanisms to selected partners in exchange for reservoir operation schedules and other data. Forecasts cover drought, normal flow, and long-term flow probabilities.[3] To develop its forecasts, NERFC uses information from a variety of sources, such as stream gauges,[4] weather surveillance radars, Geostationary Operational Environmental Satellites (GOES), and ground-based Automated Surface Observing System (ASOS) sensors.

During floods, NERFC issues forecasts on the flood crest, when a river is expected to reach flood stage, and when a river is expected to recede. NERFC coordinates directly with water management agencies to optimize reservoir flood control during major flood events

Primary NERFC Partners and Customers. NERFC collaborates with federal, state, and local agencies and organizations to acquire and provide accurate, up-to-date information, which enables NERFC to pool resources and fulfill the NWS mission of providing forecasts and warnings for the protection of life and property and the enhancement of the national economy. NERFC partners include:

- *NWS Weather Forecast Offices.* WFOs prepare forecasts and issue timely and accurate watches and warnings to the citizens, public officials, and the media, in their county areas. RFCs support WFOs and facilitate hydrologic services at both the WFO and the RFC offices. As noted above, the NERFC works directly with the 8 WFOs that serve New England and parts of three Middle Atlantic States.

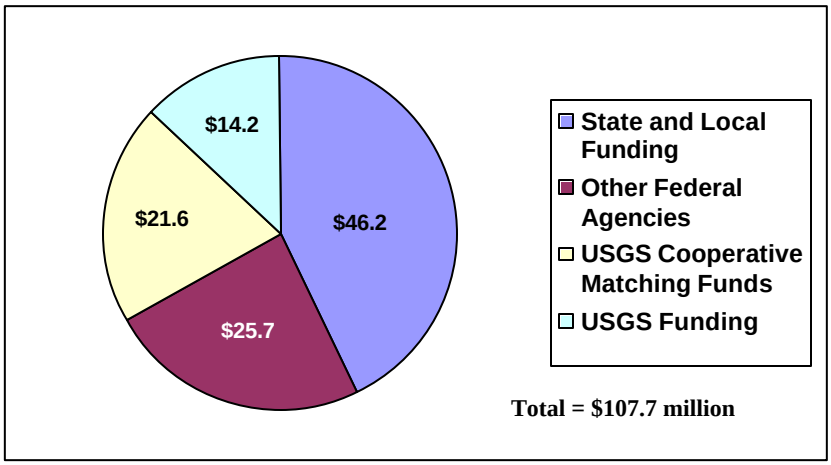
- *U.S. Army Corps of Engineers (USACE).* The Corps, part of the Department of Defense, designs, builds, and operates river and harbor navigation, flood control, water supply,

[3] See NWS Directive 10-912 for a list of official products, which specifically identifies whether or not a product is to be distributed over NWS-supported public dissemination pathways – www.nws.noaa.gov/directives; last accessed 2/18/05.
[4] Also referred to as a river gage or gauge.

hydroelectric power, and other civil works projects. The Corps' New England District operates and maintains 31 dams across six New England states. The Corps provides NERFC with current and forecast reservoir outflows. NERFC provides river stage and precipitation data to the Corps for dam and reservoir management.

- *United States Geological Survey (USGS)*. The Water Resources Division of USGS, which is part of the Department of the Interior, collects and publishes stream flow data and provides other hydrologic information for use and management of water resources. USGS operates a network of about 7,400 stream gauges nationwide, which measure and record the quantity and variability of surface water flows, as well as water quality indicators such as conductivity, temperature, pH, and turbidity. All 13 RFCs collect information from more than 3,000 of these gauges, of which 420 are utilized by the NERFC. USGS and other partners, such as USACE and state and local governments, fund the operation of these gauges. (See Figure 2)

Figure 2: FY 2003 Funding Sources for USGS Streamgaging Network Operations (In millions $)



Source: U.S. Geological Survey

The $107 million needed to annually operate the gauges comes from a blend of funds appropriated to USGS and other federal agencies, and funds from State and local agencies. The majority of gauges are funded from the cost-sharing partnership between the USGS and more than 800 state, local, tribal, and other cooperating agencies. With relatively few exceptions, NWS does not own or operate gauges, and it does not receive funding to maintain them.

National Weather Service Modernization. In 1989, NWS began a long-range modernization effort. NWS sought to develop and utilize new satellite, radar, and other technologies, such as the Advanced Weather Interactive Processing System (AWIPS), Advanced Hydrologic Prediction Services (AHPS), and Geographic Information Systems (GIS) software to improve meteorological and hydrological forecasting.

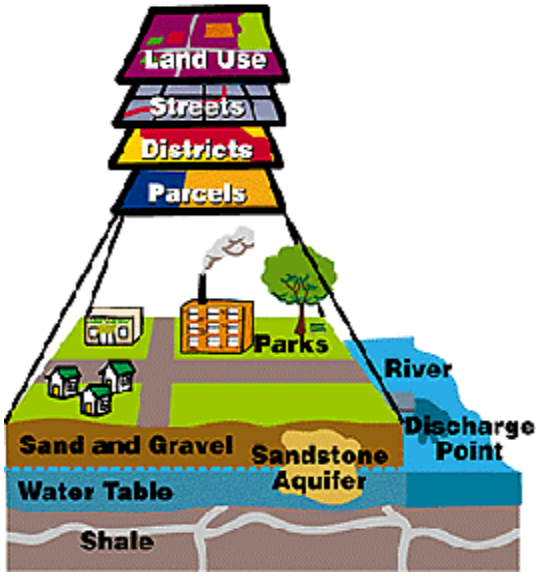
- *Advanced Weather Interactive Processing System* is a powerful data processing system first deployed in 1999 to improve weather forecasting. AWIPS uses graphic displays that help

weather forecasters and others to more easily understand and interpret data. AWIPS is composed of seven subsystems that serve the 13 RFCs, 122 WFOs, NWS' 4 national centers, and the public.

- *Advanced Hydrologic Prediction Services* is an online suite of forecast products designed to help government agencies (such as the RFCs and WFOs) and other users (such as emergency managers) make decisions to mitigate the dangers posed by floods and droughts. AHPS products include flood forecast levels, past flood levels, and maps of areas likely to be flooded surrounding a forecast point. AHPS requires extensive modeling, so implementation has been slow. For each watershed area, 16 parameters must be determined and tested using years of historic records followed by another 18 months to verify the soundness of the parameters. AHPS implementation began in fiscal year 2000 and will be finished in fiscal year 2013, costing an estimated $60 million. It is currently about 50 percent complete at the NERFC and scheduled for full implementation there by 2011.

- *Geographic Information Systems* (GIS) is a software system for the management, analysis, and graphic display of data sets, maps, and data models (traditionally spreadsheet and data base information). Each data set of information on the map (e.g., streams, roads, population, rainfall, county boundaries) is displayed as a layer. Users can turn the layers on or off according to their needs. In general, GIS software creates a digital map that links similar information and displays the layers of information about a place. GIS is particularly useful as a flood-mapping tool to graphically present areas vulnerable to flooding.

Figure 3: Illustration of GIS Capabilities



Source: http://www.csc.noaa.gov/products/sccoasts/html/gisover.htm

OBJECTIVES, SCOPE, AND METHODOLOGY

Pursuant to the authority of the Inspector General Act of 1978, as amended, the Office of Inspector General conducted an inspection of the National Weather Service's (NWS') Northeast River Forecast Center (NERFC) in Taunton, Massachusetts.

Inspections are special reviews that the OIG undertakes to provide agency managers with timely information about operational issues. One of the main goals of an inspection is to eliminate waste in federal government programs by encouraging effective and efficient operations. By asking questions, identifying problems, and suggesting solutions, the OIG hopes to help managers move quickly to address problems identified during the inspection. Inspections may also highlight effective programs or operations, particularly if their success may be useful or adaptable for agency managers or program operations elsewhere.

This inspection was conducted in accordance with the *Quality Standards for Inspections* issued by the President's Council on Integrity and Efficiency in 1993. Our fieldwork was conducted from December 14, 2004, through February 4, 2005. This includes interviews we conducted and files and other pertinent information reviewed at the NERFC from January 3 through 7, 2005.

OIG inspected NERFC to determine the adequacy of the center's management, programmatic, and administrative operations; the effectiveness of both local management and regional oversight; and how well NERFC coordinates with federal, state, and local government agencies. We examined records and documents and interviewed the staff at the river forecast center; NWS officials at NOAA headquarters; NWS regional officials; current and former NWS service hydrologists at eight WFOs; NWS field staff from other regions, such as officials from the California-Nevada RFC, Arkansas-Red Basin RFC, and Southern Region headquarters; and NOAA regional administrative officials. In addition, OIG officials met with staff at the Southeast River Forecast Center near Atlanta, Georgia. We also evaluated the frequency of regional reviews, general visits, and communication with regional management. In addition, we spoke with several NERFC partners and customers, including regional and headquarters officials from the USGS and USACE, state emergency management officials, and staff from NOAA's National Ocean Service.

During the review and at its conclusion, we discussed our findings with the hydrologist-in-charge (HIC) of the NERFC and officials from NWS' Eastern Region Headquarters in Bohemia, New York. We also briefed the Assistant Administrator for Weather Services and other senior officials at an exit conference on April 27, 2005.

OBSERVATIONS AND CONCLUSIONS

I. Management and Oversight of the NERFC Are Adequate

As part of our review, we examined both local management and regional oversight of the NERFC. NERFC management was discussed with the staff and observed during our onsite inspection. We also looked at the output and frequency of regional reviews, general visits, and regional office communication with the RFC.

A. A positive team environment exists at the NERFC

Our observations confirmed what NERFC staff told us—that the office works well as a team to produce the best forecasts possible. All of the forecasters, regardless of job title and pay grade, rotate through the different shifts (e.g., forecaster on duty, hydrometeorological analysis and support forecaster [HAS]). Every morning at 9:15 a.m., the forecaster on duty and HAS brief staff on current hydrological conditions. Meetings are open and everyone participates, including any interested WFO personnel. Regional officials said such cross-training is unusual but works well at NERFC. As a result, other Eastern Region RFCs have been encouraged to follow a similar staff rotation.

The current HIC has held the position less than 2 years. Staff said the HIC holds monthly staff meetings and keeps them informed. The HIC also is a presence on the floor—often volunteering for the less desirable evening, midnight (when called for), and weekend shifts. The staff said when problems or issues arise, they are quickly and efficiently handled. For example, the HIC contacts his counterparts in the WFOs to discuss issues brought to his attention. Specifically he spoke with one MIC regarding the incorrect timing of data provided by WFO staff. The HIC has also addressed staff issues, such as timeliness, and has tackled a number of outstanding facility problems, some of which still need to be resolved. When he learned that the number of facility keys had not been tracked over the years, he had the locks rekeyed, distributed keys to essential personnel, and documented the information. The HIC also has established several internal teams to make recommendations for improving some NERFC practices and products.

The second member of the two-person NERFC management team is the development and operations hydrologist (DOH), who acts for the HIC in his absence. RFCs continuously recalibrate and reevaluate their forecast models because the terrain changes and because of hydrologic/hydrometeorologic scientific advancements. Although the NERFC DOH seldom conducts shift work, the DOH is actively involved with running existing models and developing new in-house programs, AHPS implementation and calibration efforts, monitoring NERFC verification scores, and providing technical assistance to the staff. Oversight of hydrology and hydrometeorology-specific training for the RFC staff is also an important DOH responsibility. NERFC staff reported that they rely on the DOH for his assistance and knowledge of the RFC forecast systems and software and technology expertise.

B. Regular oversight is performed by the Eastern Region Headquarters

NWS' Eastern Region Headquarters communicates regularly with NERFC. The regional director and hydrologic services division chief periodically visit the NERFC. The regional director visited NERFC once in 2004 and twice in 2003 (with 30 offices in the Eastern Region, site visits are made as necessary) and intends to visit in the fourth quarter of fiscal year 2005, if funding is available. The regional director holds monthly telephone conference calls with all WFO and RFC office directors in the Eastern Region and semiannual conference calls with all field employees. In addition, the Eastern Region hydrologic services chief conducts monthly conference calls with the three RFC hydrologists-in-charge in the Eastern Region.

Eastern Region headquarters staff also conducts program reviews of all WFOs and RFCs twice a year. These internal assessments score RFCs on performance across several criteria—management; AWIPS, hydrologic, and scientific services implementation; systems operations; and administrative management. The regional staff gathers information from verification web sites, events, and visits during the review period and the regional director then discusses the results with the HIC. With one exception, NERFC review scores have been satisfactory to excellent in all rating areas. A single poor score in 2003, related to an AWIPS security concern, was due to a problem originating from Silver Spring, MD, not the NERFC, and was ultimately resolved.

Regional offices are required, per NWS Directive 10-1607, issued in 2003, to conduct formal on-site field office evaluations on a 3- to 4-year cycle. According to the directive, on-site evaluations provide regional office personnel an opportunity to observe office operations, verify answers to specific evaluation questions in the directive, and interact with office personnel. While many questions are focused on WFO operations, some questions cover both WFO and RFC operations, and two questions[5] specifically target RFCs. According to Eastern Region management, since 2002, they have performed comprehensive, 4-day evaluations that meet the directive's requirements at 29 WFOs and 2 Center Weather Service Units. Field evaluations for two RFCs—OHRFC and NERFC—and 11 WFOs are scheduled for this fiscal year, funding permitting.

In summary, we found both local management and the regional oversight of NERFC adequate.

[5]RFCs only: Does the office have a policy to extend hours of operation beyond normal operating hours? Does the office have established HAS coordination procedures with appropriate WFOs, adjacent RFCs, NCEP, and external customers?

II. Improvements in the RFC's Product Delivery, Outreach, and Verification Methodology are Needed

To better serve its customers and partners in the future, the NERFC must address several issues, including the expanded use of GIS to deliver products, outreach, and verification methods. In addition, it needs to actively educate customers about current capabilities and products. Although the issues below are presented in terms of what we found during our review of the NERFC, our findings and subsequent recommendations could potentially impact and improve the operations of all RFCs.

A. The use of Geographic Information System (GIS) should be expanded

The NERFC currently uses GIS software to support some of its operations and products, such as basin delineation for calibration and issuing the Significant River Flood Outlook. But it is not using the GIS technology to the fullest extent possible. Officials from emergency management and water resource agencies that we interviewed told us that they are happy with the products they receive from the NERFC. However, because of advancements in GIS technology and its ease of use, the emergency management community and the public are asking that more data be displayed in graphical form. For example, users are unable to receive NERFC's river data in a GIS format even though local emergency managers and other customers foresee a current or future need to overlay it onto their own GIS data files. GIS is particularly useful to them as a flood mapping tool to graphically show areas vulnerable to flooding or other natural disasters and to help customers visually see how high the river level is and which local streets and areas the rising river will likely affect.

Only a few NERFC staff are trained to use the current GIS software. According to NWS headquarters officials and NERFC management, this is primarily because NWS is currently developing GIS requirements and evaluating options that may change the particular GIS software used by all RFCs. NERFC officials believe it's an inefficient use of resources to train the staff and then have to retrain them on a different GIS version or software product. Therefore, they have decided to train only a minimum number of staff in using the current GIS software. However, because a growing demand for GIS formatted data is anticipated for planning and handling disaster recovery and state and local emergencies, such as flooding, severe weather, and power outages, the few NERFC staff members who are trained in using the current GIS software will have to meet the anticipated demand.

While RFC staff and customers see the need for and value of expanded use of GIS data, additional NWS guidance and support are needed to develop a strong GIS capability. The Assistant Administrator for Weather Services wrote in a July 9, 2004 memorandum to NWS team leaders and program managers that AWIPS must be transformed into a NOAA-wide service delivery system that incorporates GIS capabilities to deliver geographic information to meet customer needs and achieve NWS mission goals. And, the NWS Strategic Plan for 2005-2010[6] identifies the need for NWS weather, water, and climate enterprises to work together to

[6] *Working Together to Save Lives, National Weather Service Strategic Plan for 2005-2010,* dated January 3, 2005 (page 6).

develop and expand the use of new technologies such as GIS. Specifically, NWS should document the steps, develop a timeline, and assign responsibilities needed to develop a strong GIS capability and expand its use to meet customer's needs.

Within NOAA, the National Ocean Service has made the greatest use of GIS. In December 2003, NWS' Hydrology Services Division (HSD) issued a white paper discussing RFC GIS requirements, although little progress has been made since. The paper states that implementing GIS without a standardized approach will make coordinated management of the hydrographic services program a significant challenge and national support extremely difficult. The paper also said that to assure continued effective operations, it is "imperative" that a nationally integrated and nationally supported solution be deployed in order to facilitate the exchange of locally developed GIS solutions among RFCs. In January 2005, an HSD official said that it would take approximately six to nine months to develop the GIS requirements and study the life cycle cost and a year before a final decision was made. While this discussion focuses on the RFCs, the impact of any GIS decision on the rest of the weather service, as well as all of NOAA, and particularly NOAA organizations already using GIS, should be taken into account.

All of the RFCs have been provided with GIS software, and some RFCs, WFOs, regional and headquarter offices are actively studying, developing, and deploying GIS products. For example, other RFCs in the Southern, Eastern, and Central regions have created precipitation estimate products compatible with GIS software. The Dallas/Fort Worth WFO has integrated weather data with high-resolution geographic data to determine the characteristics of the population at risk in a warning area. NWS' National Operational Hydrologic Remote Sensing Center has an interactive snow depth estimate map that allows users to zoom in and select up to 19 overlays (e.g., rivers, roads, county boundaries, ski areas). These are just a few examples of some of the current GIS efforts. But with no established GIS guidelines, these independent efforts are not always implemented across all RFCs and other NWS organizations. Also, while some RFCs are developing applications, others like NERFC are reluctant to invest training resources, staff time and development efforts on a software application that could change because another software version better meets NWS plans and system specifications. In interviews conducted during this review, RFC, WFO, regional, and headquarters NWS personnel stated that while pockets of GIS efforts are occurring, those efforts are fragmented, with no clear plan or coordinated GIS effort from headquarters.

RECOMMENDATION

The Assistant Administrator for Weather Services should assign responsibilities, document the steps that need to be taken, and develop a timeline to implement a strong GIS capability in NWS.

NOAA concurred with the recommendation, stating that an integrated work team is being formed to identify NWS-wide information needs and systems architecture to support GIS-compatible format(s). The team will use an Operations and Service Improvement Process (OSIP) to prioritize requirements and identify solutions. A Statement of Need has been submitted and a project plan is currently being developed. We request that as part of its action plan, NOAA

provide the OSIP project plan, which should contain a timeline for implementing GIS in the NWS. This recommendation remains open.

B. NERFC needs to increase its outreach to meet the demand for new AHPS products and services

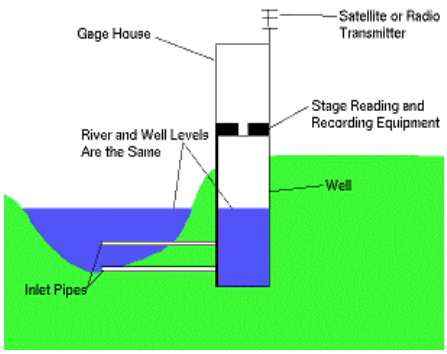
Traditionally the WFOs have had the official and primary contact with the public, while RFCs have only assisted with hydrologic outreach and training efforts when requested by the WFO and RFC resources permitting. However, with the implementation of AHPS and the introduction of new hydrologic products with greater complexity, there is a growing need for more RFC hydrologic outreach. Consequently, NERFC staff should increase their outreach efforts with water management agencies and others who use hydrology data. In addition, RFCs depend on USGS gauges, which provide essential information to AHPS. Therefore, a key issue to recognize and address in such outreach efforts is the importance of stream gauges to the NERFC mission. Although we do not have a specific recommendation regarding USGS gauges, the critical role they play in the NWS mission is important to note.

USGS stream gauges are critical to NWS river forecasting

USGS gauges are critical to RFCs, which depend on them for measuring current river conditions as well as providing the historical streamflow information used in the flood forecasting river models. NERFC uses information from about 420 gauges and issues forecasts at 150 of those gage locations, which will increase to 200 forecast locations over the next five years.

The NERFC lost one forecast location gage in 2004, the Upper Ammonusuc River near Groveton, NH, and over the years it has lost a number of gauges at non-forecast locations that support the river flood program. In addition to no longer issuing forecasts near Groveton, NH, the loss of the gage negatively impacts the quality of forecasts provided at downstream locations, as the river flows out of the tributary are no longer monitored. However, according to the National Research Council, "It is very difficult to quantify the lives or property saved by a single gage used in a flood forecasting system. Without a doubt, gauges are extremely valuable, but their value is encapsulated in the operation and accuracy of the entire forecast system, the forecast delivery mechanisms, and the flood forecast response."[7]

Figure 4: Stream gauges



The most common source of river stage measurement is a gage house, which consists of a stilling well dug along the riverbank with a surrounding shelter to protect the equipment inside. Water enters the well through one or more inlet pipes rising to the same level as the river. Water level in the well (the stream stage) is recorded and can either be accessed by telephone or transmitted via satellite directly to the RFCs. Gauges must continue to function and transmit information during severe flooding, thus sturdy housing is necessary.
Source: U.S. Geological Survey

[7] National Research Council of the National Academies/Water Science and Technology Board, 2004. *Assessing the National Streamflow Information Program.* Washington, DC: The National Academies Press, 40.

NERFC officials report that there are also a larger number of locations where new or enhanced gauges would be beneficial. About 10 locations have been calibrated using historical information from discontinued gauges. If those gauges were restored, forecast services could be provided at those locations. About 10 other gage locations could use enhancements such as a routine estimation of the rating curve (flow versus gage height). Of particular note in this category is the Connecticut River at Hartford.

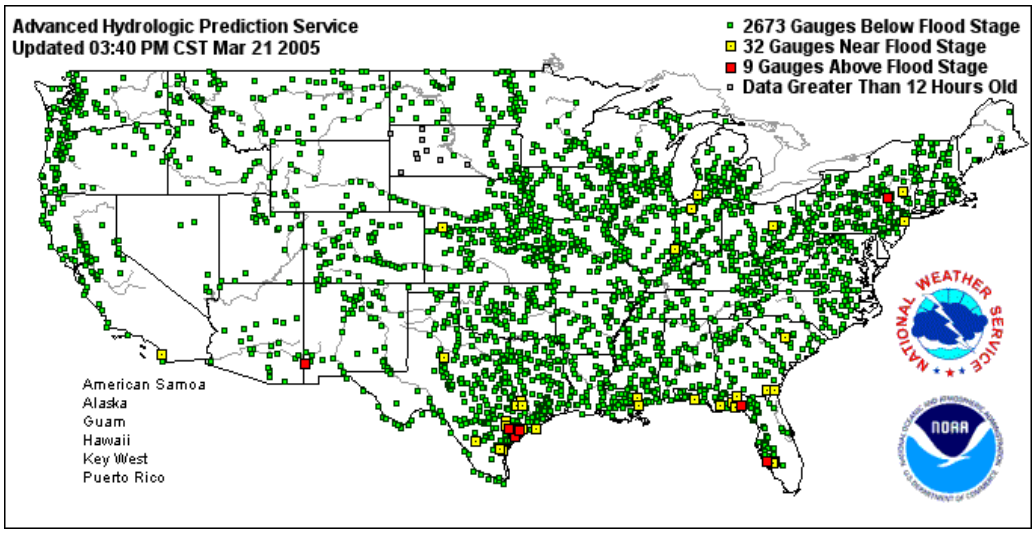
Headquarter officials meet regularly with USGS to discuss impending gage losses and gage priorities, however dialogue with the cooperating agency and local officials occurs in the field. WFOs, and to a lesser extent the NERFC, have worked closely with USGS to explain to the cooperating agency the consequences of losing a gage. NWS hydrology officials state that education is the primary role NWS can play and according to one New York State agency, NERFC is providing information to help the agency demonstrate the need for funding additional gauges.

USGS has suffered from years of stagnant and declining budgets, and the loss of gauges can jeopardize NWS' flood forecasting capabilities. Although we do not have a specific recommendation regarding USGS gauges, the critical role they play in the NWS mission is important to note.

Implementation of AHPS will increase the demand for more hydrology products and services

AHPS is a web-based suite of real-time products that uses a combination of data from remote sensing devices, data automation, and advanced weather, climate, and hydrologic modeling to analyze data and graphically display probability forecasts. Stream gauges provide critical information that feeds into AHPS. For example, the AHPS web site provides a map of gauges, showing which gauges are below, near, and above flood levels. AHPS allows users to click on a gage and obtain flood forecast information that can answer questions such as: how high will the river rise? When will the river reach its peak? Where will property be flooded? How long will flooding continue or how long will the drought last?

Figure 5: AHPS Internet Web Page



Source: http://weather.gov/rivers_tab.php (last accessed 3/21/05)

NERFC officials say implementation of AHPS, about halfway complete, is going well at the center. Staff members have been actively involved with the modeling efforts—defining, calibrating, and verifying 16 parameters for each watershed area.

AHPS, according to the NWS website, will (1) create easier to use products in new formats, including graphics; (2) create information useful in assessing risk to flooding including forecast probability; (3) provide products with forecast horizons for two weeks into the future and beyond; (4) increase the distribution of products using advanced information technologies (e.g. Internet) therefore, providing broader and more timely access and delivery of information; and (5) expand outreach and engage partners and customers in all aspects of hydrologic product improvement. It is anticipated that as technology advances and customer sophistication and needs intensify, AHPS products will continue to evolve. WFO staff may not be equipped to interpret the technical content of AHPS products and services or discuss evolving customer and partner hydrology requirements and needs, consequently there is an anticipated need for RFCs to conduct more outreach.

During our review period, most of the NERFC public outreach efforts consisted of meetings with water management agencies and partners at the federal, regional, and state levels to discuss what information the partner would like and what information the RFC needs (for example, the "rules" in place for dam water releases), and to coordinate forecasting efforts. Visits were also made to the eight WFOs, and the NERFC participated in the local, Boston-area, emergency management briefings. While this level of outreach may have been adequate in the past, the changes in hydrology services and products, primarily due to the implementation of AHPS, would benefit from a more extensive outreach effort by NERFC officials.

With the implementation of AHPS, NWS is currently considering creating a service coordination hydrologist (SCH) position. The SCH's job would be to make customers and partners more aware of NWS hydrologic capabilities, seek out and understand customer needs, and provide interpretative assistance and training. At the time of our on-site review, the new position was still a working proposal, and the staff was primarily concerned that the SCH, which would replace a GS-13 senior hydrologist position with a GS-14 management position, would shift the operational forecasting workload of the lost GS-13 hydrologist to the remaining staff.[8] However, a January 31, 2005 proposal to the NWS Workforce Human Capital Committee, states that the SCH must know and understand operational capability in order to be effective at outreach and coordination, and therefore would need to spend up to 25 percent of his or her time on operational forecasting. This can be compared to the existing staff workload of one-third operational and two-thirds model development. According to a briefing prepared for the NWS Workforce Human Capital Committee, the 13 HICs, 5 regional hydrologic service division chiefs, and 2 NWS headquarter hydrology offices all support the creation of the SCH position.[9] NWS believes that with the implementation of AHPS, there is sufficient justification for the need

[8] NWS management informed OIG staff that SCHs, if approved, would join each RFC when a forecaster position opens.
[9] In addition to enabling an RFC to conduct more outreach, the position would increase the RFC management team from two to three, and would increase the candidate pool for RFC HICs and GS-15 hydrology leadership positions.

to increase outreach and coordination efforts. Whether or not the SCH is the correct mechanism, it appears more outreach is warranted.

RECOMMENDATION
The Assistant Administrator for Weather Services should explore options to increase RFC outreach for the purpose of informing others about existing and new hydrologic services.

In its response to the draft report, NOAA stated that it is developing an outreach plan for FY 2006, which includes partnered RFC-Weather Forecast Office outreach activities for the purpose of educating NWS users on the NWS Hydrologic Services Program in general and the Advanced Hydrologic Prediction Service in particular. The outreach plan proposed by NOAA meets the intent of our recommendation, and we will consider this recommendation closed upon receipt of the outreach plan.

C. Advancements in RFC verification are needed to improve forecaster skill and river models

NWS determines how well it handles its forecasting and warnings through its verification process—a quality control process that matches forecasts to actual weather observations and compiles statistical results of forecasting performance. Currently, two RFC forecasts are verified: river stage forecasts and quantitative precipitation forecasts (QPF). This section will describe the measures and NERFC's scores. We will also discuss how little information is actually derived from the river forecast verification scores and how much more needs to be done.

River forecast verification

NERFC issues 150 river forecasts every day. A forecast can extend out several days, in 6-hour time intervals. Forecasts and gage observations are collected, and from these pairs of data, verification statistics measuring performance are calculated monthly. The verification scores, which can be accessed on the NWS intranet, can be aggregated in a number of different ways (see appendix A for a description of the statistics and description of how the statistics can be viewed).

For example, figure 6 shows a 2-day forecast, with day 1 in yellow (6, 12, 18, and 24-hour time intervals) and day 2 in green (30, 36, 42, and 48-hour time intervals). For verification purposes, the 8 forecast time intervals are treated as separate events. The day 1, 1 PM forecast is compared to the closest observation to 1 PM, and so on for each time step in the forecast.

Figure 6: Two-Day Forecast (for illustrative purposes only)

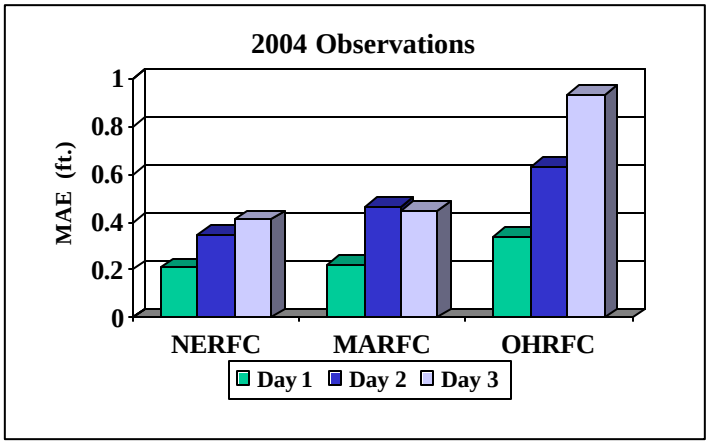
BLACKSTONE RIVER AT WOONSOCKET RI
FLOOD STAGE 9.0
LATEST STAGE 3.1 FT AT 0745 EST ON 0210

	7AM	1PM	7PM	1AM
0210:		3.8	4.1	4.2
0211:	4.2	4.1	3.9	3.6
0212:	3.4			

Source: NERFC

Figure 7 on the following page shows the total 2004 mean absolute error rates (MAE)[10] for days 1, 2, and 3 forecasts for the Northeast, Mid-Atlantic, and Ohio RFCs. The figure shows that near-term forecasts are more accurate than extended forecasts. NERFC's forecast scores were better than the other RFCs and its overall (days 1 through 3 combined) score of .292 was the best in the region. However, given geographical and climatological differences between RFCs, such comparisons are not always useful.

Figure 7: Mean Absolute Error for Eastern Region RFCs



Source: Performance Branch, Office of Climate, Water, and Weather Services

NERFC Verification		
Year	**MAE (ft.)**	**Inches**
2002	.292	3.5
2003	.369	4.4
2004	.292	3.5

However, observing verification score trends from the same RFC can be useful. In the case of the NERFC, an increase in the MAE from 2002 to 2003 represents a decline in accuracy, and then a return to the 2002 level of accuracy in 2004. Unfortunately, none of this information provides specific information regarding what improvements have been or need to be made.

Quantitative precipitation forecast verification

NERFC also issues daily quantitative precipitation forecasts—the estimate of how much rain will fall over a specified region or area. The accuracy of QPF is critical to predicting river levels. QPF verification scores are generated and used to compare the forecasts generated by five different sources, including one from the NERFC.

NWS' Hydrometeorological Prediction Center (HPC) uses several models and creates a final QPF that is available to all users, including the NERFC. Some NERFC forecasters make no or few changes to the HPC forecast, while others, particularly those with a meteorology

[10] MAE is the average of the difference between actual and forecasted values, without regard to sign (under or over forecasting). The closer the score is to zero the better the accuracy. See appendix B for more information.

[Erratum: Appendix B was incorrectly referenced when the report was issued. Please see Appendix A.]

background, may extensively rework the QPF. The NERFC staff issues a forecast predicting the basin average precipitation amount for the NERFC's forecast area over the next 24-48 hours. The QPF uses the HPC forecast as a baseline and is produced for 4 eight-hour intervals.

As with river forecasts, QPFs are verified against observations made at the same time interval to assess their accuracy. Though several scores can be generated for QPF verification, using the MAE is considered sufficient for measuring forecast accuracy. An analysis of NERFC fiscal year 2004 day 1 forecasts shows that the NERFC's QPF error rate compared to those of the four National Centers for Environmental Prediction (NCEP) models is equal to or lower for 5 out of 6 precipitation intervals.[11] This means that the NERFC's QPF forecasts were generally more accurate than those produced by the NCEP models.

Verification improvements are needed

River stage and QPF verification scores provide some useful information, such as forecast accuracy trends and identifying models that perform better in certain situations. However, the scores do not provide sufficient detail to identify sources of error. Since QPF is primarily generated out of the HPC, while river forecasting is entirely modeled out of the NERFC, NERFC forecasters have significantly more input into the river forecasts than QPF. Consequently, our remarks regarding verification improvements are primarily focused on river forecast verification, which should provide enough detail to identify river basin model errors and identify areas where improvement in forecaster skills and training is needed.

Although the DOH reviews and posts the verification statistics, the scores are not useful for assessing basin model or staff performance because the data is calculated at too few points across a large geographic area and computed for periods of one month or longer to ensure a sample size large enough to compute a statistically valid MAE. Specifically, only 13 of NERFC's 150 river forecast points are verified nationally, only four statistics are compiled, and too few forecast types, such as river forecasts with and without QPF, are tested. NERFC also provides the same verification information for most of its forecast points.

NWS Office of Hydrologic Development (OHD) officials informed us that they have started work on a verification program and that during fiscal years 2001 through 2004, $225,000 was spent on planning and developing prototype verification software. This fiscal year $150,000 has been allocated to develop a comprehensive verification system. E-mail correspondence from OHD officials outlined their verification plans, stating that "any system put into place should verify hydrologic forecasts and guidance products, identify sources of error and skill in the forecasts across the entire forecast process so we have a basis to improve our scientific and operational techniques, and support "hindcasting" so we can objectively determine if our forecasts are improving as new science and technology is introduced." OHD officials also acknowledged that an NWS and an external hydrology community peer review, to evaluate the scientific and technical merits of a proposed verification system, would be conducted.

[11] A precipitation interval is a prescribed range of measured precipitation, usually calculated in inches (e.g., 0.00 < .01 inches, 0.5 < 1.00 inches).

However, it is difficult to assess NWS' progress in developing the verification system, as NWS has not documented how it intends to achieve such a system. For example, there is no documentation discussing (1) local, regional, and national verification responsibilities, (2) what metrics will be computed and how often, and (3) data archival requirements. In addition, the software system development remains incomplete and there is no plan in place to determine when and how forecasters will be trained. Finally, the plan and timing for educating local, regional, and national management on the use and integration of verification metrics into their management processes, are not defined. OHD officials did state that once a peer review goal is determined, a plan will be developed.

NWS is a leader in weather event verification—having implemented the first formal severe weather verification system over 25 years ago. However, unlike meteorological forecast verification, NWS officials told us that there are no well-defined procedures for verifying river forecasts that will provide enough detail to make river basin model and forecaster skill improvements possible. Given the amount of work to be accomplished, developing a plan and timeline now would be beneficial to those working on the verification system and those in the field who will ultimately have to implement the system.

RECOMMENDATION

The Assistant Administrator for Weather Services should develop, document, and implement a timeline and action plan for completing the comprehensive river forecast verification system as soon as practicable.

NOAA concurred with the recommendation. NOAA's Hydrologic Services Program is currently developing a timeline and action plan to complete the implementation of the National River Forecast Verification System. To enhance the system, NWS intends to charter a team by the end of this fiscal year to (1) propose a more comprehensive system to verify hydrologic forecasts and guidance products, (2) identify sources of forecast error and skill, and (3) objectively determine the impact of new science and technology on NWS forecasts. The actions proposed by NOAA meet the intent of our recommendation, and we will consider this recommendation closed upon receipt of the timeline and action plan.

III. NERFC's External Partners Are Mostly Satisfied, But Some Additional WFO and NERFC Coordination Would Be Beneficial

RFCs work with a number of water resource organizations, although Weather Forecast Offices are the RFC's primary customer. We found that most NERFC customers and partners spoke highly of its products and services. However, there is room for improvement in the NERFC's coordination with some WFO forecasters in its service area, particularly when an event is occurring and forecast updates are issued.

A. Partners and customers are pleased with RFC products and services

We interviewed personnel at USACE, USGS, State emergency management agencies, and other organizations that work closely and are in frequent contact with both NERFC and their local weather service office. For example, the New England District of the Corps electronically receives and uses RFC products on a daily basis to assist with its reservoir management and dam discharge responsibilities. The Corps is pleased with NERFC products and did not offer any suggestions for new products. In our discussions with these organizations, we learned that NERFC staff, often with local WFO staff, actively participate on various committees and commissions.

The Massachusetts Emergency Management Agency (MEMA), the state agency responsible for coordinating federal, state, local, voluntary and private resources during emergencies and disasters in the Commonwealth of Massachusetts, stated that it has a great relationship with both the Boston WFO and NERFC. MEMA officials told us that they are constantly communicating with each other and that the NERFC is proactive during weather events. MEMA representatives also said that they appreciate that performance feedback is requested by the NERFC after major flooding events. Other than wanting more GIS formatted data, MEMA was pleased with NERFC products and services.

The New York State Canal Corporation is a subsidiary of the New York State Thruway Authority, a public benefit corporation of the New York State government. The Canal Corporation oversees the 524-mile inland navigable waterway that crosses upstate New York and is working closely with NERFC forecasters on its modeling of the Oswego River, Mohawk River, and Upper Hudson River basins. The Canal Corporation shares its snow measurement data with the NERFC and is pleased with NERFC products. NERFC forecasters recently met with the Canal Corporation at a WFO in the NERFC service area to discuss basin models and stream gage priorities, needs, and funding.

Since February 2004, NERFC has provided observed and forecast water level data from several Hudson River basin forecast points to NOAA's National Oceanic Service (NOS) for testing of the New York Operational Forecast System (NYOFS), which produces a hydrodynamic model to forecast water levels and current velocities in the New York harbor. These forecasts, available online, are important to port managers at the ports of New York and New Jersey, since the level of cargo ship traffic allowed in the harbor is affected by tides and currents. Since February 2004, the NERFC has provided observed and forecast water level data from several Hudson River basin forecast points on an experimental basis for testing in the NYOFS model. NOS officials

intend to use the NERFC data, but only after rigorous testing and verification. NERFC plans to use optimal tidal flow information from NOS in the future. This will help forecasters accurately model tidal fluctuations on the Lower Hudson River, thereby improving the accuracy of the NERFC's river forecasts.

B. Some additional coordination between NERFC and the WFOs would be beneficial

NERFC regularly meets its deadlines for transmitting daily and weekly products, and most WFO staff have excellent working relationships with the RFC staff. However, NERFC staff and regional office officials said a few WFO forecasters do not properly coordinate with NERFC, particularly during flood events when updates are being issued, even though it is required in NWS Directive 10-921 (see box).

NERFC issues its products on a regular schedule. For example, the short-term hydrologic forecast is prepared and transmitted every day by 11 a.m., the flash flood guidance by 11:30 a.m., and the extended-range stream flow prediction is prepared and transmitted every Tuesday afternoon. WFOs use RFC guidance products to issue hydrology products to the public, sometimes with minor modifications, often with none.

During a weather event, RFCs issue flood updates to the WFOs, and WFOs issue weather updates to the public, as needed. Occasionally, WFOs issue or modify flood products without coordinating with the RFC—or before receiving RFC updates. NERFC staff and regional office officials stated that while the number is small, some WFO forecasters do not properly coordinate with the RFC. For example, a WFO requested updated guidance on a specific basin, but then issued an updated forecast while the NERFC staff was still working on the hydrology model. In some cases, this may result in different forecasts on the NERFC and WFO websites, thereby confusing the public.

WFO forecasters should be made aware of and held accountable for complying with NWS Directive 10-921, which explicitly requires them to coordinate with RFCs for larger streams, including main stem-rivers, unless an emergency situation, as defined in the directive, exists. RFCs' river modeling takes into account complex hydrologic operations and RFC input is

NWS Directive 10-921, Section 3.1.2.b.

Large-scale forecast points: WFO hydrologic operations for large-scale rivers involve incorporation of RFC forecast values into WFO products. When issuing a hydrologic forecast or warning product for large-scale forecast points, a WFO may modify the forecast values provided by the supporting RFC. However, modifications are explicitly coordinated with the RFC unless an emergency situation exists, such as a communications outage, a rapidly changing event when time does not permit contacting the RFC, or an event occurring when the RFC is closed or otherwise unavailable. During the coordination process, all reasonable efforts will be made to arrive at a consensus, but in the unlikely event that agreement on proposed modifications to RFC forecast values cannot be reached, WFO forecasters will use the RFC values in the official forecast.

If RFC forecast values are unavailable for a large-scale forecast point during an event, a WFO may issue appropriate preliminary forecast or warning products. Such actions should be coordinated with the supporting RFC unless an emergency situation exists as described above.

Source: http://www.nws.noaa.gov/directives

essential to WFO large stream and main stem river forecasts.

By that same token, we were told that NERFC staff, striving to obtain the best possible forecast, may become too focused on modeling the perfect forecast and miss WFO deadlines for issuing an updated forecast. In addition, according to NERFC staff, some WFO forecasters have a tendency to issue updates early, with or without the RFC guidance. WFO and RFC forecasters should clarify the timeframe, including when the RFC guidance is needed, to ensure large-scale forecast point guidance is taken into account when updated forecasts are issued to the public.

Although the NERFC has included WFO visits in employee performance plans, participated in a number of collaborative events, and included collaboration and technology and information transfer in its office Annual Operating Plan, a formal Hydrologic Collaboration Plan between the NERFC and the WFOs in its service area, as described in Directive 10-911, Section 4.5.6, has not been developed. The directive states that RFCs and WFOs should make collaboration and teamwork an intentional activity whereby programs, initiatives, and ideas that advance NWS hydrologic services should be identified, recognized and shared.

RECOMMENDATION

The Assistant Administrator for Weather Services should ensure that the Eastern Region Headquarters takes action to maintain proper WFO coordination with the NERFC, as required in NWS Directive 10-921, including adequate coordination on the deadline for receiving updated RFC guidance products during an event.

NOAA concurs with this recommendation and reports that the Eastern Region Headquarters will issue a memorandum reminding WFOs and RFCs of their respective roles during the coordination process. The issue will also be discussed during the July 2005 Eastern Region telephone conference call with all WFO and RFC office directors and the July 2005 bimonthly hydro-program managers' conference call. The actions proposed by NOAA meet the intent of our recommendation. We request that a copy of the memorandum be included with the action plan.

IV. Facility Maintenance Problems Need To Be Addressed

A. NWS should take the actions necessary to ensure facility repairs and maintenance are accomplished

The National Oceanic and Atmospheric Administration of the U.S. Department of Commerce entered into a lease agreement with a commercial property company for a one-story building with 10,417 square feet of office space and the surrounding 2.34 acres of land on June 29, 1992. The building, which is occupied by both the NERFC and the Boston WFO, was constructed in accordance with NWS specifications described in the solicitation for offers. The 20-year lease period is May 19, 1993 through May 18, 2013.

NWS has now occupied the building for more than half of the lease period and the aging building requires maintenance. A list provided to us during the review indicated that since April 2004, 46 work orders have been submitted for repairs and maintenance. Of these, only four were completed and 42 were not completed. Of the 42 that were not completed, 17 were reissued work orders and 25 were new work orders. The length of time that work orders remain outstanding ranges from 2 to 10 months. These work orders include, for example, repairing a roof drain splash that presents a winter ice hazard on the sidewalk, replacing and fixing general wear and tear items such as door and window weather stripping and pavement cracks, and properly maintaining the landscape by removing dead trees. The lease states that the lessor is responsible for the maintenance and repair of the facility, including road repair, snow removal, landscaping, and maintenance, testing, and inspection of equipment and systems. NERFC officials told us that the lack of maintenance on the Taunton facility has been a problem in the past, but it is getting worse as the building gets older.

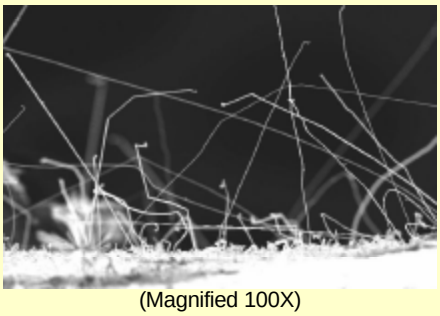
Additionally, although they have not been officially notified, NOAA officials said they believe the lessor is in the process of selling the facility, and therefore is not inclined to ensure that maintenance and repairs are completed when requested. However, the lease clearly states that the government can make necessary repairs and deduct the cost from the rent, because the covenants to pay rent and to provide maintenance and repair are *interdependent*. NOAA officials informed us they are in the process of pursuing this approach to obtain the needed maintenance.

B. Steps taken to address the presence of zinc whiskers should be documented

In recent years, many computer equipment failures ranging from nuisance glitches to catastrophic system failures have been attributed to zinc whiskers, according to a NASA

Goddard Space Flight Center website.[12] The most commonly cited source of zinc whiskers is the bottom surface of aging floor tiles commonly used in computer room construction. Zinc whiskers break free during floor-bumping activities—such as running new cables and wiring. They become airborne, and eventually land on and in electronic equipment where they can cause electrical shorts. Continued miniaturization of electronic circuits increasingly makes zinc whiskers a hazard because the distance between circuits is smaller and an electrical short is more likely to occur.

What are Zinc Whiskers?



(Magnified 100X)

Zinc whiskers are tiny conductive filaments of zinc typically less than a few millimeters long and only a few thousandths of a millimeter in diameter. They "grow" on metal surfaces that have been electroplated (galvanized) with zinc for corrosion protection. Zinc whiskers are conductive and cause electrical shorts if they bridge tightly spaced electrical conductors.

Source:
http://nepp.nasa.gov/whisker/photos/pom/2003april.htm

Since January 2000, equipment repair, replacement, and related shipping charges at NERFC have cost more than $16,000. According to NWS officials, a study conducted by a private contractor on the indoor air quality at the Taunton facility found the presence of zinc whiskers in the air and on surfaces (see box).[13]

After the April 2004 air quality study was issued, confirming the presence of zinc whiskers, NERFC electrical technicians have successfully minimized equipment failures by covering all equipment with plastic before beginning any work that requires the raised floor to be moved or in any way disturbed and thoroughly dusting or vacuuming the surfaces before removing the plastic.

Now that NERFC appears to have identified a way to minimize the damage that may be caused by zinc whiskers, it should document the measures taken to avoid equipment losses. NWS should share this information with other similar facilities at risk of incurring damage due to zinc whiskers.

RECOMMENDATIONS

1. The Assistant Administrator for Weather Services, in conjunction with the Director of NOAA's Facility and Acquisition Management Division, should ensure that repairs and maintenance at the Taunton facility are completed in a timely manner.

2. The Assistant Administrator for Weather Services should instruct the Eastern Region Headquarters to document the NERFC's handling of the zinc whisker problem and make that information available to other NWS facilities to enable them to reduce any potential damage or equipment losses from zinc whiskers.

[12] http://nepp.nasa.gov/whisker/reference/tech_papers/Brusse2003-Zinc-Whisker-Awareness.pdf (last accessed March, 28, 2005).
[13] Although the potential health hazard from breathing zinc whisker debris is unknown, air quality tests taken at NERFC are within the federal recommended exposure level.

NOAA concurred with both recommendations and reported that progress has been made regarding outstanding facility issues. NOAA's Real Property Division and NWS Eastern Region have met with a representative from the lessor regarding the facility, and discussions to resolve facility issues are underway. The actions taken meet the intent of our recommendation.

NOAA also agreed to prepare a document regarding NERFC's experience and solution for the zinc whisker problem and make it available to other NWS facilities. The proposed action meets the intent of our recommendation.

V. NERFC's Financial and Administrative Operations Are Generally Well Managed

We verified select items in NERFC's inventory of assets; reviewed time and attendance, cell phone, and travel records; assessed the timeliness of performance appraisals; and reviewed the staff's use of both government-issued purchase cards and a government-owned vehicle. We found only minor omissions on time and attendance forms and three instances of missing documentation. However, we recommend that NERFC management evaluate the continuing need for its government vehicle based on future staff needs.

A. Most financial and administrative operations are managed well with a few exceptions

We found that NERFC's inventory of assets, valued at $4.3 million, was accounted for and properly maintained. Our review of monthly statements for fiscal year 2004 indicates proper use of government cell phones by staff. In addition, the OIG reviewed NERFC fiscal year 2004 travel authorizations and travel reimbursement vouchers for compliance with Chapter 301 of the *Federal Travel Regulations*, "Temporary Duty Travel Allowances." Specifically we determined whether travel authorizations and vouchers were properly issued and signed, reimbursements fell within the guidelines, and that the stated purpose of travel supported NERFC's mission. We found that official travel was authorized and travel vouchers were processed consistent with the *Federal Travel Regulations*.

The OIG reviewed time and attendance records from 8 separate, two-week pay periods during calendar years 2003 and 2004 and found that they were properly processed, except for three minor omissions. In addition, aside from 2 leave requests and 1 overtime authorization that could not be accounted for, we found that all employee requests for leave and overtime were properly authorized and the records maintained. Finally, we found that employee performance appraisals for the previous 2 years were conducted promptly within 6 weeks of both the ends of the midpoint and the annual rating periods, respectively, which is generally consistent with federal personnel management policies.

The OIG also found that the NERFC's use of its government-issued purchase cards is generally good. SmartPay® purchase cards are currently issued to two employees. Both employees, as well as the HIC, have completed SmartPay®'s online purchase card training course. Our review of fiscal years 2003 and 2004 monthly statements found no significant problems with use of the NERFC's purchase cards.

B. NERFC should evaluate the need for its government vehicle

NERFC staff use a 2004 model minivan, obtained in September 2004 under a contract with the General Services Administration. Prior to this vehicle, the staff had used another minivan for 6 years, from 1998 to 2004. During 2003 and 2004, NERFC staff drove the government-issued vehicle an average of 6,000 miles per year. According to the *Federal Property Management Regulations*, this is less than the recommended annual mileage for an agency to maintain a government vehicle on a full-time basis.

GSA Interagency Fleet Management Systems utilization guidelines (41 CFR 101-39.301) state that light trucks and general purpose vehicles should be driven at least 10,000 miles per year in order for the agency to maintain the vehicle.[14] If the miles traveled guidelines are not met, the regulations state that other utilization factors, such as agency mission and relative costs of alternatives to a full-time vehicle assignment, may be considered as justification.

According to NERFC staff and vehicle logs, staff uses the government vehicles for long trips to conduct research, survey river conditions, and attend meetings with both government and non-governmental officials. The HIC believes that it would be possible to share vehicles with the Boston WFO (which uses five vehicles) given the low amount of mileage the NERFC puts on the vehicle annually. Our review of logs for the Boston WFO's vehicle that is designated for administrative purposes found that it was driven approximately 12,300 miles over a 21-month period or an average of 7,000 miles annually.[15] As such, it appears that the Boston WFO's administrative vehicle is similarly underutilized.

However, the HIC noted that NWS has proposed adding a service coordination hydrologist (SCH) position (see discussion on page 10) at all river forecast centers. If approved, the SCH would be required to travel extensively within his/her service area to conduct outreach activities and would need a government vehicle.

RECOMMENDATION

The Assistant Administrator for Weather Services should request that the Eastern Region Headquarters examine the use of the NERFC government vehicle and, based on future staff requirements, evaluate its continuing need for one assigned on a full-time basis.

NOAA has agreed to evaluate the usage of government vehicles. The evaluation will be completed before the end of the current fiscal year. The evaluation proposed by NOAA meets the intent of our recommendation, however, we ask that a copy of the evaluation be included with the agency's action plan.

[14] A GSA Interagency Fleet Management Systems representative confirmed that minivans are classified under the category of "light trucks and general purpose vehicles."
[15] We reviewed vehicle logs for travel after March 28, 2003 through December 31, 2004.

SUMMARY OF RECOMMENDATIONS

We recommend that the Assistant Administrator for Weather Services ensure that the following actions are taken:

1. Assign responsibilities, document the steps that need to be taken, and develop a timeline to implement a strong GIS capability (see discussion starting on page 8).

2. Explore options to increase RFC outreach for the purpose of informing others about existing and new hydrologic services (see page 10).

3. Develop, document, and implement a timeline and action plan for completing the comprehensive river forecast verification system as soon as practicable (see page 13).

4. Ensure that the Eastern Region Headquarters takes action to maintain proper WFO coordination with the NERFC, as required in NWS Directive 10-921, including adequate coordination on the deadline for receiving updated RFC guidance products during an event (see page 18).

5. In conjunction with the Director of NOAA's Facility and Acquisition Management Division, ensure that repairs and maintenance at the Taunton facility are completed in a timely manner. (see page 20).

6. Instruct the Eastern Region Headquarters to document the NERFC's handling of the zinc whisker problem and make that information available to other NWS facilities to enable them to reduce any potential damage or equipment losses from zinc whiskers (see page 20).

7. Request that the Eastern Region Headquarters examine the use of the NERFC government vehicle and, based on future staff requirements, evaluate its continuing need for one assigned on a full-time basis (see page 23).

Please address an additional recommendation in Appendix B separately.

APPENDICES

APPENDIX A

Verification Statistics

Mean Absolute Error (MAE), also referred to as Absolute Mean Error, is the mean of the absolute differences between the observations and forecasts in the interval. The closer the score is to zero the better the accuracy.

Root mean-squared error (RMSE) is the square root of the mean of the squared differences between the observations and forecast in the interval. The score provides a good measure of forecast accuracy, while giving a greater weight to the larger differences than the MAE does. If the RMSE is significantly greater than the AME, it means that there were several forecasts whose errors were larger than the average forecast error. The closer the RMSE is to zero the better the accuracy.

Algebraic mean error is the mean of the arithmetic differences between the observations and forecasts in the interval. The score is a measure of forecast bias, where positive values denote overforecasting, negative values denote underforecasting, and zero indicates no bias.

Count of observation pairs is the total number (*n*) of forecasted time intervals. Time intervals are in 6-hour increments and can extend out to three (24-hour) days. Time intervals and days are not associated with a typical 24-hour day. Below shows a 3-day forecast beginning at 1 PM.

DAY 1				DAY 2				DAY 3			
6 hr	**12 hr**	**18 hr**	**24 hr**	**30 hr**	**36 hr**	**42 hr**	**48 hr**	**54 hr**	**60 hr**	**66 hr**	**72 hr**
1 PM	*7 PM*	*1 AM*	*7 AM*	*1 PM*	*7 PM*	*1 AM*	*7 AM*	*1 PM*	*7 PM*	*1 AM*	*7 AM*

Summary verification statistics can be aggregated and viewed in a number of different ways, by:

- Any month or months from April 2001 through the most recently compiled month.
- Region, RFC, forecast location
- Forecast 6-hour interval period
- Day 1, 2, 3
- River Response (each forecast location is designated as a fast, medium, or slow rising river)

Source: http://www.hpc.ncep.noaa.gov/npvu/help/ and the performance branch of the headquarters office of climate, water, and weather services.

Appendix B has been with held in its entirety.

Appendix B has been with held in its entirety.

APPENDIX C

Agency Response to the OIG Draft Report

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
CHIEF ADMINISTRATIVE OFFICER

JUN 30 2005

MEMORANDUM FOR: Jill Gross
Assistant Inspector General for Inspections and Program Evaluations

FROM: William F. Broglie
Chief Administrative Officer

SUBJECT: *The Northeast River Forecast Center Is Well Managed, But Some Improvements Are Needed*
Draft Inspection Report No. IPE-17259/May 2005

Attached is the National Oceanic and Atmospheric Administration's response to the Office of Inspector General's draft report on the inspection of the National Weather Service's Northeast River Forecast Center. The response was prepared in accordance with Department Administrative Order 213-3.

We appreciate the opportunity to respond to your draft report.

Attachment

NOAA Comments to the Draft OIG Report Entitled
"The Northeast River Forecast Center Is Well Managed,
But Some Improvements Are Needed"
(Draft Inspection Report No. IPE-17259/May 2005)

General Comments

Executive Summary, page i, third paragraph, second sentence:
In the report, the following statement is presented: "WFOs primarily issue forecasts, watches, and warnings to the public while RFCs, not directly responsible for interfacing with the public, devote approximately one-third of staff time to operations and two-thirds to hydrologic modeling and development work." This statement is not accurate. First, the ratio of time spent on "operations" and "modeling and development" will vary considerably from one RFC to another. Second, a major effort at most RFCs for "modeling and development" involves data processing and quality control, and model calibration and enhancement. These efforts are critical to providing quality forecasts that allow the National Weather Service (NWS) meet its mission of helping to save lives and protect property. Given this, the "modeling and development" effort would better be considered an integral component of "operations." Please see suggested revisions under the section called "Recommended Changes for Factual/Technical Information and Editorial Comments."

Executive Summary, page iii, fourth paragraph, first sentence and page 6, Observations and Conclusions, Section I heading:
In reference to the OIG's use of the word "appear" concerning the adequacy of NERFC management and oversight, this word casts some doubt on how well the NERFC and Eastern Region Headquarters manage the office. The OIG exit conference indicated that the audit team was pleased with the management and oversight of NERFC. The title of the report is "The Northeast River Forecast Center is Well Managed…" We recommend the report state that fact, or at a minimum, the word "appear" be deleted from the document.

Recommended Changes for Factual/Technical Information and Editorial Comments

Executive Summary, page i, second paragraph, second sentence:
Change "On average, flooding reportedly claims the lives of 100 people each year and causes damages in excess of $2 billion." to "On average, over the past 20 years, flooding has annually claimed over 90 lives and caused damages in excess of $4.25 billion."

Executive Summary, page i, second paragraph, last sentence:
Remove New Jersey and Pennsylvania. These states are not part of the NERFC service area.

Executive Summary, page i, third paragraph, first sentence:
Change sentence to read "WFOs cover smaller geopolitical areas, while RFCs service substantially larger river basin areas."

1

Executive Summary, page i, third paragraph, second sentence:
Change sentence to read "WFOs are the primary source of NWS forecasts, watches, and warnings. RFCs support WFOs by providing flood and hydrologic forecast guidance. RFCs, as centers of hydrologic expertise in the NWS, continuously enhance forecast models to ensure their guidance information supports the highest quality forecasts possible. RFCs also support hydrologic users that require information integrated over basins larger than individual WFOs and and/or require more technically sophisticated hydrologic information (e.g., probability) than is typically required by the majority of WFO customers. A notable example is in the area of water supply forecasting, where RFCs are typically the primary point of contact for many water supply managers."

Executive Summary, page i, third paragraph, third sentence:
Replace "seasonal hydrologic products" with "seasonal hydrologic information."

Executive Summary, page i, third paragraph, fourth sentence:
Change sentence to read "During periods of flooding, the RFC issues guidance forecasts for the height of the flood crest, the time a river is expected to reach flood stage, the time to crest and the time when the river is expected to recede below flood stage and back to normal levels. The WFOs use RFC river forecast guidance and incorporate local knowledge to issue public river forecasts, flood watches and flood warnings, and river flood warning information."

Executive Summary, page ii, first paragraph, second sentence:
Change first part of sentence to read "Although the hydrologist-in-charge has been at the RFC for only two years, this person has addressed problems or issues…"

Executive Summary, page ii, second paragraph, second sentence:
Add the word "full" between the words "taking" and "advantage" in the second sentence that begins "The NERFC is not taking advantage…" The current wording makes it appear as if the NERFC is not working with the GIS software, but this is not the case. NERFC is producing a number of GIS products on a daily basis that are posted to the web.

Executive Summary, page ii, third paragraph, fourth sentence:
Replace "While traditionally" with "Currently." Before the NWS modernization, the RFCs had hydrologic service area responsibility.

Executive Summary, page iv, last sentence:
Change sentence to read "On pages 24 and 27, we offer eight recommendations to address our concerns."

Page 1, first paragraph, first sentence:
Replace "…which claims 100 lives and causes more than $2 billion in damage each year" with "… which over the past 20 years, has annually claimed more than 90 lives and caused damages in excess of $4.25 billion."

Page 1, second paragraph, last sentence:
Remove the word "customized."

Page 2, first paragraph, first sentence:
Remove Pennsylvania and New Jersey. These states are not part of the NERFC service area.

2

Page 2, second paragraph, first sentence:
Clarify if "smallest" refers to service area, population, or forecast points.

Page 4, first sentence:
Replace "123 WFOs" with "122 WFOs."

Page 6, fourth paragraph, third sentence:
Reword third sentence to be two sentences to read "The NERFC DOH occasionally works operational shifts. In addition, the DOH is actively involved with running existing models and developing new in-house programs, AHPS implementation and calibration efforts, monitoring NERFC verification scores, and providing technical assistance to the staff." The current wording in the draft report makes it appear as if the DOH never works any shifts. This has never been the case. As a point of clarification, the DOH is not supposed to be part of the regular shift rotation.

Page 7, first paragraph, last sentence:
Replace "weekly" with "monthly."

Page 7, first paragraph, last sentence:
Incorporate this information to the last sentence – The Eastern Region Director holds semi-annual all hands audio conference calls with all field employees.

Page 7, third paragraph, fourth sentence:
Replace "weather center units" with "Center Weather Service Units."

Page 8, second paragraph, first sentence:
Rewrite sentence to read "The NERFC currently uses GIS software to support some of its operations including issuing products (e.g., the Significant River Flood Outlook product and in basin delineation for calibration)." The current wording makes it appear as if the NERFC is only using GIS for a single product when in fact the NERFC generates a number of products using GIS on a daily basis. Furthermore, the NERFC heavily utilizes GIS in the basin delineation aspect of their calibration efforts.

Page 9, second paragraph, second sentence:
Change sentence to read "For example, other RFCs in the Southern, Eastern, and Central Regions have created precipitation estimate products compatible with GIS software."

Page 14, Figure 7:
On the Y-axis, replace AME with MAE. Also, we recommend a legend describing what the three colors indicate for the bars on the graph.

Page 14, third paragraph:
Change paragraph to read "NWS' Hydrometeorological Predication Center (HPC) uses several models and creates a final QPF that is available to all users, including the NERFC. Some NERFC forecasters make no or few changes to the HPC forecast, while others, particularly those with a meteorology background, may extensively rework the QPF. The NERFC staff issues a forecast predicting the basin average precipitation amount for the NERFC's forecast area over the next 24-48 hours. The QPF uses the HPC forecast as a baseline and is produced for 4 eight-hour periods."

3

Please note that the HPC does not run models. Instead, this center uses computer model information to assist in producing QPF products. The model is run by the National Centers for Environmental Prediction (NCEP).

Page 14, fourth paragraph, third and fourth sentences:
Replace both references to "HPC" with "NCEP."

Page 15, second paragraph, last sentence:
Change sentence to read "Specifically, only 13 of NERFC's 150 river forecast points are verified nationally, only four statistics are compiled, and too few forecast types, such as river forecasts with and without QPF, are tested." Also, the following should be added: "It should be noted that the NERFC is locally performing a level of verification on most of their forecast points with some analysis in addition to the national hydrologic verification program." The current wording refers to the national verification and needs to be listed as such. In fact, the NERFC performs similar verification locally on the majority of our forecast points.

NOAA Response to OIG Recommendations

Recommendation 1: We recommend that the Assistant Administrator for Weather Services ensure that the following actions are taken: Assign responsibilities, document the steps that need to be taken, and develop a timeline to implement a strong Geographic Information System (GIS) capability.

NOAA Response: We concur. For RFC operations, NWS has recently instituted an Operations and Service Improvement Process (OSIP) to provide an integrated approach to meet requirements that reflects real world resource limitations. It will do this by prioritizing requirements and identifying synergies and overlaps among distinct requirements to assure cost-effective and technically sound solutions are selected. A Statement of Need for an integrated GIS capability to support RFC operations has been submitted to the OSIP. Overall responsibility lies with OSIP.

For dissemination and exchange of GIS information, there is a requirement to make the full spectrum of NWS information available in GIS-compatible formats. Given the large volume of information provided by NWS, NWS's Office of the Chief Information Officer and Office of Climate, Weather, and Water Services will conduct an analysis to identify a subset of NWS information whose value will be significantly increased if provided in GIS-compatible format(s). In parallel with this analysis, a well-designed, integrated systems architecture to support provision of GIS information will be specified. This will be done in consultation with other NOAA line offices that have similar requirements, and in some cases, already have experience in this area. NWS is in the process of forming an integrated work team (IWT) to address these issues. The IWT will perform the needed analyses and will develop one or more submissions to OSIP to meet NWS requirements for GIS information. Specific timelines will depend on the outcome of the IWT analyses as well as budget priorities.

4

Target Implementation Date:

May 31, 2005 (completed) – RFC Operations – Statement of Need submitted to OSIP.

August 31, 2005 – Dissemination and Exchange of GIS Information – Initial GIS formatted information will be available.

Recommendation 2: We recommend that the Assistant Administrator for Weather Services ensure that the following actions are taken: Explore options to increase RFC outreach for the purpose of informing others about existing and new hydrologic services.

NOAA Response: We concur. NWS is developing an outreach plan for FY 2006, which includes partnered RFC-Weather Forecast Office (WFO) outreach activities to educate our users on the NWS Hydrologic Services Program in general and the Advanced Hydrologic Prediction Service (AHPS) in particular.

Target Implementation Date: September 30, 2005

Recommendation 3: We recommend that the Assistant Administrator for Weather Services ensure that the following actions are taken: Develop, document, and implement a timeline and action plan for completing the comprehensive river forecast verification system as soon as practicable.

NOAA Response: We concur. NOAA's Hydrologic Services Program is currently developing a timeline and action plan to complete implementation of a National River Forecast Verification System. This timeline and action plan will be developed by September 30, 2005. A prototype verification system was implemented in spring 2001, and verification data are routinely available for a minority of NWS river forecast locations. The timeline and action plan being developed will facilitate the implementation of this prototype at river forecast locations nationwide. In an effort to enhance this national system, NWS will charter a team by September 30, 2005. The team's focus will be to propose a more comprehensive system to verify hydrologic forecasts and guidance products, identify sources of error and skill in the forecasts across the entire forecast process so we have a basis to improve our scientific and operational techniques, and support "hind casting" so we can objectively determine if NWS forecasts are improving as new science and technology is introduced." The team will develop requirements for an enhanced national verification system by June 30, 2006.

Target Implementation Date:

September 30, 2005 – Timeline and action plan developed, documented, and implemented. Focus group formed to propose a more comprehensive verification system.

June 30, 2006 – Requirements for an enhanced national verification system developed by focus group.

5

Recommendation 4: We recommend that the Assistant Administrator for Weather Services ensure that the following actions are taken: Ensure that the Eastern Region Headquarters takes action to maintain proper WFO coordination with the NERFC, as required in NWS Directive 10-921, including adequate coordination on the deadline for receiving update RFC guidance products during an event.

NOAA Response: We concur. The Eastern Region Headquarters will issue a memorandum reminding WFOs and RFCs of their respective roles during the coordination process. Also, this issue will be discussed during the Eastern Region's July 2005 Meteorologist-in-Charge/ Hydrologist-in-Charge (MIC/HIC) call and the July 2005 bimonthly hydro-program managers' conference call.

Target Implementation Date:

June 30, 2005 – Issuance of memorandum
July 13, 2005 – Eastern Region's July MIC/HIC call
July 31, 2005 – Hydro-program managers conference call

Recommendation 5: We recommend that the Assistant Administrator for Weather Services ensure that the following actions are taken: In conjunction with the Director of NOAA's Facility and Acquisition Management Division, ensure that repairs and maintenance at the Taunton Facility are completed in a timely manner.

NOAA Response: We concur. Since the OIG review, senior staff from NOAA's Real Property Management Division and NWS Eastern Region has been working closely to force the lessor to adhere to their obligations. A letter was sent to the lessor in March 2005 outlining the outstanding facility issues and placing the lessor on notice if action was not taken, the government would begin to address the issues and deduct costs from rent payments. Subsequently, a representative from the lessor met with government officials on three occasions (plus another meeting planned for June 14, 2005) to discuss the issues. Because of this responsiveness, the government has not moved forward with rental deductions. The May 26, 2005 meeting was devoted to the representative providing the government with his plans for alleviating the outstanding facility issues. The June 14, 2005 meeting was scheduled to allow the government to respond to these plans and to discuss any unresolved issues.

Target Implementation Date: July 25, 2005 – A schedule for contractually mandated service repairs and maintenance will be developed.

6

Recommendation 6: We recommend that the Assistant Administrator for Weather Services ensure that the following actions are taken: Instruct the Eastern Region Headquarters to document the NERFC's handling of the zinc whisker problem and make that information available to other NWS facilities to enable them to reduce any potential damage or equipment losses from zinc whiskers.

NOAA Response: We concur. The document will be completed and made available to other NWS facilities.

Target Implementation Date: July 29, 2005

Recommendation 7: We recommend that the Assistant Administrator for Weather Services ensure that the following actions are taken: Request that the Eastern Region Headquarters examine the use of the NERFC government vehicle and, based on future staff requirements, evaluate its continuing need for one assigned on a full-time basis.

NOAA Response: We concur. Evaluation of government vehicles will be completed in summer 2005.

Target Implementation Date: July 29, 2005

[redacted]