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Operations and Services
Hydrologic Services Program, NWSPD 10-9

RIVER FORECAST CENTER OPERATIONS

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SUMMARY OF REVISIONS: This directive supersedes NWS Instruction 10-911, "*River Forecast Center Operations*," dated October 1, 2014. Changes made to reflect the NWS Headquarters reorganization effective April 1, 2015.

The following revisions were made to this instruction:

1. In section 4.11, removed reference to rescinded Policy Directive 80-7

Signed 3/27/2017
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Director
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1 Introduction

This directive specifies national instructions on operations at River Forecast Centers (RFC) in National Oceanic and Atmospheric Administration's (NOAA) National Weather Service (NWS). It ensures basic consistency among all centers while providing flexibility to account for user requirements in each RFC area. Instructions on content of RFC products are described in NWS Instruction 10-912, *River Forecast Center Product Specification* and NWS Instruction 10-913, *River Forecast Center Product Examples*, as well as a few web-based products that are mosaicked to national scale and described in NWS Instruction 10-932, *National Hydrologic Web Products Specification*. This directive provides instructions on key RFC operations supporting provision of those products and services.

2 Staff Operational Responsibilities and Specialty Areas

Operational staff responsibilities specified here are common to all RFCs. Many centers have unique staff responsibilities which account for hydroclimatological characteristics and specialized requirements of core partners and other users in the RFC area.

2.1 Hydrologist In Charge

The Hydrologist in Charge (HIC) provides oversight and management for all activities in the RFC, and has ultimate responsibility for quality of services provided by the RFC. The HIC manages RFC involvement in cooperative efforts with Weather Forecast Offices (WFOs) and other NWS offices, as well as water-oriented agencies outside the NWS (e.g., universities, private sector groups, international groups). As needed, HICs participate in research and development activities, and work operational shifts as well.

2.2 Development and Operations Hydrologist

The Development and Operations Hydrologist (DOH) is part of the RFC management team, and among other managerial functions, directs the implementation and operational support for hydrologic and hydraulic forecasting technology employed at the RFC. The DOH is the point of contact for research activities at the RFC. These efforts include outreach, publication, and collaboration with science and research groups within NOAA, as well as partner agencies and academic institutions outside NOAA. The DOH also oversees training activities for the RFC staff, and ensures hydrologic training to the staff of supporting WFOs as requested. He/she works operational forecast shifts as needed.

2.3 Service Coordination Hydrologist

The Service Coordination Hydrologist (SCH) is part of the RFC management team and leads the RFC effort to (1) make partners and other users aware of NWS hydrologic capabilities, (2) seek out and understand partner/user needs, and (3) provide technical guidance to partners and other users. In coordination with WFO Service Hydrologists (SH) or Hydrologic Focal Points (HFP), the SCH provides WFOs with technical guidance and training assistance needed for effective hydrologic science and service outreach. The SCH also assists the HIC in interactions with

partner agencies, including other organizations within NOAA. He/she works operational forecast shifts as needed.

2.4 Senior Hydrologic Forecaster

Senior hydrologic forecasters serve as the lead hydrologic forecasters in daily RFC shift operations, and are ultimately responsible for timeliness and accuracy of the river forecasts issued by their shift. Senior hydrologic forecasters perform hydrologic forecasting operations as outlined in section 2.6 below. As needed, they may also work hydrometeorological analysis and support (HAS) shifts (outlined in section 2.7 below) if qualified per the Hydrology Professional Development Series 1 (PDS 1) and in accordance with local Office Training Plans (OTPs) (ref. NWS Instruction 20-106, *Office Training Plans*).

At the discretion of the HIC, a senior hydrologic forecaster may serve as the RFC's subject matter expert in a variety of specialty areas determined by the requirements of the RFC. Such specialty areas include flash flood hydrology, extended range streamflow forecasting, computer systems and their application to RFC operations, snow hydrology, dam failure hydrology, site specific hydrologic modeling at WFOs, hydrologic/hydraulic modeling techniques, ensemble hydrologic modeling, water supply forecasting, and hydrometeorological data systems. He/she may also provide training in these specialty areas to the RFC staff and, when requested, the staff at associated WFOs.

2.5 Senior Hydrometeorological Analysis and Support (HAS) Forecaster

The senior HAS forecaster serves as program leader for the RFC's HAS functions. Senior HAS forecasters perform HAS operations as outlined in section 2.7 below and may work hydrologic forecast shifts (outlined in section 2.6 below) as needed. The senior HAS forecaster guides the execution of hydrometeorological operations at the RFC and ensures that the necessary hydrometeorological training is available to other staff personnel. The senior HAS forecaster oversees development, maintenance, and implementation of computerized procedures used in hydrometeorological support operations. A senior HAS forecaster may be a subject matter expert in a hydrometeorological specialty area determined by the requirements of the RFC. She/he also provides operations-oriented hydrologic/hydrometeorologic training to the RFC staff and, when requested, the staff at associated WFOs.

2.6 Hydrologic Forecaster

Hydrologic forecasters perform the routine and specialized hydrologic forecast operations of the RFC in coordination with the SH, HFP or forecasters in associated WFOs, neighboring RFCs as applicable, the Weather Prediction Center (WPC) of the National Centers for Environmental Prediction (NCEP), and core partners within the water resources community. These include short-, medium-, and long-term streamflow forecast operations. Hydrologic forecasters participate in procedure development activities of the RFC. Those hydrologic forecasters that have had adequate hydrometeorological training (i.e., possess the skills to accomplish operational HAS duties as outlined in PDS 1 and in accordance with local OTPs) also work HAS shifts as needed. A hydrologic forecaster may also serve as a focal point for an area of specialization as determined by the HIC. She/he also provides hydrologic training to the staff at associated WFOs, when requested.

2.7 Hydrometeorological Analysis and Support Forecaster

In conjunction with the senior HAS forecaster, the HAS forecasters perform the basic hydrometeorological analysis and support functions at the RFC. These basic HAS shift functions include analysis and quality assurance of observed data (e.g., precipitation, temperatures), analysis of forecast data, such as quantitative precipitation forecasts (QPF), for use in the hydrologic modeling process; production of hydrometeorological discussions and other coordination products; and coordination activities with the SH, HFP or forecasters in associated WFOs, neighboring RFCs as applicable, WPC, and core partners within the water resources community. Qualified HAS forecasters (i.e., those that possess the skills to accomplish operational hydrologic forecast duties as outlined in PDS 1 and in accordance with local OTPs) may also work hydrologic forecast shifts as needed. HAS shifts during flood situations should generally be staffed by the HAS forecasters or senior HAS forecaster, with the remaining HAS shifts covered, as necessary, by other adequately trained RFC staff that possess the skills to accomplish operational HAS duties as outlined in the PDS 1 and in accordance with local OTPs.

HAS forecasters may provide advice and support to WFOs as needed. HAS forecasters also apply their meteorological expertise to specialized activities above and beyond the basic HAS functions such as QPF verification analysis and development and improvement of hydrometeorological procedures.

2.8 Hydrologic Intern

RFC hydrologic interns perform operational support and model implementation and maintenance activities designed to familiarize them with operations at the RFC and/or the WFO. Hydrologic interns may work at offices other than RFCs, such as a WFO or a regional/national headquarters office. Hydrologic interns participate in continuing education and professional development activities in hydrology and/or meteorology through NWS training mechanisms and university course work.

2.9 Hydrologic Technician

Hydrologic technicians at RFCs that employ them, conduct data collection and quality control activities. Hydrologic technicians at some RFCs also perform administrative assistant duties.

2.10 Information Technology Officer

Information Technology Officers (ITO) at RFCs that employ them, support the operational information technology and data communications needs of the RFC. They also develop new software procedures to enhance RFC services and improve efficiency.

3 Hours of Operation

As described in the following section, RFCs are available to provide 24-hours per day, 7 days per week service to their partnering water management agencies and supported WFOs. Their nominal staffing is 16 hours, 7 days per week, which can be extended to 24-hour operations when needed. RFCs designate off-hour contacts and establish procedures to ensure viability of mission-critical products and data systems during un-staffed periods.

3.1 Routine Hours of Operation

Nominal office staffing for RFCs is 16 hours per day and 7 days per week. Minor adjustments to nominal staffing and office hours are made to meet local requirements. At RFCs serving areas with climatologically-defined period(s) of low hydrologic activity, shorter hours of coverage may be provided if approval is given by regional headquarters.

3.2 Extension to 24-Hour Operation

During periods when moderate or greater flooding has begun or is expected, RFCs extend staffing to 24 hours per day. For periods of prolonged moderate flooding, 24-hour operations may not be necessary. For these cases, RFCs will coordinate with WFOs to determine the optimum hours of operation. In addition, following coordination with affected WFOs, RFC management may decide to extend RFC staffing: (1) during periods when minor flooding is observed or expected; (2) to provide hydrometeorological support during periods when flash flood events are either occurring or expected on a widespread basis; or, (3) to provide support for other significant hydrologic events (e.g., hazardous spill into a river).

3.3 Off-hour Contact

RFCs will establish procedures to be used by their supported WFOs for contacting RFC personnel during off hours to obtain hydrologic expertise or request RFC office staffing. These contacts will be achieved through a mutually agreeable mechanism and instructions for contacts will be shared with supported WFOs on a daily basis.

3.4 Continuous Product/Data System Viability

Per NWS Instruction 10-2201, *Backup Operations*, and associated regional supplements, procedures will be established to ensure the viability of mission-critical RFC products and essential data systems during all periods.

4 Routine Operations

RFCs provide river forecasts and hydrologic guidance to their partners, which consist of WFOs, NCEP service centers, other RFCs, and cooperating water-related agencies. The forecasts and guidance are used for the protection of life and property associated with flooding, and to provide water resource information to support commerce and economic decisions. Instructions on key components of RFC operations are presented below.

4.1 Incorporation and Analysis of Observed Data

Incorporation of stream stage/flow data and analysis of precipitation, temperature, and other hydrometeorological data from ground-based networks as required for the hydrologic modeling process are essential to RFC operations. WFOs support the quality control of data from ground-based networks which are utilized by the RFCs. RFCs also analyze gridded precipitation estimates from remote sensing technologies such as radar and satellite to form a mosaic of precipitation observations. Additional airborne observations of snow water equivalent and soil moisture from NOAA aircraft may be used to complement ground-based observations.

The mosaic of precipitation observations and remotely-sensed precipitation estimates form a quantitative precipitation estimate (QPE) for the RFC area. The QPE is provided to NCEP and associated WFOs as required to support forecast and warning operations and verification activities. RFC QPE products are made available to the public and media partners via the Internet.

When river stage observations are temporarily missing due to problems such as damaged equipment, RFCs may provide the estimated stage, Standard Hydrometeorological Exchange Format (SHEF)-encoded with a Type P (model-processed simulated estimate). If observer estimates are relayed from the WFO, RFCs will consider these in their analysis of the data or through the forecast process.

4.2 Use of Forecast Data

All RFCs use quantitative precipitation forecasts (QPF), temperature forecasts, and, where applicable, other forecast forcings as input to the hydrologic forecast system. HICs coordinate RFC requirements and schedules for NCEP QPFs and temperature forecasts with the regional headquarters and the Water Resources Services Branch in the Analyze, Forecast and Support Office. RFC requirements and schedules for locally-produced forecasts supplementing national forecasts, where deemed appropriate, are coordinated by regional headquarters with the HICs and affected Meteorologists in Charge.

4.2.1 Quantitative Precipitation Forecasts

RFCs in the conterminous United States receive QPF guidance from WPC and WFOs and make adjustments as necessary before entering it into their operational modeling system. Each RFC determines how far the time window extends into the future for incorporation of QPF into the hydrologic modeling system according to the hydrometeorological characteristics of typical events in its area of responsibility. RFCs coordinate with WPC and affected WFOs when operationally significant changes are made to QPF guidance. RFCs should be proactive in communicating the impacts of QPF on river forecasts with all affected NWS field offices, particularly when changes from previous model runs cause a rise to flood stage or change in flood category.

It has been found that NWS partners and the public may assume that NWS hydrologic forecasts incorporate the expected precipitation from approaching significant weather events that extends beyond the QPF time period used in the river forecasts. After evaluating possible outcomes for an approaching precipitation event (e.g., probability, storm track, timing) and it is considered likely that moderate or greater flooding would result (or continue), RFCs should extend the time window for QPF input to their operational hydrologic modeling system to an appropriately longer time period than usual. In such situations, RFCs should also consider extending their river forecast time horizon a number of periods commensurate with the extension in the QPF time window. At appropriate steps in the forecast process, using QPF for more time periods than usual in the hydrologic modeling system and/or extending the number of future time periods in their river forecast products will be coordinated with supported WFOs, neighboring RFCs as appropriate and core partners such as the U.S. Army Corps of Engineers (USACE). Such changes should also be coordinated with WPC and other users as appropriate. The decision on

the amount of QPF and number of future forecast periods to be used should ultimately reside with the RFC in partnership with supported WFOs, neighboring RFCs, WPC, and core partners.

The greater Mississippi River basin receives forecast support from several RFCs. RFCs in that basin and the overseeing regional headquarters will coordinate optimal QPF time windows to use in each center's river forecasts. Any differences in QPF time windows between the RFCs involved should have valid, scientific justification.

RFC QPF products are made available to the public and media partners over NWS-supported public dissemination pathways and are posted on the Internet.

4.2.2 Temperature Forecasts

Temperature forecast information needed in RFC hydrologic modeling operations is acquired through use of routinely issued products from NCEP and/or supported WFOs. However, RFCs may request specialized temperature forecast support from NCEP or WFOs if routinely issued products are insufficient for hydrologic modeling operations. RFCs should be proactive in communicating temperature forecast impacts to river forecasts with affected WFOs, particularly when such impacts result in a forecast rise to flood stage or changes in flood categories. RFCs supporting the Mississippi basin and the overseeing regional headquarters should coordinate to ensure consistency in temperature forecast time windows when/where applicable.

When it is considered likely that moderate or greater flooding will occur (or continue) and temperature is a significant factor, RFCs should evaluate the possibility of extending the time window for temperature forecast input to their operational hydrologic modeling system to an appropriately longer time period than usual. Use of temperature forecasts for more time periods than usual in the hydrologic modeling system should be coordinated with WPC, supported WFOs, neighboring RFCs as appropriate, partners, and other users.

4.3 Hydrologic Forecast Operations

Partner requirements, consistent with regional and national policy, are the predominant driver of RFC hydrologic forecast operations. The two primary partners for RFCs are NWS field offices (primarily WFOs) and external water-related agencies. During routine or extended hours of operation, RFC operational staff should maintain continuous situational awareness of changing hydrologic conditions by monitoring hydrologic and meteorological data. Forecasts should be updated when they fail to adequately represent current conditions. In order for WFO staff to effectively communicate forecast changes to the public, RFC hydrologic forecasters should communicate forecast reasoning for significant changes to the WFO as described in section 4.6.2.

4.4 Water Supply Forecasts

Seasonal and annual (for Western Region RFCs) water supply forecasts can be generated through the Ensemble Streamflow Prediction (ESP) system, Hydrologic Ensemble Forecast Service (HEFS) and/or regression-based procedures. In regions of the country with a substantial winter snowpack, forecasts for spring runoff are highly valuable to partners and other users and can be produced with a high degree of skill and reliability. This is a critical and well-established service in the Western U.S. where more than 70% of the annual precipitation falls as snow. In

the Western U.S., first-of-month forecasts may be coordinated with the Natural Resources Conservation Service (and in some cases other federal and state agencies) by long-standing agreement(s). Mid-month, preliminary, and updated seasonal forecasts typically do not require coordination but may be as locally agreed. Forecasts normally begin in January and continue through the peak snow melt period. Seasonal forecast periods (e.g., April through July) vary by watershed and are based on user requirements. Water supply forecasts are primarily disseminated through individual RFC web pages or regional web pages that combine the information from multiple RFCs.

4.5 Flash Flood Guidance Operations

Flash flood guidance (FFG) serves as key input to the evaluation of flash flood threat at WFOs. It also may serve as an index of soil moisture for some simplified WFO flash flood warning and forecast applications. RFCs will monitor the quality of their FFG, particularly as it relates to areas near shared RFC boundaries, and coordinate routinely to ensure FFG is as consistent as physically reasonable from one RFC area to the next. If significant rainfall or snowmelt renders FFG values unrepresentative, RFCs should update the FFG and coordinate with affected WFOs and RFCs.

4.6 WFO Support Operations

RFCs conduct several types of support activities with WFOs which facilitate effective execution of hydrologic services at both offices. These activities can be divided roughly between HAS function coordination activities and hydrologic forecast coordination activities. RFCs and WFOs are full partners in collaborating to achieve successful warning and forecast operations for every hydrologic event.

4.6.1 HAS Function Coordination

HAS function coordination encompasses interaction with other offices on hydrometeorological inputs to hydrologic operations (see section 2.6). The HAS function serves as a liaison with WFOs and the WPC to ensure the full utilization of hydrometeorological data in the hydrologic modeling process.

4.6.2 Hydrologic Forecast Coordination

RFCs support WFO hydrologic operations by providing expert advice and assistance on hydrologic forecasts when necessary. Coordination of hydrologic forecasts should include some discussion of the parameters significantly impacting the forecast, such as QPF, to assist the WFO in the warning decision process.

RFCs and WFOs have a variety of collaborative tools available to them, including Advanced Weather Interactive Processing System (AWIPS) messages, chat rooms, telephones, and the Internet. Incoming Hydrologic Coordination Messages (AWIPS identifier HCM) from WFOs should be set to alarm/alert at the RFC. More details on this hydrologic forecast coordination process are contained in NWS Instruction 10-921 - *Weather Forecast Office Hydrologic Operations*.

4.6.3 Hydrologic Model Support

If a supported WFO uses RFC model variable states as input to its site-specific hydrologic modeling system, the RFC should provide the appropriate variable states from its operational forecast system to the WFO each time the states are updated. This applies to variable states updated through incorporation of new hydrometeorological data or manual modification of the variable states themselves.

4.6.4 Staff Training

As feasible within the limitations of existing resources, RFC personnel participate in hydrologic training activities for WFOs when requested. Within these limitations, RFC personnel should visit their supported WFOs to provide training and observe WFO hydrologic operations.

4.6.5 RFC/WFO Collaboration

RFCs and WFOs should make collaboration and teamwork an intentional activity. Programs, initiatives, and ideas that advance NWS hydrologic services should be identified, recognized, and shared. Each RFC should work with its supported WFOs to develop a hydrologic collaboration plan to improve hydrologic forecasts and warnings, increase the sharing of technology and information, and support the education of partners and other users. Collaboration should also include pre-flood season readiness activities and post-flood service evaluations and development of service improvements.

4.7 Interagency Support and Forecast Exchange

RFCs have a variety of interactions with external water-related core partners in addition to their support for WFOs. These coordination responsibilities help fulfill the NWS mission by ensuring the hydrologic services program complements the water-related activities of other agencies. RFCs have considerable latitude to configure their forecast operations to meet the requirements of these external-NWS partners and to facilitate decision support services (DSS) activities as needed.

RFCs may exchange their forecasts directly with their core partners as part of the two-way information exchange process associated with hydrologic forecast operations. If any forecast values are subsequently changed through coordination with WFOs, RFCs should ensure that the updated forecast value(s) replace the old information stored in the RFC server/database accessed by the partners.

RFCs will maintain operational contacts with partners responsible for maintaining stream gaging stations (e.g., Water Science Centers of the U.S. Geological Survey (USGS)) in the RFC area. Prior to and during high flow events, real-time coordination occurs as much as possible between the RFC and streamflow measuring crews. Agencies and key personnel who perform operational maintenance of stream gaging stations are listed in RFC station duty manuals, and RFC phone numbers are provided to these agencies. RFCs also work with partners to provide efficient two-way exchange of routine information, including forecasts, data, rating tables, and rating extensions.

4.8 Outreach

RFCs cover large geographical areas and conduct outreach with a diverse base of partners and other users. These include USACE, USGS and the U.S. Bureau of Reclamation, water authorities and management districts, river basin commissions, state and federal emergency management offices, dam and reservoir safety groups, and universities. The SCH, under direction from the HIC, leads the outreach with these partners and other users. Outreach activities such as coordinating existing products and services, providing training on new products, and learning about emerging scientific techniques and technologies through these interactions play a vital role in RFC operations.

RFCs should frequently interact with their partners and other users to help determine user requirements and overall satisfaction with RFC products and services. This interaction may involve attendance and participation at conferences or meetings, on-site visits, or participation in hydrology-related outreach events.

As feasible within existing resource limitations, RFCs should also assist WFOs in efforts to provide hydrologic outreach and training to local and state partners and other users when requested. RFCs should coordinate with their supported WFOs on ideas and proposals for improving hydrologic services.

4.9 Forecast Verification

RFCs conduct operations in support of the verification of hydrologic forecasts. All national requirements for RFC verification activities are subject to availability of nationally-supported verification procedures. A generalized description of the RFC forecast verification process can be found in NWS Instruction 10-1601, *Verification*.

4.10 Data Archive

RFCs data archive operations are conducted to support verification and non-real-time operations. A recommended baseline of data sets to be archived at RFCs is contained in Appendix A.

4.11 Non-Real-Time Operations

Non-real-time operations are defined as those non-administrative, non-training-oriented activities which are conducted in support of operational forecast functions. These non-real-time operations, or *development activities*, are recognized as essential to maintaining the ongoing operational readiness of each RFC. Each RFC should allocate a significant amount of work hours for development activities, predominately in the area of model calibration and procedure development but also in other areas deemed important by the HIC.

5 Non-Routine Operations

Certain types of unusual events require a specialized operational response at RFCs. RFC responsibilities during these events are described in this section.

5.1 Dam Failures

WFOs serve as the point of issuance for hydrologic products associated with dam failures. The RFC role in these situations is primarily in the area of support, such as providing forecast information derived from the RFC dam break (DAMBRK) model or other sources for incorporation into the WFO dam catalog. RFCs also support WFO efforts to maximize use of simplified dam break model (SMPDBK) by providing advice, training, and expertise as appropriate.

5.2 Hazardous Materials (HAZMAT) Spills

When possible, RFCs provide estimates of time-of-travel for HAZMAT spills into rivers. They also support other NOAA-related missions when they can be of service.

5.3 Significant Event Reports

RFCs provide input to "For The Record" (FTR) significant event reports, as appropriate. This can be done in conjunction with the WFO for flood events, or individually to report events such as forecast support for a HAZMAT spill. See NWS Instruction 10-1603, *Significant Event Reporting*, for more information.

Appendix A – Data Sets for Archive at RFCs

This appendix provides a recommended baseline of data sets to be archived by RFCs. If a specific data type listed below is not applicable to a particular RFC, it does not have to be archived at that site. Other items not listed in this section may also be archived as the need is determined by individual RFC

1. All SHEF encoded real-time data stored in the IHFS database. All real-time data turned on by the location table in the IHFS database will also be turned on by the RAX (RFC archive) database and stored in their corresponding tables. This data includes but is not limited to precipitation, stage and discharge data.
2. For RFCs routinely producing QPE, archive QPE files in xmrg or GRIB format.
3. The multisensor product providing the best estimate of 1- and 24-hour QPE for the RFC area.
4. All non-precipitation Community Hydrologic Prediction System (CHPS) forcings (temperature, evaporation, etc.) in the format and time interval used by CHPS.
5. All 6- and 24-hour QPF files in xmrg or GRIB format.
6. All 1-, 3-, and 6-hour gridded FFG files.
7. CHPS archive, on an at least a weekly basis.
8. All digital precipitation array (DPA) files used by the RFC.
9. All rating curves and shifts used by a RFC.
10. All adjusted historical mean areal precipitation and temperature (MAP/MAT) files used for input into ESP.
11. All text products issued by the RFC. The official archive for products sent across the NWS gateway will be at National Climatic Data Center (NCDC).
12. Flood Outlook Product (FOP) graphics created by a RFC.
13. All ESP graphics and tables.
14. All files, if an RFC chooses to generate them, for multisensor precipitation estimator (MPE) fields such as, but not limited to, the following: radar mosaic, field bias radar mosaic, local bias radar mosaic, gage only analysis, satellite precipitation (SATPRE), multisensor mosaic, local bias multisensor mosaic, and height.