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Operations and Services
Hydrologic Services Program, NWSPD 10-9

HYDROLOGIC SERVICES PROGRAM MANAGEMENT

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SUMMARY OF REVISIONS: This directive supersedes NWS Instruction 10-901, “Hydrologic Services Program Management,” dated November 11, 2009. The following revisions were made to this instruction:

- 1) In Section 2.1.1, eliminates (k) Hydrologic Remote Sensing from the list of functions of the Office of Climate, Water, and Weather Services Hydrologic Services Division (OCWWS HSD), since the National Operational Hydrologic Remote Sensing Center (NOHRSC) function has been transferred to the Office of Hydrologic Development (OHD). Adds hydrologic remote sensing to the list of functions of the OHD in section 2.2.
- 2) In Section 2.1.5, adds a sentence describing the OCWWS Training Division’s role in managing the grant which supports COMET (Cooperative Program for Operational Meteorology, Education, and Training).
- 3) In Section 2.2, breaks out OHD functions into lettered bullets with descriptive, underlined sub-headings to parallel the format used for the Hydrologic Services Division.
- 4) In Sections 2.3 through 2.7, adds a descriptive, underlined sub-heading for each lettered bullet.
- 5) Revises the responsibilities listed in Sections 2.4 (Office of Operational Systems) and 2.5 (Office of the Chief Information Officer) to reflect the maturity of NOAAnet into OPSnet.
- 6) Changes the name of Section 3 from “Interdisciplinary Programs” to “Interdisciplinary and Partnered Programs” to reflect its broader content.
- 7) Adds the following sentence to the end of the introductory paragraph to Section 3: “Some of these efforts depend on NWS collaboration with other Federal, state, and local partners.”
- 8) Adds “Roles” subsections to Sections 3.1 (Advanced Hydrologic Prediction Service), 3.2 (Water Resources Forecasting), 3.3 (Flash Flood Program), and 3.4 (Flood Inundation Mapping Program).
- 9) Substantially expands and revises Section 3.4 (Flood Inundation Mapping Program) to reflect the increasing importance and visibility of this program.
- 10) Adds a new Section 3.5 on the NOHRSC Hydrologic Remote Sensing Program, which is a condensed version of what was previously provided in NWS Instruction 10-931.
- 11) Adds a new Section 3.6 on the NWS Flood Safety Program.

12) Throughout the directive, changes “national HSD” to “OCWWS HSD.”

(Signed)

June 9, 2011

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Date

Hydrologic Services Program Management

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1. Introduction. National Weather Service (NWS) Policy Directive 10-9 provides the high-level policies for the Hydrologic Services Program. This instruction explains how NWS Policy Directive 10-9 is implemented by providing a more detailed description of headquarters and field office activities required to support and carry out operations of the Hydrologic Services Program.

2. Hydrologic Services Program Activities. The Hydrologic Services Program is managed in accordance with Department of Commerce (DOC), National Oceanic and Atmospheric Administration (NOAA), and NWS policies. The Assistant Administrator for Weather Services has final management authority over the Hydrologic Services Program. Under oversight of the Assistant Administrator, several organizational units are responsible for aspects of the Hydrologic Services Program as identified in the following sections. Mission statements for these organizational units are provided in the [NOAA Organizational Handbook](#).

2.1 Office of Climate, Water, and Weather Services. The Office of Climate, Water, and Weather Services (OCWWS) is responsible for a wide variety of activities which support the NWS Hydrologic Services Program. OCWWS accomplishes these responsibilities through functions of its divisions as described in the following sections.

2.1.1 Hydrologic Services Division. In coordination with NWS regions, the OCWWS Hydrologic Services Division (HSD) manages the NWS Hydrologic Services Program through the following activities:

- a. Service coordination – coordinate issues and activities related to hydrologic services with NWS headquarters offices, NWS regional headquarters, NOAA, and Congressional offices.
- b. Interagency collaboration – coordinate technical, policy, and operational issues which impact hydrologic services with federal agencies having a complimentary water mission, as well as agencies having a vested interest in water resources.
- c. Outreach – conduct and participate in national-level outreach activities to increase external awareness on flood safety and the uses and benefits of NWS hydrologic services.
- d. Service requirements – compile and evaluate requirements received through national-level outreach activities and integrate them into national policies, plans, and requirements specifications.
- e. Field office requirements – assimilate field office requirements for hydrologic software systems acquired by the regional headquarters and others and provide them to the Office of Hydrologic Development (OHD), Office of Science and Technology, and other development entities. OCWWS HSD also provides appropriate developmental and management entities with requirements for computational hardware, communications, staffing, facilities, and observing systems needed by the Hydrologic Services Program.
- f. Service and operations policy – develop and maintain hydrologic service and operations policy through the National Directives System and other mechanisms.
- g. Service and operations planning – develop strategic plans for the enhancement and evolution of NWS hydrologic services and operations.
- h. Hydrologic systems support services – provide on-call support services for hydro-meteorological forecast systems used in river forecast centers (RFC) and weather forecast offices (WFO).
- i. Hydrologic data network services – work with other NWS entities and partners to maintain and expand the data network required for hydrologic forecast and warning services, including activities related to automated flood warning systems (AFWS).
- j. Training – Assimilate hydrologic training requirements of field office personnel and ensure development of needed national training. Also assist in the provision of hydrologic services-related training for field office personnel.
- k. National hydrologic information – provide information on national hydrologic conditions through the Hydrologic Information Center.

2.1.2 Meteorological Services Division. The Meteorological Services Division supports the Hydrologic Services Program by managing NWS weather services programs, serving as the primary link between the NWS and weather-sensitive industries, and developing the plans,

policies, and procedures for weather operations and services which support hydrologic forecast and warning operations.

2.1.3 Climate Services Division. The Climate Services Division supports the Hydrologic Services Program by developing the plans, policies, and procedures for climate and long-term weather forecasting services. They also oversee long-term forecast services which incorporate hydrologic information such as drought information statements.

2.1.4 Performance and Awareness Division. The Performance and Awareness Division supports the Hydrologic Services Program by conducting verification for river forecasts and flood/flash flood warning products. The Performance and Awareness Division manages the National Precipitation Verification Unit, which is responsible for verification of national quantitative precipitation forecast (QPF) products. The division also supports hazard awareness activities for extreme hydrologic events and manages the service assessment process initiated after events causing substantial loss of life and/or property such as regional floods.

2.1.5 Training Division. The Training Division supports the Hydrologic Services Program by overseeing the annual process of allocating training resources for hydrologic science, operations, and services. The Training Division's branches (NWS Training Center, Warning Decision Training Branch, and the Forecast Decision Training Branch) provide instructional resources covering operational hydrology. The Training Division also manages the grant supporting the Cooperative Program for Operational Meteorology, Education, and Training (COMET), which provides instructional resources focused on hydrologic science applied to operations. Close coordination occurs with the hydrologic components of the Branches and COMET to ensure the development and provision of hydrologic training materials meets the needs and requirements of the Hydrologic Services Program.

2.1.6 Observing Services Division. The Observing Services Division supports the Hydrologic Services Program by maintaining standards, policies, procedures, and plans for NWS surface and upper air observing services. Many of these observing systems provide data used in hydrologic operations and services.

2.1.7 Operations and Requirements Division. The Operations and Requirements Division supports the Hydrologic Services Program by processing requirements for the NWS systems infrastructure which supports hydrologic operations and ensuring they are addressed.

2.2 Office of Hydrologic Development. The OHD supports the Hydrologic Services Program through a number of activities, including:

- a. Hydrologic development – develop and maintain hydrologic/hydrometeorologic models, systems, and procedures in response to requirements provided by OCWWS HSD.
- b. Web page administration – oversee the development and implementation of the national hydrologic web presence which provides access to Advanced Hydrologic Prediction Service (AHPS) and Water Resources Forecasting products and information.
- c. Hydrometeorological data delivery – maintain the operational system used to provide operational data to NWS field offices – the Hydrometeorological Automated Data System (HADS).

- d. Hydrologic remote sensing – provide remotely-sensed hydrologic data products used by WFOs, RFCs, National Centers for Environmental Prediction (NCEP), and other users through the National Operational Hydrologic Remote Sensing Center (NOHRSC).
- e. Research and operations planning – develop strategic plans related to the evolution of hydrologic science, and the transition of hydrologic science research to hydrologic operations.
- f. Applied research – in collaboration with outside research institutions, cooperating agencies, RFCs, WFOs, and NCEP, conduct applied research activities needed to infuse new hydrologic science into the operational hydrologic systems at field offices.
- g. RFC development – oversee the RFC development process as described in directives under [NWS Policy Directive 80-7, River Forecast Center Development Management](#).
- h. Program management – The Director, OHD acts as the NOAA focal point for hydrology.

2.3 Office of Science and Technology. The Office of Science and Technology (OST) supports the Hydrologic Services Program through the following activities:

- a. Science and technology management – maintain overall responsibility for plans, programs, and development in NWS science and technology activities.
- b. Operational applications and systems development – plan and develop applications providing observed and forecast information used in hydrologic operations. The Meteorological Development Lab (MDL) within OST develops WFO applications used to produce selected hydrologic watch/warning/advisory products. MDL also supports the Model Output Statistics (MOS) software, which provides temperature forecast guidance used as input to RFC hydrologic models.
- c. Technology and applications integration – ensure that hydrologic technologies and applications developed by the OHD are integrated into operational NWS systems and address requirements for system upgrades to accommodate hydrologic needs.

2.4 Office of Operational Systems. The Office of Operational Systems (OOS) supports the Hydrologic Services Program through the following activities:

- a. Engineering services and infrastructure support – provide engineering software management, facilities, communications, and logistical services for NWS field offices.
- b. System management – manage NWS observing, forecasting, and dissemination systems required to conduct hydrologic operations and provide services.
- c. NWS Telecommunications Gateway operations – manage, operate, and supply software and data support for the NWS Telecommunications Gateway essential to the dissemination of public warnings, forecasts, guidance and observational data.
- d. Communications network management – administer and maintain an NWS-wide communications network (OPSnet).

- e. Systems security oversight – ensure security controls are in place to protect systems and data, including those used in the support of the Hydrologic Services Program. Ensure security controls are implemented for OPSnet at a moderate system level.
- f. System acquisition – manage the acquisition of large-scale systems which host operational hydrologic forecasting systems.

2.5 Office of the Chief Information Officer. The Office of the Chief Information Officer (OCIO) supports the Hydrologic Services Program through the following:

- a. Provide the key information technology (IT) planning for the NWS, including coordination and development of all NWS IT security and critical IT infrastructure activities.
- b. Develop, monitor, and coordinate the overall NWS systems architecture in close concert with the weather system architecture activities of the OST and develop hardware and software management policies and standards for the NWS.
- c. Provide overall planning and policy oversight for the NWS use of the Internet, and develop NWS telecommunications policies and guidance.

2.6 Regional Headquarters. Each regional headquarters has staff managing a regional hydrology program. Alaska Region provides hydrologic support for the Pacific Region. The regional director is the first-line supervisor of regional division chiefs, RFC hydrologists-in-charge (HIC) and WFO meteorologists-in-charge (MIC), and assigns hydrology program responsibilities for the region. Regional hydrology program responsibilities include but are not limited to:

- a. Hydrologic service delivery oversight – monitor and assess the practices, local policies, and performance of the hydrology program at each RFC and WFO in the region. This includes support for service hydrologist program leadership activities.
- b. Forecast improvement – direct and support improvements to RFC and WFO hydrologic modeling and forecast operations. This includes supporting hydrometeorological operations such as those for QPF and flash flood as well as overseeing routine WFO/RFC interactions and longer-term collaborative activities.
- c. Training – facilitate training activities specific to local field office requirements and hydro-climatologies in the region.
- d. Policy/procedure implementation – develop supplements to national directives for the Hydrologic Services Program. Ensure WFO and RFC compliance with regional directions on hydrologic/hydrometeorologic operations and services provided in supplements as well as all applicable national directives.
- e. Service, science, and operations planning – develop strategic plans for hydrologic service and science improvements within the region.

- f. Outreach – represent NWS, NOAA, and DOC in regional intra-agency, interagency, and river basin commission activities. Receive and assimilate service requirements from partners and other users in the region.
- g. National requirements – assimilate hydrologic systems and services requirements from WFOs and RFCs, conduct intra-regional coordination, and provide requirements to OCWS HSD per the established process. Coordinate regional data requirements and resolve hydrologic/hydrometeorologic data problems affecting hydrologic operations in the region=s WFOs and RFCs.
- h. Regional requirements – work with WFOs and RFCs to establish regional requirements (e.g., for data, hardware, etc.) for provision of hydrologic services. Work with other regional staffs to meet these requirements.
- i. Information exchange – work with WFOs, RFCs, and other regional headquarters to facilitate the sharing and exchange of information, procedures, software, and related items between field offices and regions.
- j. National headquarters interactions – represent Hydrologic Services Program concerns of the regional director and field offices to the NWS headquarters and provide regional input to procedures, plans, proposals, training, and other products developed by NWS headquarters.
- k. Service assessment – provide assessments of field office performance during significant hydrologic events to the regional director and/or NOAA/NWS management as appropriate.

Other regional headquarters functions support the hydrology program in areas such as training, observation/data collection, climate, verification, and system operations.

2.7 National Centers for Environmental Prediction. The NCEP collects global meteorological data and uses it to generate a wide variety of environmental guidance information. Individual national centers support the Hydrologic Services Program through activities briefly summarized as follows:

- a. NCEP Central Operations – executes the numerical analysis and atmospheric forecast models and ensembles of models used in everyday hydrometeorological analysis at RFCs and WFOs.
- b. Hydrometeorological Prediction Center (HPC) – produces the forecaster-developed QPF and probabilistic QPF (PQPF) products for all types of weather systems, including tropical systems. These QPF products are used as guidance by WFO and RFC forecasters, and after possible editing to account for local hydrometeorological conditions, serve as input to RFC models. The HPC provides gridded QPFs to WFOs, which serve as a starting point for production of QPFs for local use. The HPC also produces other products which assimilate hydrometeorological information on a national basis, including a flood outlook product and a flash flood hazards product.

- c. Environmental Modeling Center – develops, maintains, and improves the atmospheric models which produce the graphical and numerical output (e.g., forecast precipitation and temperature) used in short- and medium-term AHPS products.
- d. Climate Prediction Center – provides products quantifying how precipitation and temperature is expected to deviate from climatic averages through the long-term forecast period.
- e. Storm Prediction Center – produces event-based, short-term rainfall rate forecasts.
- f. Tropical Prediction Center – provides official NWS forecasts for the movement and strength of tropical weather systems.

2.8 River Forecast Centers. Each RFC conducts continuous hydrologic modeling of river basins, provides hydrologic forecasts and guidance, and carries out liaison activities with partners. RFCs assimilate hydrologic/hydrometeorologic data and forecasts from multiple sources including the NCEP, WFOs, and other partners, and use this information in real-time hydrologic modeling and forecast operations. Each RFC provides a range of hydrologic forecast and guidance products for one or more major river basins to WFOs and selected water agencies. Each RFC supports multiple WFOs. RFC operations are described in [NWS Instruction 10-911, *River Forecast Center Operations*](#) and RFC products and services are described in [NWS Instruction 10-912, *River Forecast Center Products Specification*](#).

2.9 Weather Forecast Offices. Each WFO provides hydrologic forecasts, warnings, and related products to partners and other users for its local area of responsibility. WFOs also provide gridded temperature and precipitation forecasts that can be used in RFC hydrologic models and forecasts. Service hydrologists and hydrology focal points serve as the hydrology program managers at each WFO. As part of an integrated mode of operations, the entire WFO operational staff participates in hydrologic activities, including issuing routine hydrologic products and collecting and quality controlling the hydrologic/hydrometeorologic data. WFO hydrologic operations are described in [NWS Instruction 10-921, *Weather Forecast Office Hydrologic Operations*](#) and WFO hydrologic products and services are described in [NWS Instruction 10-922, *Weather Forecast Office Hydrologic Products Specification*](#).

2.10 WFO/RFC/NCEP Operational Relationship. Managers at WFOs, RFCs, and the NCEP should encourage operational interactions between their operational staffs while recognizing the uniqueness of each entity's operations. Hydrologic modeling and hydrometeorological data technologies developed by the OHD are vital in supporting these interactions. The goals of these interactions are to further the NWS mission by: (1) integrating interrelated aspects of hydrologic and meteorologic science into WFO, RFC, and NCEP operations; (2) encouraging hydrometeorological collaboration activities between WFOs, RFCs, NCEP, and the OHD; and (3) supporting integrated operations, where appropriate, within field offices.

WFOs, RFCs, NCEP, and OHD should collaborate in the development of hydrometeorological applications such as flash flood models, precipitation processing algorithms, and QPF techniques. They should maximize the routine sharing of support, data, forecasts, and other information and collaborate in the development of procedures to enhance such exchanges.

NWS hydrologic forecasts on the short-term (out to 7 days), medium-term (7 out to 14 days), and long-term (2 weeks out to 3 months or more) time scales are heavily dependent on the effective coupling of hydrologic and meteorologic observations and forecast information from WFOs, RFCs, and NCEP. Quantitative precipitation estimates (QPE) from radar, satellite, and ground-based observations; snowpack information; QPF; temperature forecasts; and forecasts for other hydrometeorological variables serve as critical input to the hydrologic modeling process for all time scales. Extended-range meteorologic forecasts and predictions from global climate models are important input to long-term hydrologic forecasts.

The operational coupling of hydrologic and meteorologic observations and forecasts for all time scales requires effective real-time coordination between the RFCs, WFOs, and NCEP. The RFC hydrometeorological analysis and support (HAS) function is the catalyst for this coordination. However, RFC, WFO, and NCEP managers should ensure this coordination occurs through a team effort of their entire staffs. Key hydrometeorological coordination activities of these three partners can be summarized as follows:

- a. NCEP – provision of discussions and related products on current/forecast meteorological conditions and hosting of coordination conference calls during significant weather events.
- b. RFCs – collaboration with WFOs and NCEP on forecast parameters such as QPF, production of discussions on current/forecast hydrologic conditions, and notification of WFO and NCEP forecasters of important changes in current or forecast streamflow conditions. RFC coordination activities also include supporting WFO site-specific hydrologic modeling operations and providing technical expertise on hydrologic events and other water-related issues.
- c. WFOs – notification to RFCs when changing hydrometeorological conditions or special observations indicate the need for updated hydrologic forecasts and when data quality problems have been identified at specific gage locations.

Other joint coordination activities between these partners which managers should encourage include: pre-event conference calls, site visitations, joint training, workshops, collaborative research projects, flood drills, and collaborative preparation of long-term outlooks.

3. Interdisciplinary and Partnered Programs. The special hydrometeorological relationships and interdisciplinary programs described in this section need the support of all managers participating in the Hydrologic Services Program. Some of these efforts depend on NWS collaboration with other Federal, state, and local partners.

3.1 Advanced Hydrologic Prediction Service. AHPS is a national effort to provide enhanced hydrologic information and products through the infusion of new science and technology. The goal of AHPS is to improve river forecasts and flood warnings nationwide to meet the diverse and evolving needs of partners and other users. While it is a budget initiative with a defined life span and an accompanying set of goals, managers involved in the Hydrologic Services Program should address AHPS as an effort to modernize and energize all aspects of hydrologic services provided to partners and other users.

3.1.1 Roles.

3.1.1.1 Weather Forecast Offices. WFOs coordinate AHPS-related forecast services with local, county, and state partners and relay new requirements to RFCs and regional headquarters. WFOs assimilate and update much of the metadata which accompanies AHPS products, such as the location information for forecast points.

3.1.1.2 River Forecast Centers. The forecast information output from RFC hydrologic modeling systems serves as the foundation for AHPS products. RFCs coordinate AHPS-related forecast services with partners having comparable areas of responsibility such as river basin commissions and district or regional offices of Federal agencies, and relay new requirements to regional headquarters.

3.1.1.3 Regional Headquarters. Managers of hydrology programs in regional headquarters oversee AHPS activities of their field offices, participate in coordination meetings with partners in state or regional agencies with comparable levels of responsibility, and relay requirements for AHPS products and services to NWS headquarters.

3.1.1.4 NWS Headquarters. The AHPS program is managed by the OHD. The AHPS Program Manager in OHD conducts planning, administers the budget, and guides and tracks implementation for the program. OCWWS HSD assimilates service, science, and operational requirements for AHPS and provides prioritized requirements to OHD. OCWWS HSD also develops general operations concepts for AHPS as well as other plans for specific AHPS components.

3.1.1.5 AHPS Review Committee. Program planning, oversight, and resource allocation for AHPS is provided by the AHPS Review Committee (ARC). The ARC is comprised of representatives from NWS regional headquarters as well as OCWWS, OHD, OST, and NCEP.

3.2 Water Resources Forecasting. The Water Resources Forecasting activity builds on AHPS and other NOAA services and delivers new services at higher resolution (down to the neighborhood scale) with more information; such as soil moisture, soil temperature, snow pack, and surface runoff volume. It enables NOAA to provide nationally consistent water quantity and quality condition forecasts via: 1) a national digital database which assimilates hydrometeorological data and observations, and 2) an advanced modeling system which brings the current state of science to NWS hydrology.

The national digital database will integrate fresh water resource observations and analysis components such as precipitation estimates, snowpack analysis, and soil moisture data. The goal of this database is to increase the amount, type, and accuracy of water resources information for use within the NOAA and by partners and other users.

The advanced modeling system, known as the Community Hydrologic Prediction System (CHPS), engages NOAA and the external (federal and non-federal) research community in the advancement of water prediction science. CHPS builds on existing modeling capabilities, standard protocols, and open data exchange standards to develop a common suite of tools for making water predictions. CHPS will facilitate the sharing of data and algorithms between government, university, and private sector research groups. The goal is to use CHPS to develop and infuse new science to produce a new suite of high-resolution forecasts (including estimates of uncertainty) for streamflow, soil moisture, soil temperature, water quality, and many other variables directly related to watershed conditions.

3.2.1 Roles.

3.2.1.1 Weather Forecast Offices. WFOs coordinate services that can be provided through the water resources forecast activity with local, county, and state partners and relay new requirements to RFCs and regional headquarters.

3.2.1.2 River Forecast Centers. RFCs implement and maintain hydrologic modeling systems under the CHPS architecture and develop new modeling and data management capabilities following CHPS standards in collaboration with entities in the larger water community. RFCs coordinate services that can be provided by the water resources forecast activity with partners having comparable areas of responsibility, such as river basin commissions and district or regional offices of Federal agencies, and relay new requirements to regional headquarters.

3.2.1.3 Regional Headquarters. Managers of hydrology programs in regional headquarters oversee their field office's efforts in the water resources forecast activity and relay state/regional partner's requirements to NWS headquarters.

3.2.1.4 NWS Headquarters. The water resources forecast activity is managed by the OHD in conjunction with and through the same structure as the AHPS program. OCWWS HSD assimilates service, science, and operational requirements for water resources forecast services and provides prioritized requirements to OHD.

3.3 Flash Flood Program. The NWS Flash Flood Program was originally implemented in 1970. According to Operations Manual Letter 74-8, *Management of the Flash Flood Program*, dated March 21, 1974, the program was implemented to provide a flood warning service when timely stage forecasts cannot be provided by river forecast centers. This led to a program based largely on watch/warning products for areas, issued by weather offices and supported by areal RFC products known as flash flood guidance. Because heavy precipitation from convective weather systems is the primary cause of flash floods, and watches and warnings are most often handled on a defined area basis like other weather events, a meteorological perspective has historically prevailed in the Flash Flood Program.

Collaborative efforts to improve flash flood guidance, short-term QPF, and QPE have led to more timely areal flash flood products. However, forecasting technologies which improve the site-specificity and information content of warning products are allowing flash flooding to be increasingly addressed from a hydrologic perspective. These technologies include:

- a. The Flash Flood Monitoring and Prediction (FFMP) function, which provides the ability to pinpoint individual basins threatened by flash flooding.
- b. The Site-Specific Hydrologic Prediction (SSHP) function, which allows products to include stage/flow forecasts for specific locations in small stream basins.
- c. Distributed rainfall-runoff models, which allow hydrologic processes to be more realistically simulated in stream basins of all sizes.

AHPS supports these and other technologies used in the Flash Flood Program. National headquarters, regional headquarters, and field offices accounts for the application of geographic

information systems (GIS), hydrologic science, and computer modeling in determining the decision support infrastructure for the Flash Flood Program.

3.3.1 Roles.

3.3.1.1 Weather Forecast Offices. WFOs are the point of issuance for flash flood watch/warning and associated follow-up products. WFOs use applications such as the Flash Flood Monitoring and Prediction: Advanced (FFMPA) and Site Specific Hydrologic Predictor (SSHP) in their flash flood operations and provide on-station upkeep of these systems. Some flash flood applications are developed at local WFOs and their use eventually spreads to other WFOs.

3.3.1.2 River Forecast Centers. RFCs provide the gridded guidance used in WFO flash flood operations. This guidance reflects or at least indexes the conduciveness of the ground, as affected by soil moisture or other surface characteristics, to producing flash flooding in response to precipitation.

3.3.1.3 Regional Headquarters. Regional headquarters manage RFC and WFO support for flash flood operations and provide appropriate regional procedures and policies.

3.3.1.4 NWS Headquarters. NWS Headquarters manages the national Flash Flood Program and provides appropriate national procedures and policies. NWS headquarters develops flash flood applications and transitions appropriate tools and techniques from the research to operational environment. The OCWWS Performance Branch supports the software and databases used in flash flood warning verification and OCWWS HSD monitors and reports on verification statistics.

3.4 Flood Inundation Mapping Program. The NWS has undertaken an expanded effort to provide information on the spatial extent and depth of flood waters in the vicinity of NWS river forecast locations. The key product of this program is a web-based flood inundation mapping interface which allows users to display maps for various levels of flooding including observed and forecast stages, user-selected stages, and established flood categories. The maps can be used to show if roadways, streets, buildings, airports, and other structures are likely to be impacted by floodwaters. Combined with river observations and NWS forecasts, these maps enhance the communication of flood risk and provide users additional information for mitigating the impacts of flooding and building more resilient communities.

There are four critical phases in the implementation of flood inundation maps: (1) Planning/ Scoping – identifying users who need such maps for NWS forecast locations and are willing to partner with the NWS in their development, (2) Hydrologic/Hydraulic/Geospatial Analyses – performing the engineering, scientific, and technical analyses necessary to produce a map, (3) Implementation – making the map available through the interface in the NWS’s hydrologic web presence (AHPS web pages), and (4) Maintenance – providing changes and updates necessary to keep a map current.

3.4.1 Roles. Since the development of flood inundation maps involves significant financial resources, human capital, data requirements, and data analysis, NWS works with partners who can contribute financial resources and technical mapping expertise towards the development of flood inundation maps for new areas. Offices at all levels of the NWS contribute to the process. For each river location or group of locations for which maps will be developed, a project team is

formed consisting of WFO, RFC, and regional headquarters personnel and the technical mapping partner.

3.4.1.1 Weather Forecast Offices. WFOs demonstrate the benefits of flood inundation maps to local and state partners and identify those who want to work with the NWS to develop flood inundation maps. WFOs assist in evaluating the feasibility of creating flood inundation maps for specific locations in their areas of responsibility. They coordinate with partners to acquire the supporting data required to develop flood inundation maps and provide these data to the project team. WFOs review the final flood inundation maps and use them to review and revise the impact information associated with local forecast locations which they provide through the NWS hydrologic web presence and in flood products.

3.4.1.2 River Forecast Centers. RFCs demonstrate the benefits of flood inundation maps to their partners with regional responsibilities, such as river basin commissions and district offices of Federal agencies, and identify those who want to work with the NWS in this effort. RFCs assist in evaluating the feasibility of creating flood inundation maps for specific locations in their areas of responsibility. They implement and maintain the modeling infrastructure necessary to support new forecast locations as necessary. RFCs evaluate the GIS shapefiles and the hydraulic model output used in the development of flood inundation maps. They also participate in the final review of flood inundation maps.

3.4.1.3 Regional Headquarters. Regional headquarters oversee WFO and RFC efforts to seek out partners interested in establishing flood inundation maps for specific locations. Once partners have been identified, they notify NWS headquarters and begin coordinating the next steps in the development process with the partners and NWS headquarters. Regional headquarters manage flood inundation mapping projects, serving as the central point of coordination. They coordinate requests for various types of supporting data with WFOs and RFCs. They communicate quality control and quality assurance (QA/QC) standards for supporting data and sign off on final QC reviews (note: regional headquarters may designate an RFC to perform some of these functions).

3.4.1.4 NWS Headquarters. Funding support for enhancement of the NWS AHPS Flood Inundation Mapping Web Interface, updates to the NWS AHPS Flood Inundation Mapping Guidelines, and training is determined through ARC and managed by OHD. The National Flood Inundation Mapping Services Leader within OCWWS HSD leads the national effort to implement flood inundation maps and enhance this program. He/she leads a team of representatives from regional headquarters, WFOs, and RFCs which performs the following functions:

- Collect and prioritize requirements for development and enhancement of flood inundation maps;
- Provide program management support to regional managers, WFOs, and RFCs;
- Advise regional headquarters and partners on the collection and QA/QC of required supporting data;
- Prioritize and schedule map development with the AHPS program;
- Monitor the actual development of maps and reports status to the AHPS program;

- Work with regions to ensure quality of the final product; and
- Ensure that required training is provided to WFOs, RFCs, and regional headquarters personnel.

3.5 Hydrologic Remote Sensing Program. OHD maintains the National Operational Hydrologic Remote Sensing Center (NOHRSC) in Chanhassen, Minnesota. The NOHRSC (a.k.a. “the Center”) is collocated with the North Central RFC and Minneapolis/St. Paul WFO. A complete backup facility is maintained in Hanover, New Hampshire. RFCs and WFOs serving areas where seasonal snow cover is a significant hydrologic variable use products and services provided by the Center when developing a variety of hydrologic products such as spring flood outlooks, water supply outlooks, river and flood forecasts, and reservoir inflow forecasts. Additionally, the Center provides and supports GIS data sets and applications used by the RFCs in generating automated hydrologic forecast basin boundaries.

3.5.1 Information Sources. The NOHRSC maintains an airborne snow survey program that provides airborne snow water equivalent data for portions of 31 states and 8 Canadian provinces. The Center ingests a broad variety of point, gridded, and modeled data sets from various sources within NOAA including: the National Environmental Satellite, Data, and Information Service (NESDIS); NCEP; Forecast Systems Laboratory (FSL); and the NWS Advanced Weather Interactive Processing System (AWIPS). The Center ingests Landsat and near-real-time, Advanced Very High Resolution Radiometer (AVHRR), MODerate resolution Imaging Spectroradiometer (MODIS) satellite data via the internet. Additionally, the Center receives data sets from other Federal, state, and Canadian cooperators.

3.5.2 Operations. Remotely sensed and simulated snow cover products, provided through the four NOHRSC programs described in this section, support the Hydrologic Services Program.

3.5.2.1 Airborne Gamma Radiation Snow Survey Program. The NOHRSC uses low-flying aircraft to make near real-time, airborne surveys of snow water equivalent over large regions of the country where snow is a significant hydrometeorological variable. The same technology is used to survey soil moisture conditions.

3.5.2.2 Satellite Hydrology Program. The satellite hydrology program uses data from polar orbiting satellites to map areal extent of snow cover and flood inundation, in near real-time, over the coterminous U.S. and Alaska. Satellite-based products are produced and made available in image format in a reasonable time frame after satellite overpass. Satellite derived areal extent of snow cover is assimilated into the Center’s snow model.

3.5.2.3 Snow Data Assimilation Program. The snow data assimilation program simulates gridded snow water equivalent and other snow pack properties using a distributed energy-and-mass-balance snow model known as the SNODAS (SNOW Data Assimilation System). Output from a mesoscale atmospheric model is used to force the snow model. All available ground-based, airborne, and satellite-derived snow observations are assimilated by the SNODAS to produce a “best” gridded-field estimate of snow water equivalent and other snowpack properties.

3.5.2.4 Geographic Information System Support Program. The NOHRSC uses high-resolution GIS databases in carrying out its mission to produce remote sensing and simulated gridded snow pack products. The Center provides GIS-based applications and data sets to RFCs and WFOs in

support of hydrologic modeling and flash flood operations, such as the Integrated Hydrologic Automated Basin Boundary System (IHABBS) and associated data sets, which are used by RFCs when generating, updating, modifying, or editing hydrologic basin boundaries. RFCs provide their finalized basin boundaries to the NOHRSC, which makes them available for use in AWIPS, NEXRAD, and other applications.

3.5.3 Products and Services. The NOHRSC generates products and data sets in a resolution, format, and time frame required to support the NWS Hydrologic Services Program. Products are distributed, in near real-time, over AWIPS to NWS users and over the Internet to all users at: <http://www.nohrsc.noaa.gov> or via an FTP-based data subscription service. Information on NOHRSC products and links to these products are provided in [*Hydrologic Information on the Web: A Manual for Users.*](#)

3.5.4 Roles. In carrying out its mission, the NOHRSC interacts with NWS offices and external entities according to guidelines in the following sections.

3.5.4.1 River Forecast Centers. The NOHRSC coordinates operational snow pack modeling and assimilation, airborne snow survey, and satellite data collection schedules and activities with appropriate RFCs. These RFCs incorporate NOHRSC-assimilated data into their hydrologic modeling and forecast operations. In interacting with the NOHRSC, RFCs are responsible for: (1) requesting specific basins where satellite snow cover mapping is needed, (2) requesting establishment of new flight lines, and (3) providing requirements for airborne snow measurements to be taken for existing flight lines. RFCs work with their supported WFOs to ensure that all ground-based snow data collected by WFOs (e.g., snow water equivalent, snow depth, and snow density) are encoded in SHEF and distributed over AWIPS for use by the NOHRSC snow data assimilation program and incorporation into SNODAS. The NOHRSC interacts with RFCs to provide IHABBS software and database support upon request.

RFCs may request emergency or non-scheduled airborne snow surveys in coordination with their supported WFOs and regional headquarters. When possible, these requests should be submitted to the NOHRSC seven to ten days before the required survey date. Meeting requests with shorter lead-time may cause schedule conflicts with other airborne surveys. In evaluating conflicting requests involving two or more areas, the criticality of airborne data to the hydrologic forecasting effort for each area should be evaluated in coordination with the affected offices and regional headquarters.

3.5.4.2 Weather Forecast Offices. Through their supporting RFCs, WFOs request: (1) specific basins where satellite snow cover mapping is needed, (2) establishment of new NOHRSC flight lines, and (3) emergency snow surveys on existing on existing flight lines. Additionally, WFOs encode all available ground-based snow data (e.g., snow water equivalent, snow depth, and snow density) in SHEF products which are distributed via AWIPS and used in the Center's SNODAS model. WFOs incorporate NOHRSC data into products disseminated to the public, mass media, partners, and other users.

3.5.4.3 Regional Headquarters. Before the onset of cold weather each year, the NOHRSC holds planning meetings at the regional level to lay out schedules for airborne data collection during the snow accumulation season and to coordinate SNODAS-related activities. The Center provides regional headquarters with information of concern to WFOs and RFCs regarding

NOHRSC status and products. Regional headquarters, or the RFCs as delegated by regional headquarters, provide requirements to the NOHRSC for model-, airborne-, satellite-, and GIS-based products within the regions. Cancellations of scheduled airborne survey missions are coordinated with regional headquarters as well as affected RFCs and WFOs. Hydrology program managers in regional headquarters relay information on NOHRSC status and products to their regional directors and resolve conflicting requests for airborne surveys from field offices located in the same region. Conflicting schedule requests between regions should be resolved through coordination and if necessary, are resolved by the OHD Director.

3.5.4.4 Office of Hydrologic Development. The Chief, NOHRSC provides reports on status of the Center to the Chief, Hydrology Laboratory in the Office of Hydrologic Development. These status reports include data collection schedules, airborne and satellite data sets, program accomplishments, and future plans.

3.5.4.5 NOAA Aircraft Operations Center. The NOHRSC coordinates with the NOAA Aircraft Operations Center to ensure that suitable, reliable, snow survey aircraft and NOAA Corps pilots are available to support the airborne snow survey program.

3.5.4.6 Local, State, Federal, and International Agencies and Commissions. The NOHRSC maintains contacts with key local, state, and Federal agencies and organizations across the U.S. and Canada. Periodic contacts are required to ensure the appropriate exchange of data, products, and technology between the NOHRSC and these external interests. The Center represents the NWS and NOAA at various local, state, Federal, and international agencies and commissions on issues associated with the generation and use of satellite and airborne remotely sensed data, the simulation of snow pack properties for the U.S. using an energy-and-mass-balance snow model, and operational products used in the NWS Hydrologic Services Program.

The Center serves as a liaison between the NWS and Natural Resources Conservation Service (NRCS). The Center maintains a database of reference information on NRCS SNOWpack TELEmetry (SNOTEL) and snow course observation locations. This reference information is made available to WFOs and RFCs upon request.

3.5.4.7 Commercial and Private Sectors. The NOHRSC distributes gridded snow pack products to interested commercial and private sector stakeholders via a public-facing website (<http://www.nohrsc.noaa.gov/>) and an FTP-based data subscription service.

3.6 Flood Safety Program. Over 75 percent of all Presidentially declared disasters are at least partially related to floods. On average, floods cause about 100 deaths per year and over 7 billion dollars in damage. Destructive flooding can affect any area of the U.S. and its territories. To help Americans guard against the dangers of flooding, the NWS has a Flood Safety Program aimed at arming America's communities with the safety skills necessary to save lives and property.

3.6.1 Roles. The NWS supports flood safety activities at several organizational levels to increase the American public's awareness of the dangers of flooding.

3.6.1.1 Weather Forecast Offices. WFO hydrology program managers, with the support and oversight of warning coordination meteorologists (WCM), perform the vital flood safety

outreach activities at the local level. Key flood safety outreach activities of warning coordination meteorologists and hydrology program managers include:

- Establishing and maintaining the necessary flood coordination and information sharing mechanisms between the WFO and local, county, and state emergency managers and other government officials.
- Leading flood safety activities at schools and community/city/county events.
- Working with news media outlets in the WFO area to help them disseminate the most useful flood safety information.
- Developing flood safety programs and materials tailored to the pressing hydrologic issues faced in the local WFO area. For example, the phrase “Turn Around Don’t Drown®” was originated by a WFO as part of a new outreach effort.

3.6.1.2 River Forecast Centers. RFC outreach is primarily of a technical nature and involves partners and other users operating on the large river basin scale, but on occasion RFC service coordination hydrologists may support the flood safety efforts of WFOs.

3.6.1.3 Regional Headquarters. Managers of hydrology programs at regional headquarters provide leadership, expertise, and financial support for WFO flood safety efforts. They document best practices to ensure that highly effective flood safety efforts developed by individual WFOs are known and available to all of their field offices.

3.6.1.4 National Headquarters. National outreach focuses primarily on enhancing relationships with national headquarters of other Federal agencies and supporting outreach efforts of regional headquarters and field offices. National outreach is led by the National Hydrologic Outreach Program Coordinator in OCWWS HSD. Flood safety activities of the National Hydrologic Outreach Program Coordinator include:

- Ensuring NWS hydrologic services outreach activities and information meet the changing needs of our diverse partners and other users.
- Planning and participating in training, education, and outreach activities such as user forums, workshops, and conferences.
- Developing, disseminating, and maintaining outreach information such as brochures briefings, user guides, videos, and web-based resources.

3.6.2 Outreach Materials. Nationally developed hydrologic outreach brochures are stored in the National Logistics and Supply Center in Kansas City, MO. Requests for outreach materials should be made directly to the center by calling (816) 926-7794. Two internet web sites ([AHPS Toolbox](#) and the [TADD Toolbox](#)) also contain hydrologic outreach resources. These include Fact Sheets, online versions of DVDs, printable brochures and flyers, educational links, magazine articles, and publications.

3.6.3 Flood Safety Awareness Week. [Flood Safety Awareness Week](#) occurs each year, typically during March. This national campaign is aimed at raising the awareness to the dangers

of flooding and ways to protect property. In the past, typical themes have been: 1) Advanced Hydrologic Prediction Service; 2) Turn Around Don't Drown®; 3) Floods, Droughts, and other Related Phenomena; 4) Flood Insurance; and 5) Flood Safety.

3.6.4 Turn Around Don't Drown®. The flood safety phrase “Turn Around Don't Drown®” is a registered trademark of NOAA, U.S. Department of Commerce (Trademark Registration Numbers: 2,853,276 and 2,853,277). This phrase is used in many outreach efforts aimed at reducing the number of vehicle-related drownings, injuries, and water rescues during flood events. NWS employees may use this phrase in any official flood safety activity. Policies and procedures on use of the phrase “Turn Around Don't Drown®” by internal (i.e., NOAA/NWS employees) and external entities (i.e., non-NOAA/NWS employees and NOAA/NWS employees working in an unofficial capacity) are provided in a separate document which can be found [here](#).