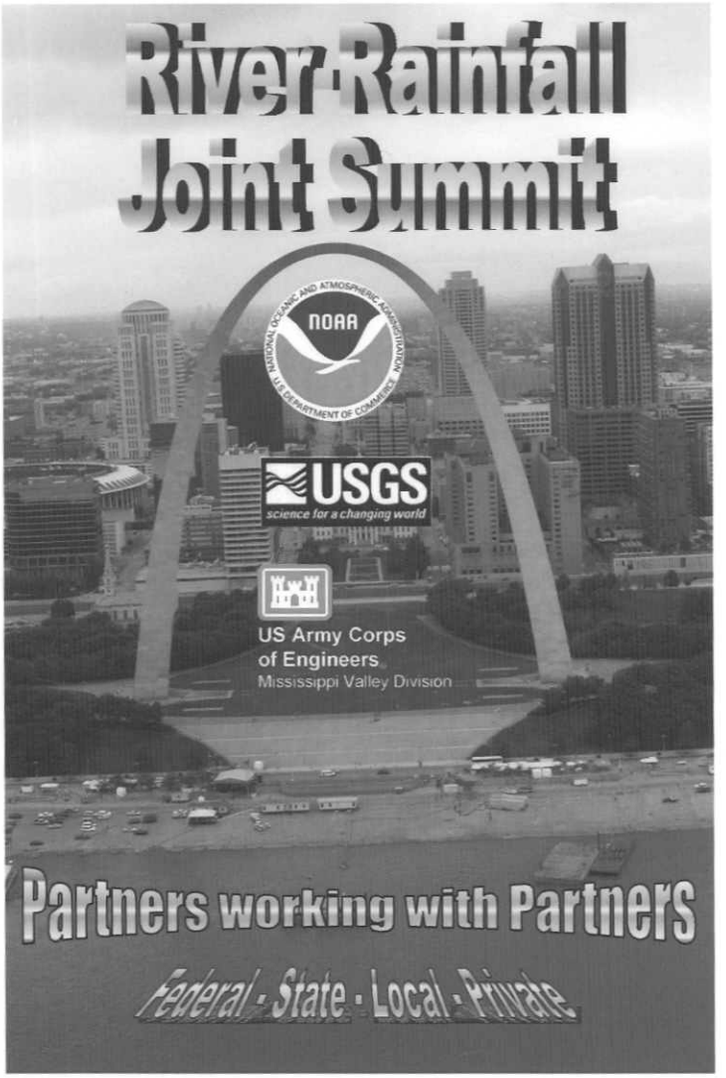

RAINFALL-RIVER FORECASTING SUMMIT REPORT
1 DECEMBER 2008

Rainfall-River Forecasting Summit Report

Summit Report Purpose: The purpose of this report is to provide a summary of the Rainfall-River Forecasting Summit hosted by the U.S. Army Corps of Engineers (COE), the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Geological Survey (USGS) in St. Louis on October 7 and 8 to discuss (1) what went well with forecasting during the recent 2008 flood events, (2) what did not go well, and (3) improvements that each agency can make individually and collectively for future floods and low flow events. Agencies agreed on the following:

What Went Well:

- **Coordination** – Coordination between Federal agencies, Corps of Engineers' Divisions, Districts, State & Local Government, Industry Groups, and the public during the floods was conducted extremely well.
- **Data Exchange** – Access to real-time and historic data was/is available on various websites (Rivergages.com, NWS website, USGS website).
- **New Products** – The three agencies have several new products which were used this year such as NWS Ensemble forecasts, Rating Curve Depot, NEXRAD, real-time satellite imagery.
- **Instrumentation** – The USGS used rapid deployable temporary gages. New instrumentation is being developed.
- **Personnel** – Cross training of personnel, deployment of personnel between agencies, co-location of agencies improved coordination between the three agencies.
- **Resources** – Resources were used appropriately, putting them where they were needed
- **Rainfall Forecasting** - Rainfall forecasting accuracy has consistently gone up 1.5% per year for the last 44 years. September 2008 was the most accurate in forecasting rainfall for that period.
- **Special Discharge Measurements –** the USGS made many special discharge measurements throughout the Midwest to better define and document the flooding. In June 2008 alone, the USGS made 450 special discharge measurements.

What Did Not Go Well:

- **Rainfall** – Due to repetitive, convective storms over a period of several days and weeks, more rainfall occurred than forecast resulting in record river stages which were not initially forecast. This resulted in lead times to crest being less than public expectations.
- **River Forecasts** - Several differing forecasts from USACE and NWS for the same reach of river occurred. Public expectations of river forecast for accuracy and speed are increasing faster than we are improving forecasts. Some customers want a single deterministic forecast while others want a range of forecasts (probabilistic). Levee failure impact forecast models didn't exist until 1993, but are not working as well as hoped. Public confusion on lower river forecasts

and NWS impact statements still exists. For the Mississippi River at Baton Rouge, people were concerned the Louisiana State University (LSU) campus was going to flood. In collaboration with officials at LSU and the former state climatologist, the impact statements were reviewed and updated during the event.

- **Public Involvement** – The three agencies did not fully engage stakeholders in keeping them more abreast of the latest flood information such as levee overtoppings. The navigation industry thinks our methods of depth forecasts are inadequate. The public and navigation industry is concerned that we missed these forecasts. Our stakeholders want to be kept well informed.

- **Information Exchange** – There was difficulty in retrieving information at times and delays in forwarding critical information i.e., levee breaks/overtopping. For the NWS web page, there were difficulties in getting consistent information from one office to another (e.g., the LMRFC website posts a summary with 5-day forecast for the Ms River (see http://www.srh.noaa.gov/lmrfc/forecast/rva.shtml) twice a day as well as for the 28-day forecast (http://www.srh.noaa.gov/lmrfc/forecast/esp.shtml) info once a week. This is not available from other River Forecast Centers (RFCs). There is a need to get river forecast summary info from one end of the Mississippi River to the other in a timely manner.
- **Data** – Conflicting discharge measurements occurred above 1,000,000 cfs using differing methods for the Mississippi River at Tarbert Landing. The loss of critical gages at or near the crest occurred and some flood impact statements on NWS Websites were inaccurate and need to be updated. (To the extent possible, updates to impact statements were done while the event was ongoing.)

What Improvements Can Be Made By The Agencies For Future Events:

- **Discharge Measurements** – Critical discharge ranges need to be established. We need to look at our procedures to get these measurements. We need consistent procedures for discharge measurements for the Mississippi River at Tarbert Landing for flows above 1,000,000 cfs.
- **Rating Curve extensions issues need to be addressed** - Curves should be extended before extreme events occur. Some Corps rating curves need updating.
- **Obtaining stage info** – We need to educate people on how to get stage info and ensure all have access to historical gauges info on the COE rivergages.com website.
- **Probability Forecasting** – The "wave of the future" is in Ensemble and Contingency forecasting.
- **Instant Messaging** – We must utilize cross-agency instant messaging to relay critical information, such as levee overtopping/breaching as soon as they're identified.
- **Develop a protocol for Phone Conferences** – Fewer phone calls will be more efficient and will allow info to be received in a more timely manner.
- **Technical experience –** We must develop the means to capture experience from retiring personnel and transfer to newer personnel.

- **Training –** We will explore execution of a "Flood Exercise" before the next flood happens, including developing an essential elements list for use during floods.
- **Data Collection –** We will coordinate a plan for installation of temporary gages in needed locations or damaged gage replacement

Public Meeting Purpose: A public open house on 8 October 2008 was conducted to hear concerns from industry and interested members of the public on rainfall-river forecasting issues. Prior to the statements from the public the following overview of each agencies roles and responsibilities were presented:

Agency Roles and Responsibilities

National Weather Service
The National Weather Service roles and responsibilities in rainfall-river forecasting: The National Weather Service provides hydrologic forecasts and warnings for the United States, its territories, and adjacent waters and ocean areas, for the protection of life and property and the enhancement of the national economy. Legal authority and responsibility for the National Weather Service to issue flood forecasts, watches and warnings to the public can be found at 15 U.S.C., Section 313 of the United States Code, available at: http://www.gpoaccess.gov/USCODE/index.html . National Weather Service data and products form a national information database and infrastructure which can be used by other governmental agencies, the private sector, the public and the global community. The River Forecast Centers provide river forecasts and hydrologic guidance to their partners, which consist of Weather Forecast Offices, other River Forecast Centers and cooperating water-related agencies. The Weather Forecast Offices disseminate river/flood forecasts and warnings which are used for the protection of life and property, and to provide water resource information to support commerce and economic decisions. To access National Weather Service river forecasts across the country: http://www.weather.gov/ahps/ . For more information contact: noreen.schwein@noaa.gov

United States Geological Survey
The United States Geological Survey roles and responsibilities in rainfall-river forecasting: Making wise decisions to manage floods and their impacts requires information derived from data on stream behavior—both current and past. For more than 100 years, the U.S. Geological Survey has collected, managed and disseminated these data, measuring and reporting on the behavior of United States streams. The USGS currently operates and maintains a nationwide streamgaging network of about 7,500 gages in cooperation with more than 850 organizations. The annual cost of operating the national streamgage network is about $130 million. USGS provides streamflow data to numerous agencies, including the Corps of Engineers for flood control management and the National Weather Service for input to river forecast models. USGS streamflow data are used for such things as: (1) planning, designing, operating and maintaining the nation's multipurpose water management systems; (2) issuing flood warnings to protect lives and reduce property damage; (3) designing highways and bridges; and (4) mapping

floodplains. Real-time streamflow data are available at: http://waterdata.usgs.gov/nwis/rt and are used by various organizations and emergency managers to better respond to floods as they occur. During major floods, the USGS enters a mode of intensive data collection. This additional information is needed to provide improved estimates of risk and impacts for better hazard response and mitigation. Information collected includes systematic field surveys of precipitation, river stage, river discharge, and water quality. In addition, temporary streamgages are deployed during floods to ensure adequate data are available for forecasting and response activities in critical locations where there are no permanent streamgages. For more information contact: Mike Norris (mnorris@usgs.gov).

United States Army Corps of Engineers

The United States Army Corps of Engineers Roles and responsibilities in rainfall-river forecasting: The U.S. Army Corps of Engineers is a significant steward of the nation's water resources and is responsible for all water control activities to achieve project purposes such as flood control, water quality, water supply, irrigation, navigation, hydropower, recreation, and fish and wildlife enhancement. The Corps is responsible for "management" of these activities, which requires expert knowledge of the engineering and scientific aspect of the work and water control management policies. In carrying out water control activities, the Corps recognizes and observes the legal responsibility of the National Weather Service, National Oceanic and Atmospheric Administration, for issuing weather forecasts and flood warnings, including river discharge and stage forecasts. The Corps of Engineers has the responsibility for developing situational forecasts for the operation and maintenance of the Corps projects and to provide timely and accurate information to the National Weather Service for their use in developing official public forecasts. The Corps is also responsible for coordinating with other agencies and providing relevant, coordinated forecasts to Corps of Engineers flood fight teams. For more information contact: robert.t.anderson@usace.army.mil

Public Meeting Panel Members

The public meeting featured a panel comprised of the following members:

Senior representatives

NWS – Dr. James E. Hoke
Director, Hydrometeorological Prediction Center National Centers for Environmental Prediction

USGS – Stephen F. Blanchard
Chief, Office of Surface Water

Corps - Brig. Gen. Michael Walsh
Commander, Mississippi Valley Division

Technical Representatives

NWS - Steve Buan
Service Coordination Hydrologist
North Central River Forecast Center

USGS - Dr. Robert R. Holmes, Jr.
National Flood Specialist

Corps - Eddie Brooks
Chief, Watershed Division

Stakeholder Input: The public was then asked to provide feedback to the panel on rainfall-river forecasting issues. During the meeting several river industry leaders expressed their concerns with the accuracy and timing of the National Weather Services forecasts and the need for accurate forecasts as far in advance as possible. The majority of the river industry speakers gave praise for the efforts of the St. Louis District Corps and wanted those efforts to be used as a model for the other districts as well as the National Weather Service in developing and coordinating forecasts. The river industry stressed the importance of the confidence they must have in the forecasting agency in providing them the most accurate and timely forecast possible for every river condition. This confidence has been gained by the customer service that has been provided by the St. Louis District and the river industry stated this type of customer service should be a standard for all of the agencies to follow. It was stressed that the National Weather Service (NWS) is the official agency for issuing all forecasts to the general public and if there are questions or concerns with the forecasts those should be addressed to the NWS. The river industry asked that the Corps St. Louis District be allowed to continue to communicate with them concerning the Corps prepared forecasts to be used in conjunction with the NWS official forecast. Other members of the public voiced concerns about the levees along the rivers, especially during flood events, and stressed the need for accurate forecasts and stated they didn't want the NWS to lower their crest forecasts until they knew exactly what the crest would be. The panel closed the meeting by committing to continuing close coordination with the public on the issues presented and to provide feedback on the actions taken by each agency in improving forecast accuracy.

Summit Results: The Summit provided a much needed forum for the federal agencies to openly discuss the accuracy of current river forecasts and methods for improving future forecasts. The Summit also provided an opportunity for members of the public to express their concerns to these federal agencies in regards to the importance of accurate and timely forecasts. It should be noted that due to the short time frame in which this meeting was planned, invitations were not distributed as widely as they could have been. For example, the NWS has a well developed network of emergency management contacts who were not directly contacted and were likely not aware of the Summit.

As a result of the summit, the agencies proposed the creation of a "Fusion Cell" comprised of members from NWS, USGS, and Corps to develop a course of action to determine what improvements to the accuracy of forecasts can be made with the current science, human resources, and level of funding. The NWS also committed to meeting with members of the river industry to work on the critical areas of concern where the industry stated the official river forecasts were not accurate enough for their needs. The

following actions have been or are currently being taken in development of the Fusion Cell Mission, Team Members and proposed actions.

Fusion Cell Mission Statement: The following mission statement has been coordinated between Corps, NWS, and USGS. The Fusion Cell mission is to collaboratively develop a process for improving the accuracy of rainfall/river forecasts within the Mississippi River Basin utilizing the expertise and experience of the cell's member agencies. The Fusion Cell is comprised of representatives from the National Weather Service, U.S. Geological Survey, and the U.S. Army Corps of Engineers. The Fusion Cell will produce a report to address the current status of the rainfall and river forecasting within the Mississippi Valley (including tributaries) and develop a plan for improvements that can be made given the current science, human resources, and level of funding. The ultimate goal is to optimize the accuracy and utility of the forecasts provided to the Public in accordance with all applicable regulations.

Proposed Actions and Schedule:

1. **Set up a fusion team to accomplish our mission.**
    a. Advisory Team (Dave Busse - MVS, Noreen Schwein - NWS, Bob Holmes – USGS, Eddie Brooks – MVD)
    b. Fusion Team: Initial meeting added three Corps (Larry Murphy - NWD, Jim Stiman - MVR, Joan Stemler - MVS), four NWS employees (Ben Weiger - SRH, Steve Buan - NCRFC, Jeff Graschel - LMRFC and Joe Heim - OHRFC), and two USGS (George Arcement (LA Water Science Center) and Shane Barks (MO Water Science Center)).
    c. Stakeholder: RIAC has named Raymond Hopkins as their spokesman and he will be invited to participate in every meeting and in the writing of the final report.

2. **Give fusion team immediate and long-term action items.**

3. **Set timetables for work to get accomplished.**
    a. 10/22/08: First teleconference of Advisory Panel.
    b. 10/27/08: Naming of individuals on Fusion Team
    c. 11/6/08: First teleconference of entire team to prepare for face to face meeting.
    d. Week of December 15: Fusion Team face-to-face –Kansas City Missouri. Will develop short and long term action items and timeline to complete. Will have 95% of initial report complete before leaving. It will be a full two day meeting.
    e. 12/31/08: Distribute final Initial report for agency review.

f. TBD teleconference/face-to-face to discuss progress and using adaptive management to lay out the next steps

4. **Current Coordination of Forecasts.**
   a. MVS is sending the additional forecast information to the NWS as requested.
   b. Ensemble and no rain forecast are continuing to be worked on by the NWS.
   c. RIAC and MVR have agreed to have one day meeting in Rock Island to discuss forecast this year.

Recommendation: It is recommended that the Fusion Cell concept be incorporated as identified to determine what improvements to the rainfall-river forecasting can be made and to produce a report to address the current status of the rainfall and river forecasting within the Mississippi Valley (including tributaries) and develop a plan for improvements that can be made given the current science, manpower and level of funding.

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