

Incident: Flood Red River of the North (North Dakota)

Date of Incident: Spring/summer 1997 **Date Final Report Issued:** Aug.1998

Incident Cost: \$ 4 billion **Fatalities:** 0

Maximum Intensity: NA

Executive Summary

Flooding on the Red River of the North in 1997 established (twentieth century) records at most locations and was particularly devastating in the towns of Grand Forks, North Dakota, and East Grand Forks, Minnesota. With the exception of Grand Forks, which exceeded the previous (1979) record by over 5 feet, observed crests at most other forecast locations on the Red River of the North were about 2 feet above the previous records. Estimated damages for the complete event, including all United States portions of the Red River of the North, totaled about \$4 billion, of which \$3.6 billion occurred in the immediate vicinity of Grand Forks / East Grand Forks. No deaths directly attributable to the flooding resulted from this event. The National Oceanic and Atmospheric Administration (NOAA) typically conducts a post-event survey for events of this magnitude. The NOAA disaster survey team found instances of innovative and excellent performance and instances where NWS products and services could be improved.

NWS services beginning with early outlooks calling for record flooding and continuing through the flood event itself were generally informative and acceptable at all of the forecast points on the Red River of the North, with the exception of Grand Forks. Forecast errors at Grand Forks were due to the unprecedented complex interaction of hydrologic and hydraulic conditions. This report notes limitations to current flood forecasting techniques and capabilities, identifies areas for improving communications between the NWS and cooperating agencies, and provides recommendations for improving the way the NWS prepares and explains its flood forecasts.

The survey team recommended several steps be taken to improve the hydrologic forecast process through a series of important investments in NWS forecast procedures. The NWS needs to improve the methods used to estimate and convey the uncertain nature of its flood forecasts and outlooks. The most promising methods to address these issues have been prototyped in the Des Moines demonstration of the Advanced Hydrologic Prediction System, which should be extended to National coverage as resources allow.

The survey team found that cooperation among the USGS, the USACE, and the NWS was instrumental to the services the NWS provided. The survey team also supports the interagency technical review hosted by the North Central River Forecast Center (NCRFC) on July 28-30, 1997, in Chanhassen, Minnesota, as an ongoing step in

the interagency review of technical methods used to forecast flooding in the Red River of the North.

Recommendations

1. The NCRFC should immediately include new rating curves in the NCRFC modeling system as soon as the USGS updates all single-valued rating curves for the Red River of the North to reflect data from the 1997 flood.
2. The NCRFC should conduct an interagency review of all available data that might be applicable to the hydraulics of the Red River of the North.
3. The NCRFC should review the hydraulic study of this report for its applicability to the existing forecast procedures at East Grand Forks and use it as the basis to develop a more sophisticated model for the rating at East Grand Forks.
4. The NCRFC should develop a plan for implementation of dynamic routing procedures for real-time forecasting for the entire Red River of the North.
5. The OFS should provide a clear warning when a forecast goes beyond the top of a rating curve so the forecaster is aware of it and can determine whether the extension is appropriate.
6. The NWS and the USGS should add a parameter to their joint review of the relationship between NWS forecast locations and USGS stream gage sites to identify those sites where development of a looped rating is warranted for use in flood forecast operations.
7. The NCRFC should develop and execute a phased plan for recalibration of the Red River of the North using a model that is compatible with ESP.
8. The Office of Hydrology should develop a method to model the temporary storage of meltwater and add it to NWSRFS.
9. The Eastern North Dakota office in Grand Forks should review and update the existing E-19s for the Red River Basin, including the defined flood stages.
10. NCRFC should include both stage and discharge in information exchanged with water managers.
11. All NWS RFCs should include both stage and discharge in information exchanged with water managers.
12. NCRFC cannot realistically add physically-based transbasin flow simulation to its current forecast procedures and should, therefore, continue to rely on

empirical / subjective estimates of the effects of transbasin flows for the near term.

13. The feasibility of adding physically-based transbasin flow procedures to a future advanced hydraulic model should be included in the plan for dynamic routing recommended above.
14. The NWS should continue to set aside funds to support routine and special airborne snow surveys for the Red River of the North Basin.
15. The NCRFC and the NOHRSC should develop an implementation plan for the SEUS-E procedure for the Red River of the North.
16. NWS RFCs and offices with hydrologic service area responsibility should review this report as regards the potential for early coordination in response to heightened flood risks.
17. NWS RFCs and offices with hydrologic service area responsibility should review this report as regards the potential for misunderstanding the precision of NWS products.
18. NCRFC should investigate estimating explicit exceedance probabilities for its current outlook products, based on an historical analysis of outlooks.
19. NWS should deploy AHPS capabilities Nationwide.
20. Within the context of AHPS implementation, the NWS needs to work with users and apply their feedback to develop AHPS products that convey understandable information on the uncertain nature of river forecasts.
21. The NWS regions should establish administrative procedures to assure that adequate phone services are available.
22. The NWS should investigate the availability (and cost) of backup telephone services that might reroute calls around failed telephone switching systems.
23. In any future event that has a widespread personal impact on the staff of an NWS office, the appropriate NWS Director should be prepared to aid the staff by (1) using the Employee Assistance Program to provide on-site support and (2) providing liberal leave to the extent possible.
24. The NWS needs to evaluate, as an agency, what level of staffing support, if any, it can provide to city, county, and state Emergency Operations Centers and identify possible alternate methods to meet these needs.

25. Conduct a post-event technical session on the forecasting situation and all related technical matters among Federal agencies including the FEMA, USACE, USGS, and the NWS.
26. To continue the effectiveness of coordination with Canada, appropriate Canadian officials should be invited to the technical sessions referred to in previous recommendations.
27. Public Affairs officers in each NWS region should coordinate "flood media plans" between NWS river forecast centers and forecast offices.
28. Public Affairs officers in each NWS region should develop and conduct media training sessions for NWS field offices.