United States Department of the Interior
U.S. GEOLOGICAL SURVEY
Reston, Virginia 20192

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OFFICE OF SURFACE WATER TECHNICAL MEMORANDUM 2015.03

SUBJECT: USGS Flood-Inundation Map Development and Documentation Standards

Introduction and Purpose

The U.S. Geological Survey (USGS) is a leader in flood-inundation modeling and mapping. Flood-inundation maps (FIMs) show inundation extent, and in some cases inundation depth, for a wide range of streamflows and are distinguished from Federal Emergency Management Agency Flood Insurance Rate Maps in that they show inundation extent for specified water stages at an existing streamgage rather than annual exceedance probability flood flows.

Because of the range of data, approaches, and modeling tools available for the creation of inundation maps, the USGS National Flood Inundation Mapping (FIM) Program (URL: *http://water.usgs.gov/osw/flood_inundation/*) coordinates the USGS FIM activities. Through the FIM Program, USGS has developed and enhanced several methods for inundation map creation and display. The FIM Program also developed and maintains the USGS interactive web-based FIM mapper, and provides resources and tools for USGS offices and partners to develop inundation maps.

The purpose of this policy memorandum is to establish minimum standards for FIMs included in the USGS FIM database and displayed through the USGS FIM mapper. The *USGS Flood Inundation Mapping Science tool box* contains additional information and tools.

Policy

It is the policy of the USGS to publish only those flood inundation maps that meet USGS standards. These standards are consistent with those of USGS Integrated Water Resources Science and Services (IWRSS) partners. FIM standards are described below. The USGS will only host FIMs that meet standards and reflect the current hydraulic conditions of the mapped river reach.

USGS FIM Standards and Documentation Requirements

In general, inundation maps should be developed and documented using guidelines described in the report *NOAA Partnered Guidelines for the Development of Advanced Hydrologic Prediction Service Flood Inundation Mapping*. The NOAA guidelines Quality

Assurance/Quality Control checklist (Appendix B) is available in Microsoft Excel format in the *USGS FIM Toolbox*. Additional modeling and mapping tools and a list of qualified modelers and reviewers are also available in the Toolbox.

Section 3.2.2., Section 3.5., and Appendix D in the NOAA Guidelines are superseded by the USGS Report Templates and Mapping Application Submission Guidance and Templates listed in the USGS FIM toolbox. Sections 2.4.1(reach length), 3.3.1 (levee modeling), and 3.3.2 (structure depiction) should be considered but require interpretation and may be applied at the discretion of the local project team following good professional practices. Exceptions from and clarifications to the NOAA guidelines are described below.

- The hydraulic model used to develop the FIM library must be calibrated to data from at least one streamgage located in the reach for which the inundation maps are produced. If there are multiple streamgages in the study reach, the model should be calibrated using data from all stations. If available, documented high-water marks associated with known streamflows or simple stage sensors can also be included in the calibration. Only data from a USGS streamgage or from a streamgage with USGS approved furnished records may be used as the primary reference gage (See Water Resources Discipline Policy Memorandum No. 2008.01).
- In cooperation with the National Weather Service River Forecast Centers and local Service Hydrologists, river forecast information (flood forecast point), flood categories and local flood impact statements should be included in the map library for streamgages where the data are available. Contact the local NWS Forecast Office for more information.
- If the project plans include inundation mapping at levels that exceed the current streamgage rating curve, the rating curve extension must follow the guidance in Water Mission Area Policy Memorandum No. 11.01, Attachment 2. As discussed in that document, a calibrated hydraulic model, such as the one developed for creation of the FIMs, could be used to provide the required guidance for extension of a rating curve.
- The Peak Flow File for the streamgage(s) used to produce the inundation maps must be up-to-date (both present and historical peaks) and have the appropriate flags if needed. (Office of Surface Water Technical Memorandum SW 09.01.)
- Gage Operating Limits must be defined and recorded in a manner consistent with Office of Surface Water Technical Memorandum SW 14.03.
- All calibration water-surface elevations, topographic and structure elevation data, and flood map water surface elevations used in FIM must be referenced to the North American Vertical Datum of 1988.
- The hydraulic modeling can be completed with any documented computer code that is open-source and generally accepted in the hydraulic community.
- The geospatial modeling and datasets used to create two-dimensional inundation maps from one-dimensional water-surface profiles must be documented.
- Data, including floodplain topography, floodplain hydraulic roughness, hydraulic structures, channel bathymetry, and model output must be archived in accordance with USGS Model Archival Procedures outlined in WMA policy memo 2015.01.

- Minimum documentation must be provided and peer reviewed. The list of topics required in the documentation is available in the USGS FIM Toolbox. Templates for Scientific Investigation Reports and Scientific Investigation Maps are provided for convenience. The hydraulic model must be reviewed by a qualified peer (one with background and experience with the model used to generate the FIMs). Final FIMs must be reviewed for reasonable presentations of flood extents. A checklist of the minimum steps for FIM reviews are be available in the USGS FIM Toolbox.

Optional information and Services

The USGS FIM mapper allows for the spatial display of flood-loss estimation data generated with FEMA's Hazus model. These data are optional but if they are created with local community inputs, can provide very valuable information to planners and first responders. More information on how the services function can be found in the USGS FIM webpage. Documentation and submission templates are listed in the USGS FIM Toolbox.

FIM Submission Procedures

In order to submit a flood inundation map library to the USGS FIM Program, the modeling, mapping and documentation report must follow the USGS Fundamental Science Practices requirements in Survey Manual Chapter 502.3.

Prepare map library files using the submission guidelines in the USGS FIM Toolbox for posting in the peer-review mapper. Please use the peer-review mapper to assist the reviewers and document the review process. Additional step-by-step processes are available in the submission guidance.

Submit files following the submission guidelines to the USGS National FIM Program Coordinator. Beginning in FY15, the USGS Water Mission Area will support the posting and maintenance of the FIM libraries and mappers.

For any questions and/or comments, please contact Marie Peppler at mpeppler@usgs.gov or 703-648-5314.

Robert R. Mason, Jr.
Chief, Office of Surface Water

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