U.S. Department of Homeland Security
Washington, D.C. 20472

FEMA

MEMORANDUM FOR: Skagit County, Washington Flood Insurance Study File

FROM: Mr. Carl Cook, Jr., Director
Federal Insurance and Mitigation Division
FEMA Region X

SUBJECT: Skagit County, Washington Flood Insurance Study
Lower Skagit River hydraulic modeling of levee systems

The purpose of this memorandum is to document the rationale for determination of base (1-percent-annual-chance) flood elevations (BFEs) and Special Flood Hazard Areas (SFHAs) to be shown on the revised Flood Insurance Rate Map (FIRM) for the lower Skagit River in Skagit County, Washington. The Seattle District of the U.S. Army Corps of Engineers (USACE) is conducting a flood damage reduction feasibility study for the Skagit River in cooperation with Skagit County, Washington. The results of this study are being used by the Federal Emergency Management Agency (FEMA) to revise the Flood Insurance Study (FIS) and FIRM for Skagit County.

Several communities impacted by the Skagit River study have contested the hydrologic values used for the FIS. The peak discharge used in the revised Skagit FIS does not differ from the peak discharge used in the effective model. Multiple federal agencies concur on the hydrologic values used in the FIS.

Levees were built along both sides of Skagit River from Burlington Northern Railroad Bridge to the split at Fir Island into the North Fork and South Fork Skagit Rivers. Upstream of the Burlington Northern Railroad Bridge, levees were built only on the right bank of the Skagit River near Burlington. Fir Island, the delta between North and South Forks of Skagit River, is surrounded by levees and sea dikes along Skagit Bay. None of the levees or sea dikes provides protection from the base flood. USACE used the FLO-2D hydraulic model for the lower reach of the Skagit River. At issue is the modeling of the levee failure component of the study. A meeting was held on Thursday, October 19, 2006, at Michael Baker Jr. offices in Alexandria, Virginia, for FEMA HQ, FEMA Region X, USACE, and MOD staff to discuss potential levee failure scenarios to be used in the hydraulic modeling of lower Skagit River.

FEMA's *Guidelines and Specifications for Flood Hazard Mapping Partners (Guidelines), Appendix H, Guidance for Mapping of Areas Protected by Levee Systems*, Section H.5, states that if a levee does not meet the requirements of Section 65.10 of the National Flood Insurance Program (NFIP) regulations, and where levees exist on both sides of the stream, determination of BFEs shall consider the possibility of simultaneous levee failure, failure of only the left side levees, and failure of only the right side levees. To date, USACE has modeled the levees following FEMA Guidelines to sequentially fail levees on each side to determine the BFE. At the conclusion of the October 19 meeting, FEMA determined a number of levee failure scenarios for consideration for BFE determination for the lower Skagit River. These scenarios follow the Guidelines above, except for reaches near Mt. Vernon and Fir Island. The hydraulic modeling for Mt. Vernon and Fir Island is based on Guidelines for levee systems where an area of land is totally or partially surrounded by levees or where two or more flooding sources join that have levees on both sides of the stream.

Several weeks ago, a conference call was conducted to discuss the hydraulic modeling used for the Skagit River FIS and FEMA Region X was tasked to array options for that modeling and to decide on a preferred option. The three levee failure options considered for the hydraulic modeling for the Skagit River FIS are outlined below.

OPTION 1: Use the within levee water surface elevation as the BFE and simply extend it to each edge of the floodplain. This would be expedient, cheap, and easy to map. However, it would establish BFEs that are the highest possible.

OPTION 2: Follow FEMA Guidelines on levee failure modeling for right side and left side levees, and Guidelines for areas totally surrounded by levees for Mt. Vernon and Fir Island. These levee failure scenarios are identified in the attached diagram of Lower Skagit River Floodplain Mapping Scenarios. Mt. Vernon is included under scenario 4 and Fir Island included in scenarios 5, 6, and 7 on attached diagram. This option produces BFEs that are lower than option 1, but higher than currently mapped BFEs. This appears to be the most defensible option and the one that represented the consensus of the October 19 meeting. Option 2 is the option preferred by FEMA Region X.

OPTION 3: Model the reach with simultaneous failure of all levees. While this option appears immediately palatable, it produces BFEs that are lower than have been experienced recently in flooding events of a lesser magnitude than the base flood. The attached water surface profiles for Fir Island, Burlington, and Skagit River mainstem demonstrate that Option 3, as well as the 1984 FIS for Skagit River, underestimate the BFE. The hydraulic analysis for the 1984 FIS was conducted prior to implementation of current FEMA Guidelines for mapping of areas impacted

by levee systems. In addition, the 1984 hydraulic analysis was performed with a steady flow hydraulic model as opposed to the unsteady FLO-2D USACE analysis.

Option 3 would be hard to defend in other instances where a community does not desire to follow the Guidelines on levee failure modeling. It could also be seen as a risk to public safety by underestimating BFEs.

FEMA HQ, FEMA Region X, and MOD staff considered the three options above extensively, and, in a meeting on January 10, 2007, agreed that Option 2 is the preferred method for determining BFEs and mapping SFHAs for the lower Skagit River. There are no levees on the left bank of the Skagit River upstream of the Burlington Northern Railroad Bridge near the confluence of the Nookachamps River. However, this area is affected by the levees. In a conference call with FEMA, USACE, and MOD staff on February 2, 2007, it was determined that the left overbank SFHA for this area will be delineated based on the scenario that keeps all of the levees intact. USACE will complete the analysis of lower Skagit River in accordance with FEMA Guidelines as outlined in Option 2. MOD will complete preparation of Preliminary FIS and FIRM for Skagit County, Washington using the results of the USACE Lower Skagit River hydraulic model.

Attachments: Lower Skagit River Floodplain Mapping Scenarios
Lower Skagit River Water Surface Profiles

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