FLOODPLAIN MODELING APPLICATIONS FOR EMERGENCY MANAGEMENT AND STAKEHOLDER INVOLVEMENT A CASE STUDY: NEW BRAUNFELS, TEXAS

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Abstract. Implementation of the recommendations of the Metropolitan North Georgia Water Planning District (District) requires that many communities update their current floodplain maps. The FEMA Multi-Hazard Flood Map Modernization (Map Modernization) program is designed to provide digital flood hazard data and maps in a geographic information systems (GIS) format over the next several years. Assuring that the creation of new floodplain maps is a fair and technically accurate process is always a concern for both the public and governing agencies. While the technical aspects of modeling floodplains are the backbone of the process, often proactive involvement with stakeholders is the key to the overall success of community acceptance of new floodplains.

The City of New Braunfels, Texas is an example of the union of GIS-based interactive modeling capabilities and stakeholder involvement in the development of new floodplain maps. Initially, public concerns were high because the new floodplains were much larger than the effective Flood Insurance Study (FIS) floodplains. Mid-project, a large storm drenched the City, validating the updated model's predictions of a larger floodplain. CH2M HILL worked with the City's staff to not only quickly produce interim floodplain maps for evacuation purposes, but to later help the City Council and City Engineer work with the stakeholders to try to adopt new floodplain boundaries. The adoption process is ongoing; the new maps have been published and are currently in the public comment period.

INTRODUCTION

As exemplified in the catastrophic flooding of the 2004 hurricane season in the Atlanta area, many existing Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS) floodplain maps are in need of revision (FEMA 1983, 1991, 1995a, 1995b, K.M.NG & Associates, 1983). Not only do these outdated maps need to be updated to reflect the rapid development in the region over the last several decades, but the modeling and mapping exercise needs to become an interactive and cooperative endeavor. In most of the Atlanta area, recently updated floodplain maps are not easily accessible to the public or when emergency management personnel need this critical information immediately to warn the public and evacuate threatened areas.

The New Braunfels floodplain mapping project has direct applicability to what many Georgia communities will be undergoing in the near future. Implementation of District recommendations will likely include partnerships between local governments and the FEMA Map Modernization program to produce updated, digital (web-based) flood hazard data and maps over the next several years. Some communities may be interested in not only revising outdated floodplain maps but also developing new maps that predict future floodplain limits for planning and development management. As these new maps and digital data are released, local governments will be tasked with understanding and using these data in their communities. The floodplains will likely be different than they were before the Map Modernization, and local staff will have to communicate these changes and what they mean to the public. Local communities will benefit the most from these new data if they are involved throughout the map development process.

BACKGROUND

The City of New Braunfels, Texas is located in south-central Texas, about 30 miles northeast of San Antonio, Texas. The City is situated at the confluence of the Guadalupe River (85-square-mile drainage area upstream of the City, excluding upstream of Canyon Dam) and the Comal River (130-square-mile drainage area to the west). Historically, New Braunfels has seen several extreme rainfall events. Major floods were recorded in July 1869, October 1870, June 1872, December 1913, July 1927, July 1932, June 1935, September 1952, May 1958, May 1972, October 1998, and July 2002.

The ultimate purpose of the project was to develop storm water impact fees for future development.

Floodplain mapping was a step in the development of a capital improvement plan (CIP) that was used to establish the basis for storm water impact fees. During the project development, the city became eligible for a FEMA remapping grant to fund a complete FIS. The key goal for the remapping project was to create an accurate floodplain map to ensure the safety of citizens and property owners. This City loves its rivers (the Guadalupe River supports tourist and recreational fishing industries) and the adjacent riverfront private and public park property.

The 1998 flood inundated much of the area and caused extensive damage to private and public property. This event spurred the City to find ways to improve drainage conditions within the City, which led to the development of the storm water impact fee project and eventually, the revision of the floodplain maps. The FIS was in need of revision for the following reasons:

- A high-magnitude flood (greater than 100-year intensity) was experienced in 1998, which called into question the predicted flood elevations from the effective FIS.
- Flood models developed previously were calibrated to the 1998 flood conditions, but lacked sufficient detail for technical studies under the FIS program.
- New topographic mapping data were available in 2001 to prepare the model input data and map the flood boundaries in greater detail and accuracy than before.

Cities and counties throughout the US have floodplain maps that are in need of revision for similar reasons. The FEMA Map Modernization program has a goal of updating maps throughout the United States on a 5-year schedule. As these maps are updated and more readily available to the public, more people (public and private) will be aware of the changes to the floodplains and how they are personally affected.

Community planners and local officials will gain a greater understanding of the flood hazards and risks that affect their community. Builders and developers will have more current detailed information for making decisions on where to build and how construction can affect flood zones. Insurance agents, companies, and lending institutions will have easy access to floodmap updates and upcoming changes. Home and business owners will be able to have access to more information about their current flood risks.

The New Braunfels project predated the Map Modernization program, but the same implementation principles apply. The City Engineer of New Braunfels was actively involved with CH2M HILL as the models were developed and knew early on when preliminary results indicated that additional areas of the community would be impacted by the new floodplains. The City Engineer obtained additional topographic data to assure the accuracy of the models in these areas.

After a large flood event in 2002, the public became actively involved in the remapping process and the mayor wanted to use the new models to regulate floodplains across the City. The development community opposed this and the City Council deferred the decision to FEMA, which at the time, was preparing flood recovery maps using the new models. In the end, a compromise was reached; New Braunfels adopted the new floodplains along the Guadalupe River (the major flooding source in the area). All other streams are regulated using the effective FIS flood data for the time being.

Being involved with the floodplain modeling development from the beginning allowed the City Engineer to anticipate potential implementation problems, and identify flood prone areas that should be flagged for possible floodplain future buyout programs or development management strategies. The storm water impact fee was intended to help fund these programs.

METHODS

CH2M HILL began the detailed study of the New Braunfels area in late 2001. The models chosen for the project were the US Army Corps of Engineers (USACE) hydrologic model (HEC-HMS) and hydraulic model (HEC-RAS), along with a proprietary floodplain mapping software, RiverCAD™ by Boss International. The RiverCAD™ software was used in the model development as a pre-processor for the HEC-RAS geometry files. The software was also used as a post-processor, enabling the modeler to quickly convert tabular HEC-RAS water surface elevation output data into spatial GIS files that delineate the extents of the floodplain.

The models were created using aerial photography, recent landcover and soils data (USDA 1977, 1984), 2-ft topography supplemented by on-the ground surveying and underwater sonar imagery, and historical rainfall data (City of New Braunfels 2000, SCS 1972). The City Engineer worked with CH2M HILL to identify historically flood prone areas and provided historic high watermark data for calibration (Colwick 1972, GBRA 1998). Three long term US Geological Survey (USGS) gages were located within the study area for model validation (USGS 1999).

The hydrologic and hydraulic models were complete when a large storm event hit New Braunfels on the July 4th weekend of 2002. The storm had settled primarily in the Guadalupe River watershed to the north. The City Engineer requested that CH2M HILL prepare interim floodplain maps reflecting the flow rate in the Guadalupe River predicted by the USACE at an upstream reservoir flow gage. These maps were used by emergency

management teams to evacuate key areas throughout the City before the peak flow reached the area.

Without the updated floodplain maps, emergency management teams would have had to use outdated information to try to minimize the danger to citizens. The interim maps were sufficiently accurate to target the areas in immediate danger and this validation of the model output helped bolster support from stakeholders.

CONCLUSIONS

Accurate floodplain maps, developed from current data and calibrated models, are important for long-range planning and floodplain management. However, interactive data that can be used by local communities to deal with the issues that arise day to day make the information much more valuable. The City of New Braunfels Engineer's continuous involvement during the development of the project helped the community understand the validity and value of the floodplain information. The models became a working tool to help with an immediate need in the City. The accuracy of the evacuation maps helped the City Engineer explain the value of the data to the City Council and stakeholders when seeking adoption of the new floodplain boundaries.

DISCUSSION AND RECOMMENDATIONS

Both citizens and community leaders need to understand the hazards associated with flooding in their community, and how those hazards can impact their lives. Accurate and recent floodplain maps are only part of an adequate response to this need. Easy access to the information and the ability to understand and modify it for immediate needs and long-term planning purposes are also essential. Accurate and defensible floodplain information that the community can defend will help minimize future development in flood prone areas and quantify the impacts of new development located in the floodway fringe.

Based on experience in the City of New Braunfels, the authors recommend that communities become actively involved with the FEMA Map Modernization program. This active role should be pursued during all phases of the data development and validation, as it will provide a sense of ownership in the model results. In the end, the residents of the community are the ones who will live with the consequences.

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