American Water Resources Association
2009 ANNUAL WATER RESOURCES CONFERENCE
November 9-12, 2009
Seattle, WA

Wednesday, Nov. 11
10:30 AM – 12:00 Noon
SESSION 42: Flooding and Floodplain Management

An Integrated Model for Herbert Hoover Dam Breaching and Flooding - Michael Kabiling, Taylor Engineering, Inc., Jacksonville, FL (co-authors: Michael DelCharco, Guillermo Simon, Maurice B. Vaughan, Robert C. Tucker, Thomas Spencer)

The Herbert Hoover Dike (HHD) system comprises approximately 143 miles of levee surrounding Lake Okeechobee in Okeechobee, Martin, Palm Beach, Hendry, and Glades counties, Florida. The lake reservoir is unique because it has a low head and a large storage volume. The U.S. Army Corps of Engineers (USACE) estimates an average lake surface area of 450,000 acres, and Taylor Engineering estimates the lake volume varies from 1.4 million acre-ft (at surface water level of 6.4 ft-NAVD) to 10.9 million acre-ft (at surface water level of 28.4 ft-NAVD). The devastating impacts on New Orleans associated with Hurricane Katrina in 2005 renewed public interest in emergency action plans (EAP) in the event of a dam or levee breach. With public awareness stemming from Katrina and availability of recent high resolution LiDAR data, the USACE Jacksonville District contracted Taylor Engineering to simulate the expected flood inundation should the HHD experience a breach. Water through the breach would flow over a network of secondary levees, canals, and roads. Areas landward of the HHD comprise a mixture of urban population centers, agricultural land, transportation infrastructure, and water distribution facilities. With concurrence from the USACE Jacksonville District, the authors applied the MIKE-FLOOD dam break and flood routing model to route dam breach flooding and to account for backwater effect on breach development. The MIKE11 module in MIKE-FLOOD provided the built-in erosion-based dam breaching model that dynamically links with the MIKE21's two-dimensional hydrodynamic model. The LiDAR data provided sufficient topographic relief to include levees, roadways, and channels in the model domain. The results from preliminary dam break and flood routing model simulations show (1) the breach development compared well with a methodology based on a laboratory-derived relationships of reservoir head, breach width, and time of breach development; (2) the hydrodynamic model provided two-dimensional flood inundation with downstream pooling and backwater effects at the breach; and (3) the backwater reduced the head across the breach, reduced flow velocity at the breach, and slowed down dam breach development. Overall, the model provides reasonable simulations of dam break flood inundation.

Developing and Testing Adaptation Baselines for Flood Hazards: Case Studies from Canada and Bangladesh - M. Monirul Q. Mirza, Environment Canada Adaptation and Impacts Research Division, Toronto, ON, Canada (co-authors: Grace Koshida, Daria T. Smeh)

While floods are a natural phenomenon, human interventions on floodplains can either increase or decrease exposure to flood risk and damages. There remains a need to measure the effectiveness of disaster mitigation measures, and the adaptive capacity of various economic sectors, regions and activities to address a variety of natural hazards. A detailed assessment of successful and ineffective disaster mitigation policies and measures is required to better deal with future floods. The main aim of this study was to develop and test methodologies that can be used to create a reference measure of hazard vulnerability and adaptive capacity in both the developed and developing world. This measure is called an adaptation baseline. Another study goal was to quantify the adaptive capacities in response to both historic floods and future flood events in two case study locations selected in Canada and Bangladesh. Severe floods have occurred in the Canadian portion of the Red River Basin in 1950, 1979, 1997 and 2009 affecting most of Manitoba's population of 700,000. In the People's Republic of Bangladesh, 90 million people were affected in the devastating flood of 1998. Flood levels and damage data for the past 55 years were analysed to assemble a set of @100 possible indicators for the two case study locations. These adaptation baseline indicators can be used to quantify changes in adaptive capacity and vulnerability to floods and demonstrate whether flood preparedness and mitigation measures have improved or worsened over time. Qualitative indicators are also used to complement quantitative analysis to determine effective adaptations. Stakeholder consultations as well as comprehensive data collection for each case study location for each indicator are required to properly determine the state of adaptation. The Fourth Assessment of the Intergovernmental Panel on Climate Change (IPCC) projected more floods in the future in both case study locations. The results generated from indicator analyses and stakeholder consultations in the Red River Basin and Bangladesh will contribute both to the climate change-related adaptation planning knowledge base, as well as the design and implementation of effective disaster mitigation measures to floods in the future.

One-Dimensional Hydraulic Modeling of the Lower Skokomish River, Washington - Raymond Walton, WEST Consultants, Inc., Bellevue, WA (co-authors: John Howard, Jim Park)

The lower Skokomish River is formed by the confluence of the North Fork and South Fork. Downstream, HWY101 and SR106 cross the floodplain, and there are multiple bridge openings. The valley hydraulics are complicated by sediment accumulation, multiple channels, tides, structures, and the threat of channel avulsions. HWY101 has four bridges, and the Skokomish River is actually higher than Weaver Creek and Purdy Creek to the south. These means that when the Skokomish River overflows, which it now does about twice a year on average, significant flows move towards the Weaver Creek and Purdy Creek bridge openings, and often overtop HWY101. Historically, the valley was modeled using a one-dimensional hydraulic model with valley-wide cross sections. However, the valley-wide sections did not account for the distribution of overbank flows in the system and lateral movement across the wide floodplain. This model was later modified to define separate, but independent paths, through the four HWY101 bridge openings. For a detailed investigation of the hydraulic modifications in the lower valley that would result from replacing the Purdy Creek bridge and raising HWY101 to prevent overtopping, we extensively modified the HEC-RAS model to interlink the separate pathways and add more flow pathways, and we tried to update the model’s overbank geometry using more-recent Lidar survey data. This paper presents and discusses some of the challenges encountered during the lower valley modeling. These include the reliability of Lidar data, the system-wide implications of inter-linking flow pathways, how to define lateral flows in a one-dimensional model, the stability of linked one-dimensional models, the downstream impacts of “no rise” investigations, and the implications for a channel avulsion to influence the hydraulics of a replacement bridge.

The Living River Approach to Floodplain Management on the Carson River - John Cobourn, University of Nevada Cooperative Extension, Incline Village, NV

The Carson River in Western Nevada has its headwaters in the Sierra Nevada of California. The river flows 180 miles into the Great Basin, where the water evaporates before reaching an ocean. There are no reservoirs in the upper watershed. Devastating floods from rain-on-snow events inundate populated areas and agricultural lands every 15-20 years or so. In 2004, the Carson River Coalition (CRC), an interagency and inter-county watershed group, formed a committee to create a river corridor that would keep floodplain lands undeveloped. This committee worked closely with the Watershed Coordinator to produce a Regional Floodplain Management Plan. This plan was adopted by all five counties in the watershed in 2008. The plan begins by contrasting the flood damage costs of the large 1997 flood in the Carson River watershed with the damage costs of the same storm event in the more urbanized Truckee River watershed, just to the north, where Reno lies in the floodplain. Flood damage estimates show that the total costs in the Reno/Sparks area were approximately 23 times those of all flood damages in the Carson River Watershed, which has no large urban areas in the floodplain. The Carson River Regional Floodplain Management Plan summarizes a rapid evaluation of flood hazards reach by reach. It then recommends 38 specific strategies for flood risk reduction and floodplain protection. These strategies are based on non-structural flood management recommendations from the Federal Emergency Management Agency (FEMA) and the Association of State Floodplain Managers (ASFPM). The strategies encourage local governments to protect the natural functions and values of floodplains, to implement regulatory standards that go beyond minimum FEMA requirements, to upgrade flood data information, to monitor bank erosion and channel migration hazards, and to increase flood hazard outreach and education. Private non-profit and governmental agencies have begun to make progress at protecting agricultural land uses in floodplains through conservation easements. However, the development pressure, though temporarily slowed down, will be relentless over time. More work and funding will be needed to secure a safe, sustainable future for residents of the several communities, including the state capital, that cluster along the river.