

## **Flooding Impacts and Modeling Challenges of Tropical Storms in Eastern Yemen**

by **Kristi Root, P.E., CFM**, (Tetra Tech, 1 S. Wacker Drive 37<sup>th</sup> Floor, Chicago, IL 60606 E-mail: kristi.root@tetratech.com) and **Tatiana H. Papakos, P.E., CFM**, (Tetra Tech, 1 S. Wacker Drive 37<sup>th</sup> Floor, Chicago, IL 60606 E-mail: tatiana.papakos@tetratech.com)

**Section:** International Council, pp. 1970-1979, (doi 10.1061/41114(371)206)

---

**Document type:** Conference Proceeding Paper

**Part of:** World Environmental and Water Resources Congress 2010: Challenges of Change

**Abstract:** Most of Yemen is located in an arid climate with convective storms that produce flash floods and cause significant damage. A Tropical Storm landed in the eastern part of Yemen between October 23 and 25 of 2008 causing severe destruction and leaving thousands without their homes or livelihoods. A probabilistic risk assessment project, funded by the World Bank, Global Facility for Disaster Reduction and Reconstruction (GFDDR), was conducted for Hadramout and Al-Mahra governorates to (1) determine the extent and depth of flood risks in these governorates and (2) develop recommendations for the recovery and reconstruction of these areas to reduce devastation from future flood events. As a result of this Tropical Storm, the Government declared Hadramout and Al-Mahra governorates as disaster areas. Nearly 6,600 homes and huts in these two governorates sustained total or significant damage, leaving 25,000 people in need of shelter. Flooding was reported to have claimed 73 lives, left 17 people missing, and injured many others. The flooding not only damaged homes but also had a devastating effect on agricultural land. It is believed that nearly 50 percent of the population of the affected areas had their livelihoods destroyed or substantially damaged. A flood hazard analysis was performed to recreate the Tropical Storm of 2008 and to determine the extent and depth of flooding for the 100-year flood frequency event. Hydrologic modeling analysis performed with HEC-HMS software was used to process precipitation data, identify basin characteristics, and simulate the design flows produced by the Hadramout and Al-Mahra river basins. Hydraulic modeling performed with HEC-RAS software used the design flows and geometry data to model the stream conveyance. HEC-GeoHMS and HEC-GeoRAS were used in the pre- and post-processing efforts to expedite the parameter inputs and mapping process. Many challenges were addressed during the modeling processes. Specifically, there was limited historical data that could be used in the flood model developments. In addition, a high resolution digital elevation model (DEM) was not available for use in the hydrologic and hydraulic model. Finally, only a limited number of high water levels and flood extents were obtained after Tropical Storm 03B to be used in the calibration process. These challenges were overcome and floodplain maps were developed along the major waterways of the Hadramout and Al-Mahra governorates. These maps are being used to determine the areas prone to flooding and will be used to make recommendations in the rebuilding of roads, buildings in populated areas, agricultural lands, and flood

control structures.

---