Enhancing Local River Flood Hazard Communication at the Rio Grande Valley

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Abstract

River flooding along the lower Rio Grande river reached record to near record levels in middle to late July 2010, after estimates of more than 127 cm (50 in.) of rain fell across the northern portions of the Sierra Madre Oriental in Northeast Mexico, mainly in the states of Nuevo Leon, Coahuila, and Chihuahua, associated with the remnants of Hurricane Alex and Tropical Depression Two. Initial heavy rains across mountainous Nuevo Leon produced devastating flash floods in Monterrey. The heavy rains produced additional runoff, which filled a network of reservoirs on the lee of the Sierra Madre in Mexico, as well as along the lower Rio Grande River. Ultimately, the water flowed into a network of floodways in the Lower Rio Grande Valley. Flooding impacted a number of communities along and near the river in Texas and Mexico.

The National Weather Service Forecast Office (WFO) in Brownsville, Texas, utilized multiple sources of information to communicate the risk of flooding to locations along the lower Rio Grande. These sources included observed and forecasted river stage levels; near-real time situation reports from towns, cities, and portions of counties impacted by high water; expertise from the U.S. International Boundary and Water Commission, West Gulf River Forecast Center, and WFO Brownsville; photographic and video evidence, and Geo-referenced data.

The data were assimilated into a number of information streams including standard NWS River Flood Warning text products, areal-based Hydrologic Flood Advisories, near real time web page news articles and event stories, and routinely updated river-at-a-glance observed and forecast graphics. Several of these information streams were provided in English and in Spanish.

The effectiveness of combining multiple data sources into clear, specific messages for a variety of stakeholders will be discussed. Results from conversations with stakeholders will be used to provide a possible framework for location-specific hydrologic messages that incorporate geographic, demographic, and sociological information to further improve how flood threats are communicated to those in harm's way.

Flooding in Monterrey, Mexico

River flooding in Laredo, Texas

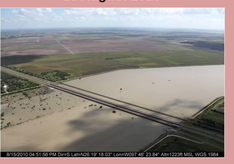
Roads washed out in La Grulla, Texas

U.S. Customs office damaged in Los Ebanos, Texas

Banker floodway before diversion at Anzalduas

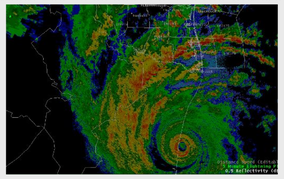
Banker floodway after diversion at Anzalduas on 8 July 2010

North floodway on 15 August 2010

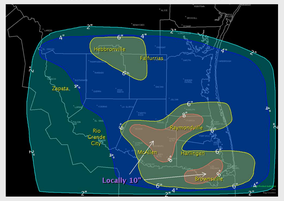


North floodway near Sebastian, Texas

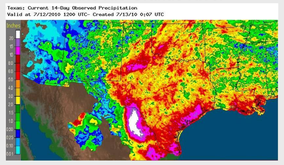
Hurricane Alex Making Landfall in Northeast Mexico on 30 June 2010, about 100 miles south of the Rio Grande



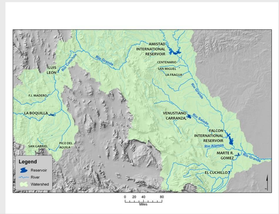
Total rainfall across Deep South Texas from Hurricane Alex



Alex leaves it mark on the watersheds of the Rio Grande River



Watersheds of the Rio Grande River

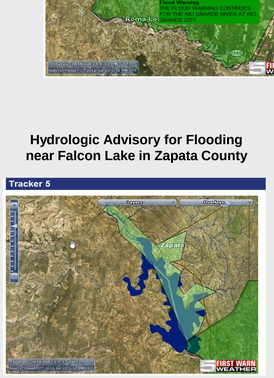


Impacts of the Rio Grande River in Deep South Texas

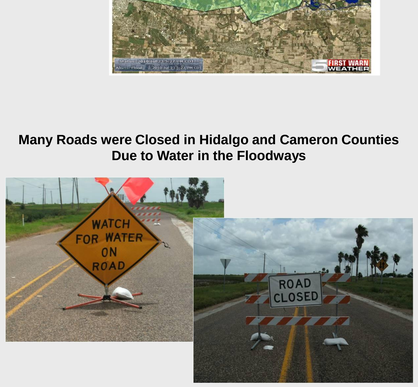
River Flood Warning for Rio Grande in Starr County

Hydrologic Advisory for the Floodways in Hidalgo County and the Santa Ana NWR along the Rio Grande

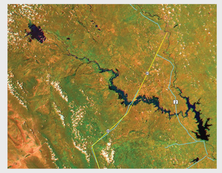
Hydrologic Advisory for Flooding near Falcon Lake in Zapata County



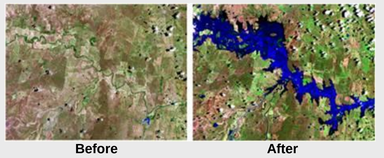
Many Roads were Closed in Hidalgo and Cameron Counties Due to Water in the Floodways



Water Flowing from Carranza Reservoir Along the Rio Salado to Falcon Lake

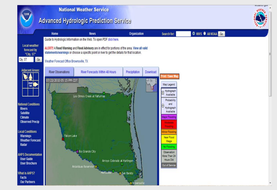


Falcon Lake Reservoir



Before After

Moderate to major river flooding along the Lower Rio Grande downstream of Falcon Lake to the diversion at Anzalduas



Diversion Floodways on the U.S. Side of the Rio Grande

How can there be a flood coming when there is not a cloud in the sky ?

Conveying the potential impact of major river flooding well after a tropical storm or hurricane affects an area can be a daunting task, especially when there is not a cloud in the sky. Summer 2010 was a perfect example, as residents and interests along the lower Rio Grande had to prepare and evacuate because of the impacts of Hurricane Alex and Tropical Depression Two weeks after landfall.

The internet, Flood Warnings, and Hydrologic Advisories provided useful ways to communicate the impacts to our many customers and partners. These methods of communication provided local, state, and federal officials useful information on the potential impacts of the heavy rainfall that brought record levels to Falcon Lake, and major flooding to points downstream of Falcon Lake. This necessitated the activation of the Lower Rio Grande Flood Control Project floodways in the United States and Mexico, which had not been used since 1988.

The staff of WFO Brownsville created various graphics and tables in English and Spanish to aid in decision support efforts. A banner was also continuously placed on the office internet page, and provided a link to a current article on the latest impacts, evacuations and flood warnings, and advisories impacting different sections of the Rio Grande in Deep South Texas.

One of the major challenges was conveying the risk of flooding for several areas in more than one county, while using one established river forecast point for a river gage between Falcon Lake and Anzalduas. Another challenge was how to address the issue of flooding in the floodways, as well as the flooding inside the levees between Anzalduas and Retamal. Using graphics and news articles on the internet along with traditional text-based Flood Warning and Hydrologic Advisory products, the WFO Brownsville office was able to address many of these challenges.

Headlining Graphics were Created and Updated for WFO Brownsville's Internet Webpage Through the Entire Flood Event both in English (Figure 1) and in Spanish (Figure 2).

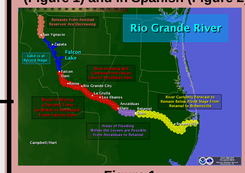


Figure 1

Figure 2

Banner Headlines were also created on the front of the WFO Brownsville internet webpage which linked to an article that was updated during the entire flood event, providing the latest information on impacts and evacuations due to major flooding on the Rio Grande River.

Anatomy of a controlled flood

Amistad Dam

Falcon Dam

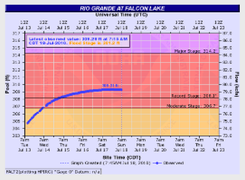


Figure A

The remnants of Hurricane Alex produced excessive rainfall across the Amistad watershed. The International Boundary and Water Commission (IBWC) began releasing water from Amistad Dam on 5 July 2010. 35,314 cubic feet per second (cfs) were eventually released from Amistad. Flood operations did not cease at Amistad Dam until 19 August 2010.

Falcon Lake reached a flood stage of 91.8 meters on 14 July 2010, reaching the all time record pool elevation of 93.9 meters on 15 July (exceeding the previous record set on 19 October 1958). A new record crest of 94.3 meters on 17 July was set on Falcon Lake (Figure A), which was just 1.5 meters below major flood stage. The pool elevation remained above the old record level through 22 July. IBWC began releasing water from Falcon Dam on 7 July at a rate of 15,000 cfs, doubling the release to 39,700 cfs on 8 July 2010. IBWC increased releases to 60,000 cfs on 14 July, with a maximum discharge of 60,035 cfs maintained through 27 July. IBWC then began gradually lowering releases to 30,000 cfs on 2 August 2010, with Flacon Lake finally falling below flood stage on 13 August. Even though Falcon Lake fell below flood stage after a little over a month, flood operations at the dam did not cease until 20 August.

In addition, reservoirs in northeast Mexico increased in flood capacity from the rainfall associated with Hurricane Alex and Tropical Depression Two. These events resulted in high flows on the Rio Salado from Carranza to Falcon on 7 July (135,608 cfs), on the Rio San Juan from El Cuchillo to Marte Gomez on 3 July (110,959 cfs), and on the Rio San Juan from Marte Gomez to the Rio Grande below Falcon on 9 July (32,772 cfs).

As a result, major flooding developed downstream of Falcon to Anzalduas, impacting communities and agricultural interests along the river in Starr County as well as southwest portions of Hidalgo County and areas inside the levees downstream of Anzalduas to Retamal in southeast Hidalgo County. The Rio Grande at Rio Grande City reached a flood stage of 15.2 meters on 8 July 2010 and major flood stage 9 July cresting at 17.57 meters on 11 July with a secondary crest of 17.47 meters on 16 July (Figure B). The river remained in major flood for approximately a month, falling below major flood stage after 3 August. After a total of 33 days in flood, the river finally fell below flood stage on 10 August.

Farther downstream, the Lower Rio Grande Valley Flood Control Project, including the Anzalduas Diversion Dam and the series of floodways (spillways) on both sides of the United States and Mexico border were activated. This includes the Banker Floodway, the Main Floodway, the North Floodway and the Arroyo Colorado in the United States. During the latter half of July and into early August 2010, the floodways were generally at half capacity, meaning water levels were several feet high but sufficiently below the height of the levee system. Visual and measured levels generally ranged from 1.2 to 2.4 meters across the system, which begins at Anzalduas and stretches east to just south of McAllen and Pharr toward Progresso Lakes, then curves northward between Weslaco and Mercedes (after a split with the Arroyo Colorado), then turns east at La Villa before entering extreme northern Cameron County, and passes between Combes and Sebastian before entering rural southern Willacy County.

Figure B

U.S. diversion dam at Anzalduas

Mexican diversion dam at Retamal

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