MEMORANDUM

Planning & Development
Regional Flood Control District

DATE: October 19, 2012

TO: Bill Zimmerman
Deputy Director

FROM: Evan Canfield, P.E.
Dave Stewart

Cc: Andy Wigg, Tom Helfrich, Dave Janders

SUBJECT: Preliminary Assessment of the 7-29-12 Flooding at Idle Hour Wash (Manning's calculation corrected from Original August 13, 2012 memo)

Background:

On July 29, 2012Idle Hour wash experienced a large flow that washed out Silverbell Rd.

You asked us to do an assessment of flow based on modeling and field investigation.

Summary:

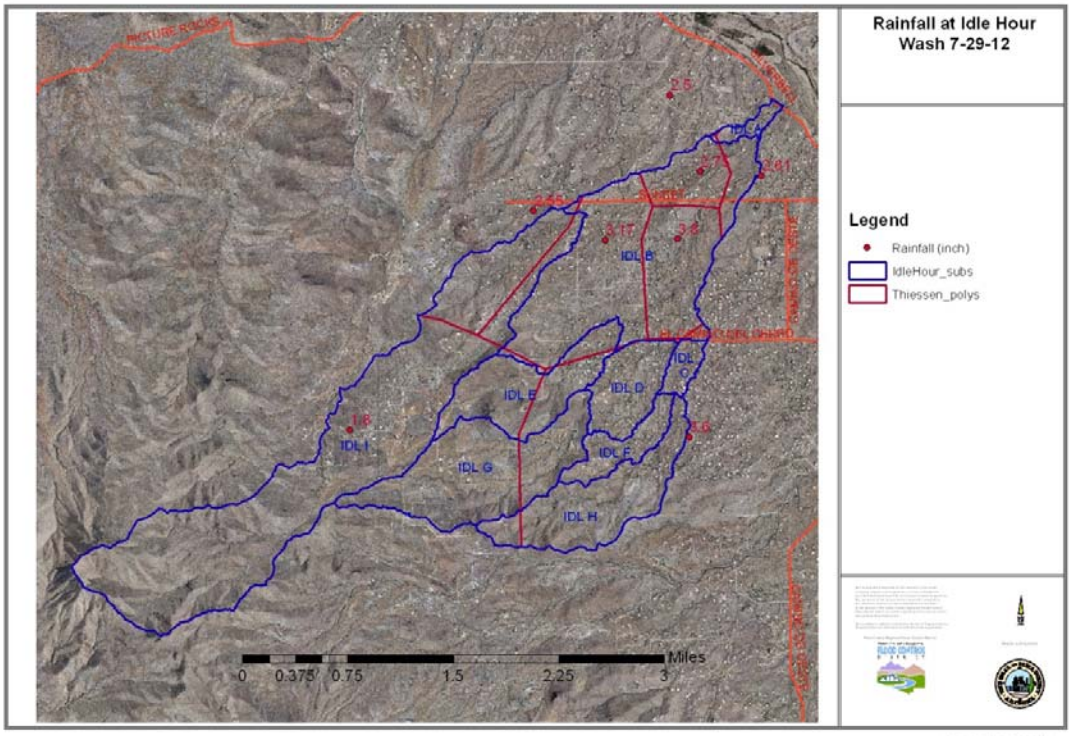
A) <u>Modeling</u>

1. **Model:** An existing HEC-HMS model prepared by Dave Stewart that was used to prepare a CLOMR was available for the Idle Hour Wash. The model and TDN for the CLOMR are available on the Z: Drive. This model showed a 100-yr discharge at Silverbell Rd of 5680 cfs for the 6.48 sq. mile watershed.
   Z:_Shared Data\Division-FPM\Special Studies\Tucson_Mountain\Idle Hour\FEMA CLOMR TDN

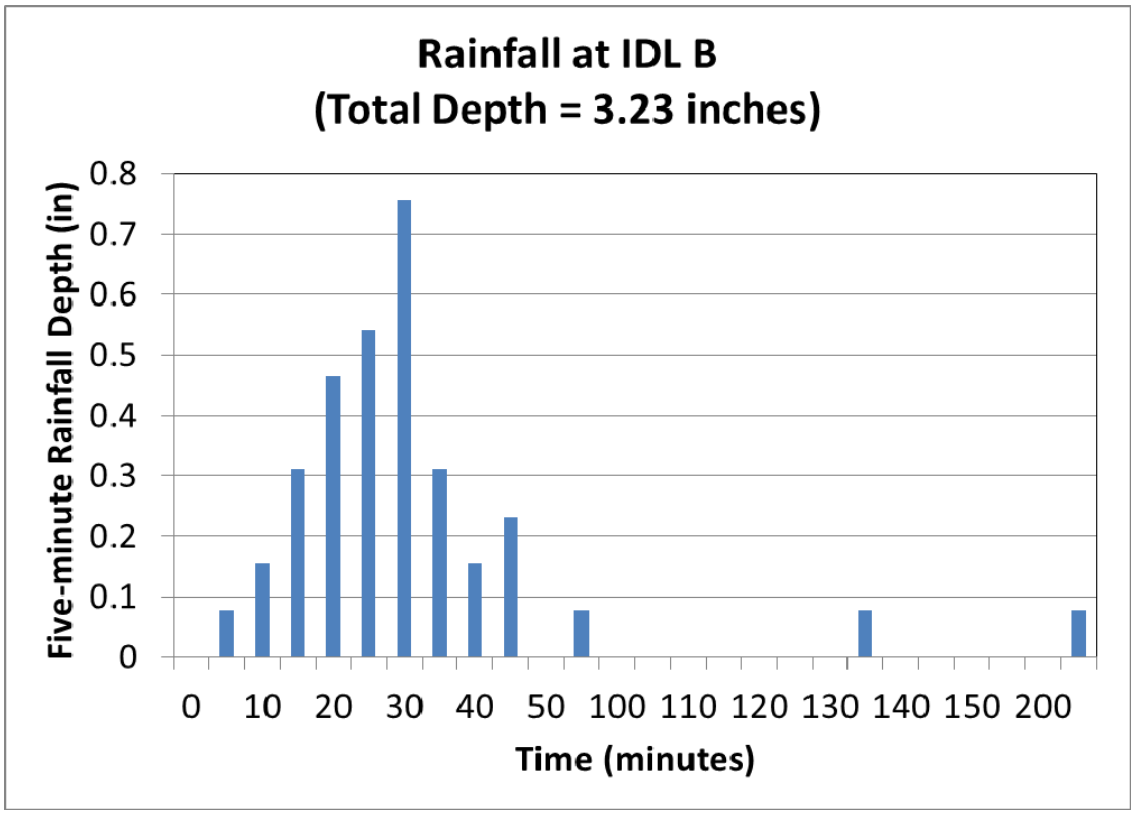
2. **Precipitation Depth:** Andy Wigg gathered rainfall data from RainLog.org and ALERT gauge at Ina and the Santa Cruz River. Precipitation depths recorded at three locations within or near the watershed over a period of approximately two hours during the July 29, 2012 event (3.8, 3.6, and 3.17 inches) exceeded the NOAA 14 Upper 90% 100-yr 3-hr rainfall depth of 3.07 inches before areal reduction as used in the CLOMR model.

3. **Precipitation Intensity:** The hyetograph recorded at the Ina Rd precipitation site during the July 29, 2012 event over approximately two hours was used as the rainfall distribution rainfall depths recorded within the Idle Hour Wash watershed.

4. **Spatial distribution of Rainfall:** Dave Stewart used Theissen Polygons to develop a rainfall estimate for each of the sub-basins on the watershed. The spatially-averaged rainfall from the Thiessen polygons found a rainfall depth greater than the NOAA 14 Upper 90% 100-yr 3-hr rainfall for five of the nine sub-basins (IDL B, C, D, F, H). These sub-basins account for approximately 39% of the overall Idle Hour Wash watershed area and are concentrated in the eastern branch and lower portion of the watershed which contributed to a higher modeled peak discharge for the July 29, 2012 event than the 100-yr CLOMR peak discharge. In addition, no areal reduction was applied to the July 29, 2012 recorded rainfall depths due to the rainfall site locations which allowed the spatially varying rainfall depth across the watershed to be represented.



An example of the rainfall depth for each 5-minute timestep is shown below.



The rainfall depths for each sub-basin are as follows:

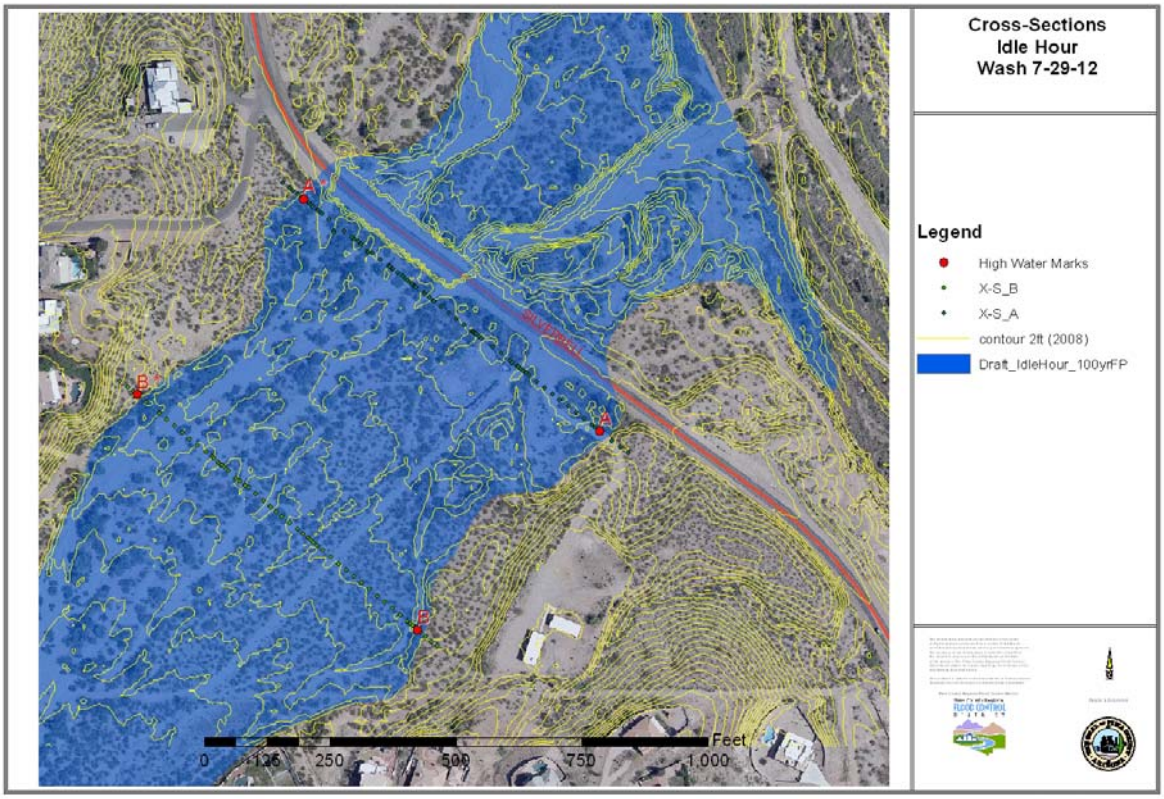
Watershed	Average Rainfall for 7.29.12 (inch)
IDL A	2.61
IDL B	3.23
IDL C	3.60
IDL D	3.60
IDL E	2.56
IDL F	3.60
IDL G	2.31
IDL H	3.43
IDL I	1.98

5. **Model Results:** Using the spatially-averaged rainfall depths and the existing HEC-HMS model, the modeled discharge was 6992 cfs which compares to 5680 cfs for the 100-yr discharge from the Idle Hour CLOMR. The larger July 29, 2012 modeled peak discharge may be attributed to recorded rainfall depths on July 29, 2012 that were greater than the NOAA 14 Upper 90% 100-yr rainfall depths.

B.) <u>Field Evaluation:</u>

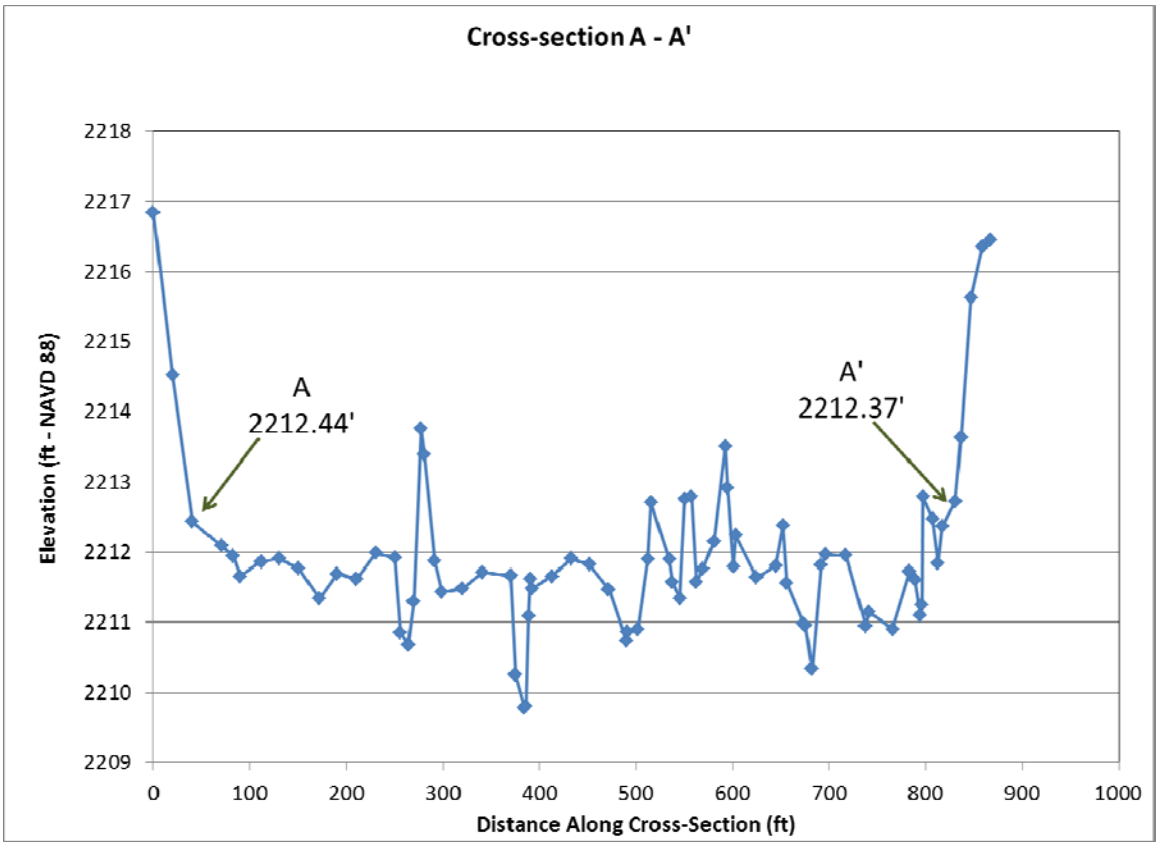
1. **High Water Mark:** Dave Janders and Evan Canfield went to the field on July 31, 2012 and identified the high water mark at four locations on cross-sections used in the preliminary mapping (labeled A – A' and B - B') so that we could estimate discharge based on the slope-area method. We identified and flagged the high water mark in the field, so that high water marks could be surveyed in.

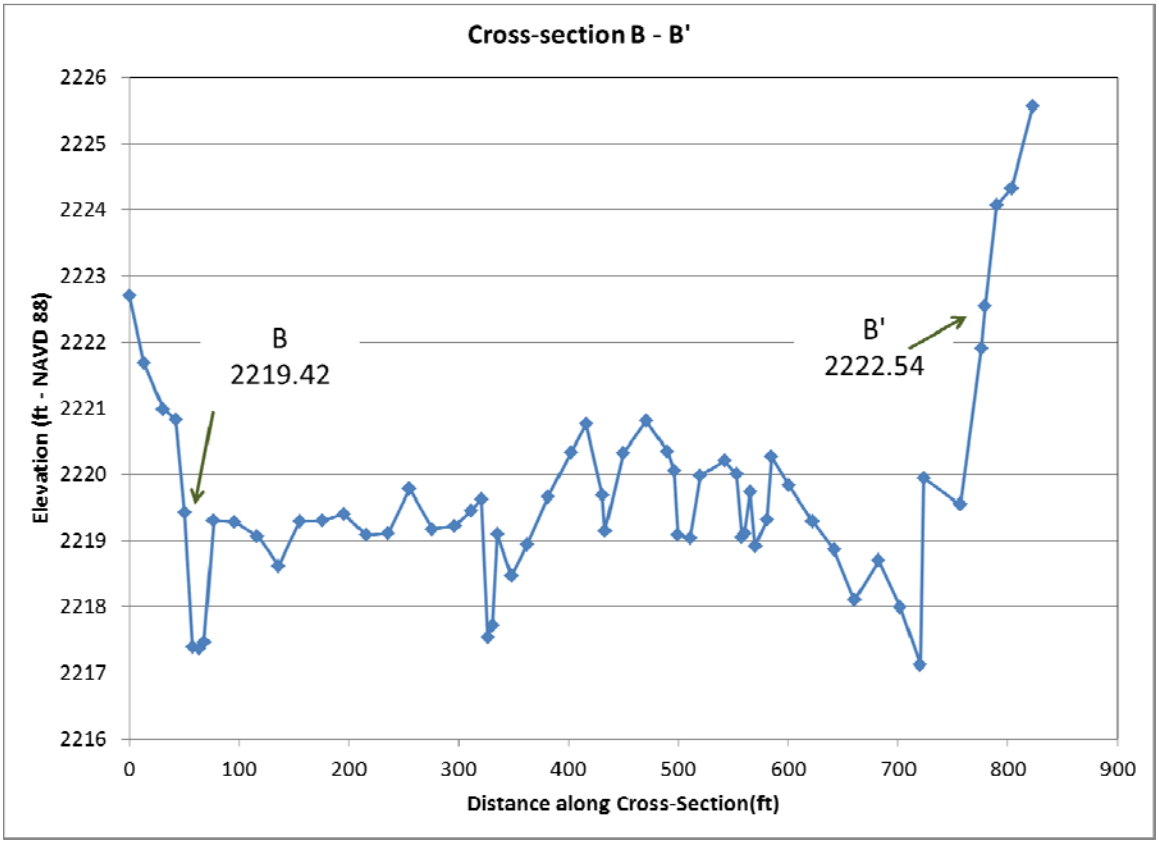
2. **Field Survey:** Pima County Field Survey went to the field and surveyed on August 6 & 7, 2012 at Cross-Sections A – A' and B – B'.



The field survey showed that the marked high water marks (shown by red dots) were at approximately the 100-yr floodplain limits with three locations (A, A' and B) inside the 100-yr limits and one (B') outside the limits.

3. Cross-Sections: The Cross-sections are plotted below:





The field-identified high water marks at A and A' were within hundredths of a feet, while there was about three-feet of difference between high water marks B and B'. This may reflect super-elevation in flow, but more likely indicates an error in identifying the high water marks in the field, or accurately surveying them.

C.) <u>Flow Calculated based on Slope-Area Method:</u> The estimated peak flow was calculated using the surveyed cross-sectional area and slope between the cross-sections. Data derived from the survey effort is as follows:

	Area (sq-ft)
A - A'	577
B - B'	1191
Avg	**884**

	Length (ft)	Elevation Change (ft)	**Slope**
A - B	534	6.98	0.013
A' - B'	509	10.17	0.020
		Avg	**0.017**

Hydraulic Depth

	Length (ft)	Area (sq-ft)	Depth (ft)
A - A'	777	577	0.74
B - B'	729	1191	1.63
Avg			**1.19**

Velocity was calculated two different ways:

1. **Using Manning's formula:** This approach used the mean calculated slope, assumed that wetted perimeter was approximately the same as hydraulic depth and assumed a Manning's 'n' of 0.035.

Manning Discharge

n	0.035	
S	0.017	
Depth (ft)	1.19	(wide rectangular)
Velocity (ft/s)	6.14	
Area (sq-ft)	884	
Q Manning (cfs)	***<u>5.432</u>***	

2. Assuming Critical Flow:

Critical Discharge (assume critical Flow)

Depth (ft)	1.19	(wide rectangular)
Velocity (ft/s)	6.19	
Area (sq-ft)	884	
Q critical (cfs)	***5,471***	

D.) Conclusion: The modeling and field analysis indicated that the July 29, 2012 flood event was approximately a base flood. The field evaluation based on the slope-area method suggested that this was slightly below a 100-yr event. The modeling suggested that the July 29, 2012 peak discharge exceeded the CLOMR 100-yr peak discharge based on recorded precipitation depths that were greater than the NOAA 14 Upper 90% 100-yr 3-hr rainfall depth.