RAYMONDVILLE DRAIN PROJECT
ENGINEERING APPENDIX A1

ATTACHMENT D

ADDITIONAL H&H MODEL VALIDATION

Introduction – A detailed report entitled "*Final Technical Memorandum, Summary of Quality Assurance Review, Hydrology and Hydraulics Base Models, Regarding Raymondville Drain Project, Project for Flood Control*," is included as Attachment C to this Appendix. Attachment C documents the previous Quality Assurance process for the hydrologic models developed for this Feasibility study. This document (Attachment D) contains additional model calibration and validation completed in March 2025 response to Independent Technical Review (ITR) and Independent External Peer Review (IEPR) comments.

Hydraulic data in the study area is extremely limited. There is no real historical information since the Raymondville Drain (RD) and North Main Drain (NMD) systems are not gauged, and there are no hydrologically similar basins from which to synthesize data. These drains are large networks of man-made channels to collect runoff from flat surrounding lands with substantial natural storage in the basin. The PDT (including USACE) has undertaken significant technical effort to develop valid and reasonable models within the existing constraints.

The Beulah storm event was utilized to validate the without-project hydrologic conditions. Based upon a comparison of the HEC-HMS results, the peak flow rates from the Beulah storm event are close to the peak flow rates for the 250-year hypothetical storm event at most flow junction locations. This is in line with previous documentation that the Beulah storm event was widely considered to be between a 100-year and 500-year event, depending on the location. Additionally, validation was performed by comparing various sources available in Hidalgo County and Willacy County. In Hidalgo County, the results were compared to available data found on Texas Department of Transportation (TxDOT) as-built plans, the USACE Hurricane Beulah report, Hidalgo County gage data, United States International Boundary and Water Commission (IBWC) documentation, and observed highwater marks that pre-date 1967. For the portion of the project in Willacy County (downstream), only TxDOT as-built documentation and the USACE Hurricane Beulah report were available for validation.

The daily rainfall totals from the Beulah report were used to develop a rainfall versus storm duration curve that represented Hurricane Beulah. This curve was then compared to several point rainfall versus duration curves for a range of frequencies from TP 40/49 (figure 1). This comparison helped determine a frequency range for Hurricane Beulah. When looking at figure 1, one can see that the Beulah frequency fluctuates with storm duration. As the duration approaches 10 days, the storm becomes more representative of a 100-yr or greater event.

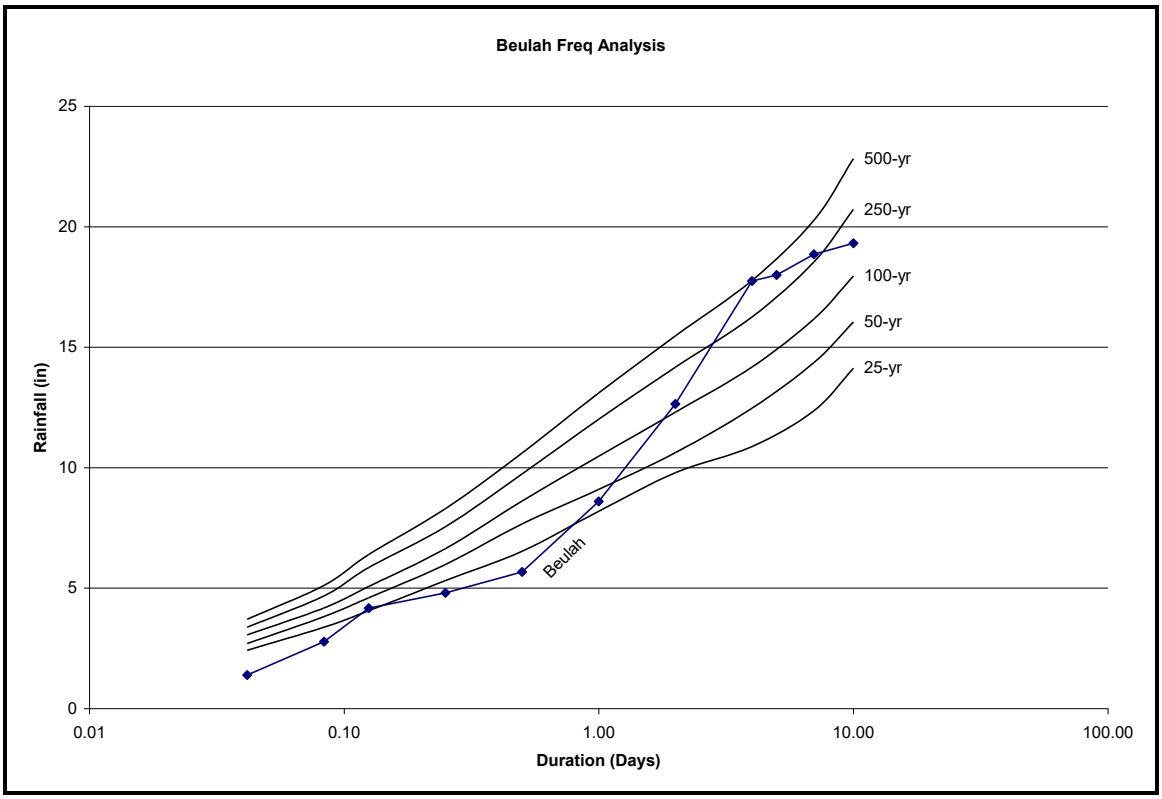

Figure 1: Hurricane "Beulah" Frequency Analysis

A similar technique was used to determine a frequency range for the storm of November 2002. The peak stage for this storm was the result of multiple small events over the period of a month. Therefore, the peak rainfall durations were collected for this same one-month period. The results can be seen in figure 2. The frequency range for the November 2002 event was concluded to be the 2-yr to the 5-yr event.

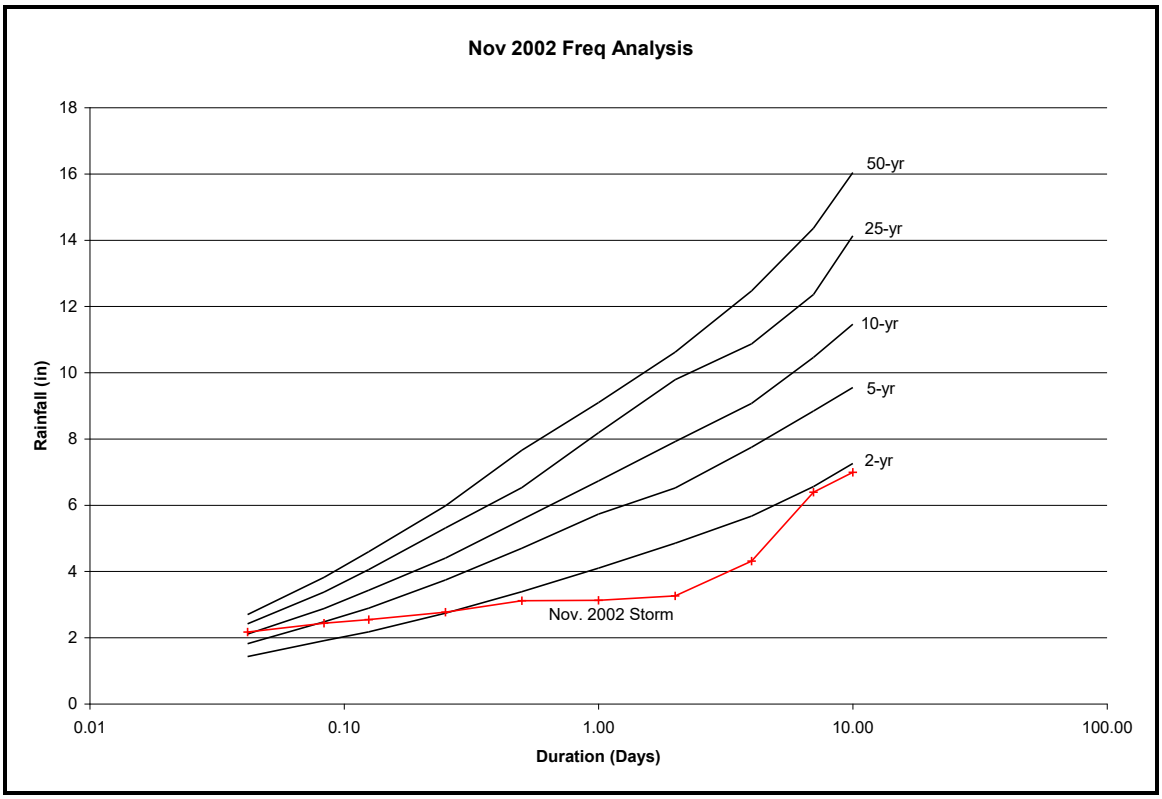

Figure 2: Storm of November 2002 Frequency Analysis

The graphs below (figures 3 - 6) depict the computed flows for junction points along the existing drainage ditches to compare the historical rainfall flow for validation of the computed flows. As mentioned above, the two storms analyzed are Beulah (high event) and Nov 2002 (low event). As the legend indicated in the figures, Beulah is represented by orange, Nov 2002 by green, and the computed flows by blue. As documented above, the assumption is Beulah was approximately a 250-year storm event (0.4% annual chance of occurring), and Nov 2002 was approximately a 2-year storm event (50% annual chance of occurring). The Beulah and the Nov 2002 flows are depicted as horizontal lines, and the computed flows are shown in relation to the actual available rainfall hydrograph data for the 10-day storm.

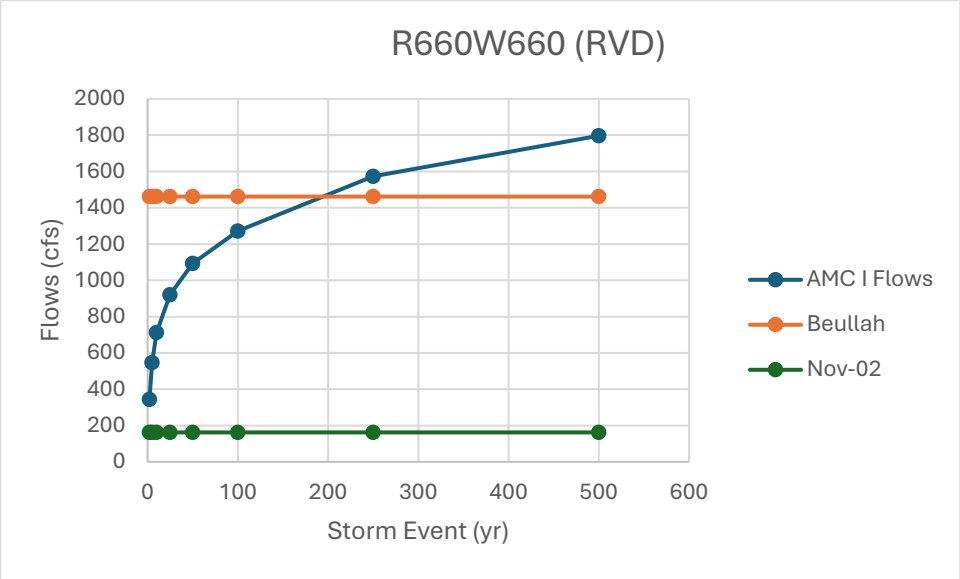

Figure 3 : Junction Point R660W660

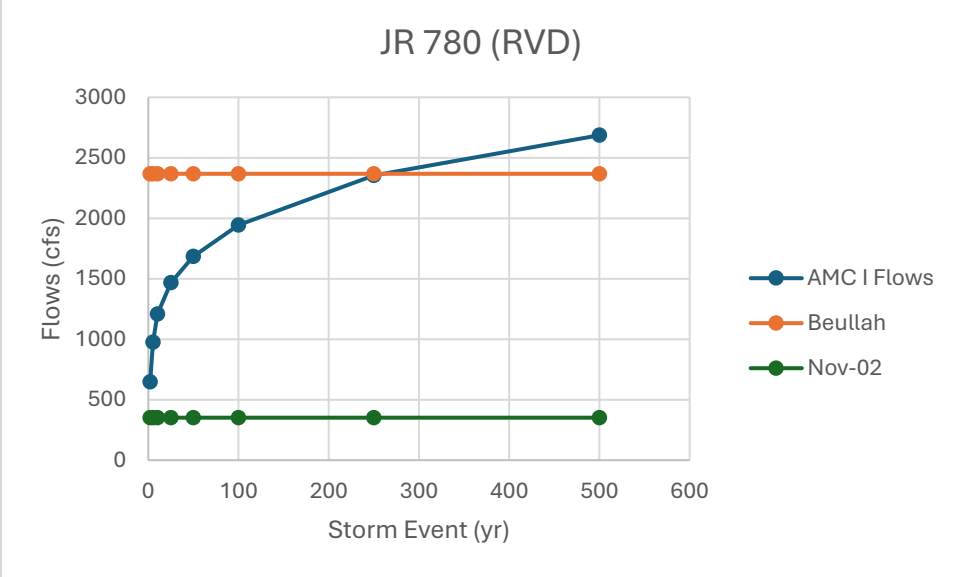

Figure 4 : Junction Point JR780

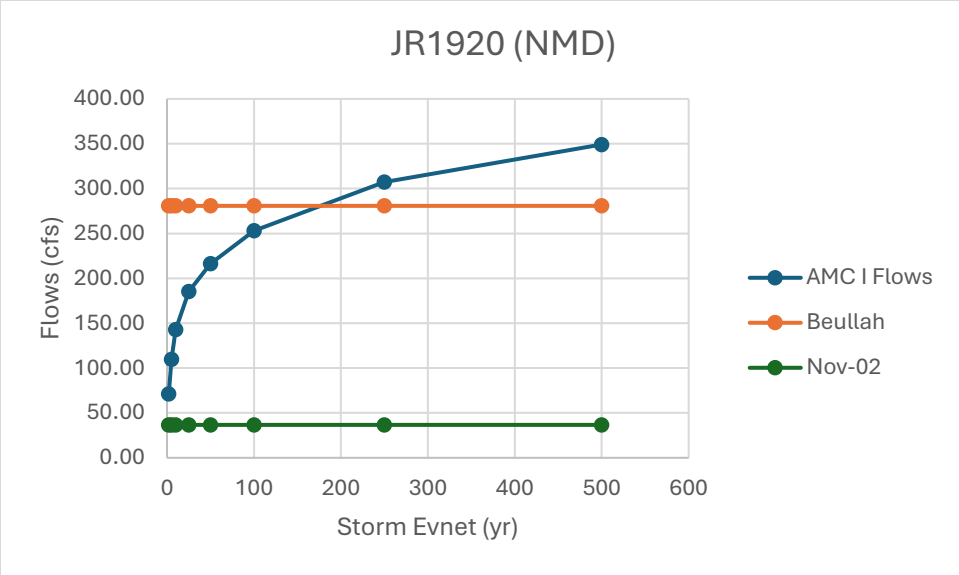

Figure 5 : Junction Point JR1920

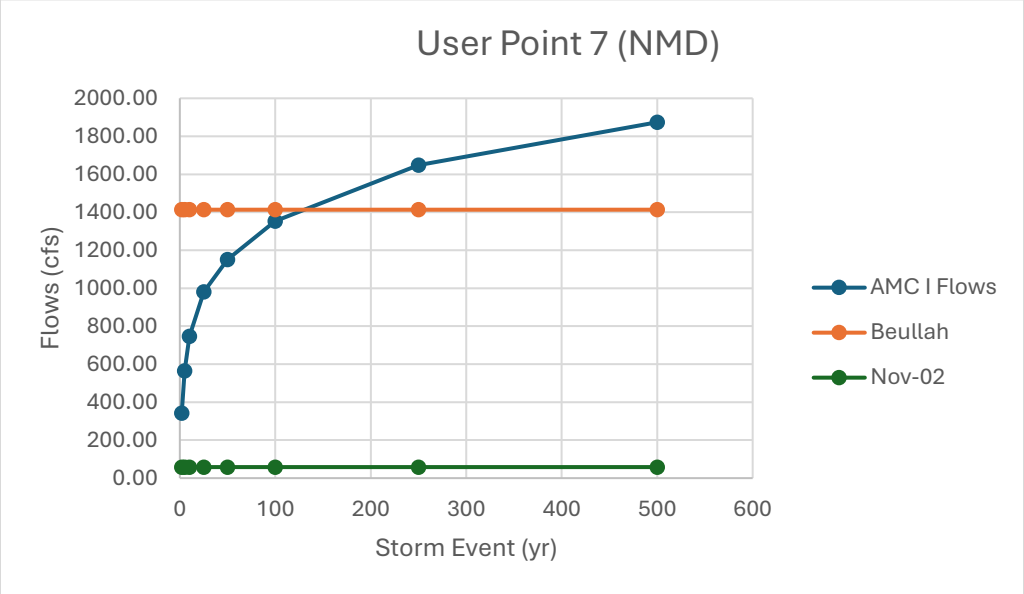

Figure 6 :User Point 7

Nash Sutcliffe Efficiency (NSE) Statistical Analysis – NSE calculations were performed as a statistical analysis method to validate the modeling utilizing the best available data. Since this drain is man-made and does not have any historical gage data, the limited observed data was used to compare the flows developed by using the actual and observed rainfall data. As previously mentioned, the rainfall data from Beulah versus the TP 40 rainfall data show the historical storm to falls near the 10-day 250-year event.

The flows generated from the Beulah storm data were used as the observed values, and the 250-year computed storm flows were used as the comparison data set to compute the NSE. As shown in Tables 4- 6, the computed NSE values were 0.98 for the RD Hidalgo subbasin, 0.90 for the NMD basin, and 0.92 for the RD Willacy subbasin. These values relatively near 1.0 indicate a reasonably low variance, indicating the model provides a good data fit, validating the calibration.

	Observed Flow	Computed Flow
Sum	544477.7	475288.8
Average	2763.846	
Numerator	4787107016	
Denominator	2.93454E+11	
NSE	0.9837	

Table 4: Raymondville Drain Hidalgo Subbasin NSE Computation

	Observed Flow	Computed Flow
Sum	1110431.9	762807.5
Average	3776.980	
Numerator	1.20843E+11	
Denominator	1.22469E+12	
NSE	0.9013	

Table 5: North Main Drain NSE Computation

	Observed Flow	Computed Flow
Sum	276589.00	200788.50
Average	5423.31	
Numerator	5745715800.25	
Denominator	73530829412.73	
NSE	0.92	

Table 6: Raymondville Drain Willacy Subbasin NSE Computation

Summary and Conclusions – The analyses conducted for this document confirm the previous conclusions of Attachment C, that the QA process for this Feasibility Study was adequate and correct. The analysis and results of the study are valid and reasonable, and the fundamental assumptions utilized in the Feasibility analysis provide the best and most accurate possible results within the constraints of the limited available data.