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APPENDIX A-5 ECONOMICS

SECTION 1 INTRODUCTION

This appendix was prepared to document procedures and results of the economic flood damage analysis for the Raymondville Drain (RD) Basin, Hidalgo, and Willacy Counties Texas Drainage Study. Economic analyses include the development of stage versus damage relationships and annual damages over a 50-year analysis period. The base year is the expected completion date, 2034, and the 50-year period of analysis is from 2034-2084.

Note that the runs of the models documented in Attachment A (FDA Design Task Protocol) were based on an earlier assumption of a 2011-2061 period of analysis, and in some cases these dates remain in the background documents. However, the updated analysis and this Appendix properly reflects the updated 2034-2084 period.

This project covers a long, linear corridor of approximately 57 miles, consisting of approximately 14 miles of new diversion drain in Hidalgo County, and approximately 43 miles of existing drain improvements in Hidalgo and Willacy Counties. Approximately 38,000 structures are impacted by flooding within the corridor. Damage assessments include inundation damage to structures and contents and vehicles. Intensification and Location Benefits, while not quantitatively assessed, provide significant additional benefit to and justification for the project.

The RD itself is not identified as a FEMA floodplain, therefore Executive Order 11988 considerations do not apply, and all flood reduction benefits on all existing structures can be considered in the analysis. Within the study area, FEMA has identified some limited areas of the 100-year and 500-year floodplains in its published FIRMs, primarily along the coast, outside of the area that would have reduced risk from the proposed project (see Appendix A-3, Attachment A, Exhibit 9 – Existing FEMA Floodplains). While many USACE projects do not consider Location Benefits, RD is different than most USACE studies. The 57-mile-long project will provide significant flood relief along a substantial reach, reducing potential flood damage risk to adjacent land, therefore increasing total value and potential of the land. Rapid growth in the region continues to force development farther into rural areas. While this project does not encourage development in a floodplain, it will improve access and therefore makes adjacent areas more desirable. The conversion of previously highly flood vulnerable lands and adjacent properties into more valuable developable land due to the project provides quantifiable location benefits from the RD project (RVD). While these benefits are not used in the NED benefit computations, they can be qualitatively considered for the impact this project will have for the growth of the region.

Flood damage calculations were performed using Version 1.4.3 of the Hydrologic Engineering Center (HEC) Flood Damage Analysis computer program (HEC-FDA, May 2016). This program applies Monte Carlo Simulation to calculate expected damage values while explicitly accounting for uncertainty in the input data. HEC-FDA models were prepared for existing without-project conditions, and for each alternative plan.

Estimates of without-project damages and with-project damages are based on October 2023 price levels and a 50-year period of analysis. Damages have been annualized over the 50-year project life using the 2023 fiscal year Federal water resource studies discount rate of 2.5%. These calculations have been based

on a 2023 price level and discount rate. At the time of submission of this draft, the 2025 discount rate has not been issued. The report will be updated to 2025 price levels prior to submission of the final version.

Attachment A of this appendix is the Design Task Protocol for the FDA model, providing details on the model, naming conventions, and procedures. Attachment B is the economics Design Task Protocol, which describes the procedures and methodology used to generate the economics for this project.

SECTION 2 DESCRIPTION OF STUDY AREA

Hidalgo and Willacy Counties are located within the Lower Rio Grande Valley (LRGV) of South Texas. The approximately 2,500 square mile study area primarily consists of the vast majority of Hidalgo and Willacy Counties, north of the Arroyo Colorado and Rio Grande watersheds. It also includes a small portion of northern Cameron County within the International Boundary and Water Commission (IBWC) North Floodway watershed. The initial study area included the IBWC North/Main Floodway System watershed to the south, the HCDD1 North Main Drain (NMD) System watershed, the RD watershed, and continues northward to the rural portions of Hidalgo and Willacy counties.

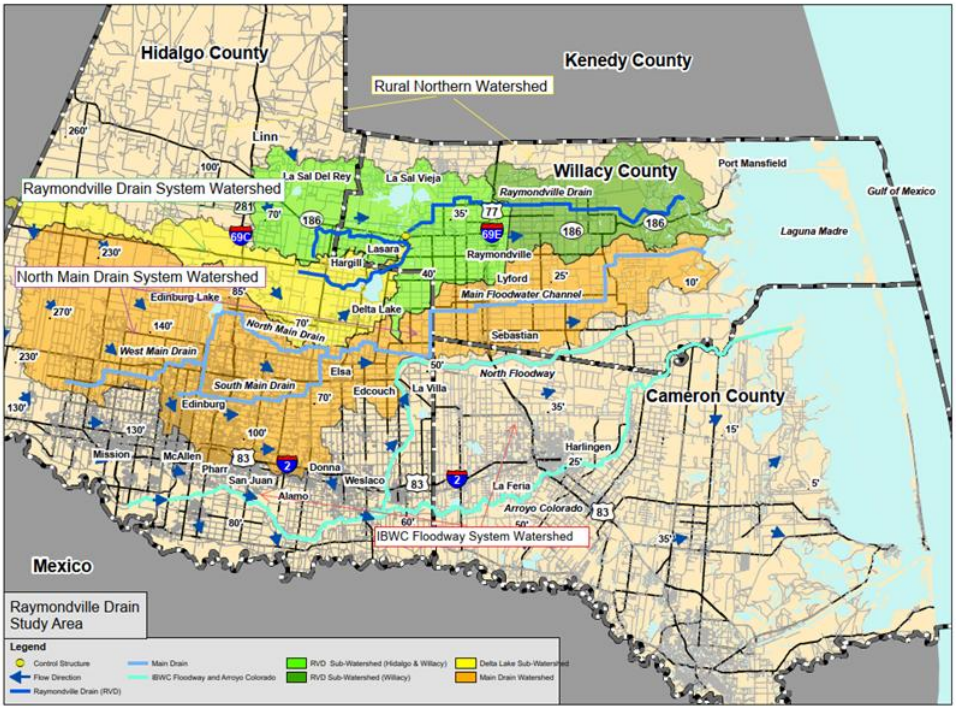

Figure 1: Initial Study Area

2.1 ACCESSIBILITY

Due to the very flat topography, flooding in the region is slow moving and covers wide areas. Flooding causes transportation disruptions and impacts lifeline services in the region. The proposed project will improve life safety by minimizing disruption to lifeline routes.

2.2 POPULATION

The need for this project is due to the rapid and continuing economic and population growth in the region, adjacent to the United States – Mexico border. The community has developed significantly with the expansion of the University of Texas Rio Grande Valley, Doctor's Hospital at Renaissance, and the Bert Ogden Arena in Edinburg. Hidalgo County has drastically changed with the introduction of the North American Free Trade Agreement (NAFTA) in 1994, transforming the primarily agricultural communities into a diverse economy which thrives off international trade due to its multiple International Land Ports of Entry

along the boundary with Mexico and its position relative to I 69-C and US 281. Freight exchange between the U.S. and Mexico is expected to continue to increase in the future resulting from the 2020 implementation of NAFTA's successor, the US-Mexico-Canada Agreement (USMCA). This trade growth is expected to increase local populations. Hidalgo County is the largest in the study area, with a population of nearly 1,000,000 in 2020, and a projection of over 70% growth by 2050 as shown in Table 1 below. Land development activities occurring within Hidalgo and Willacy Counties in recent years continue to place pressure on the existing drainage system. The aging, inadequately sized drainage infrastructure was not designed to handle the increased stormwater runoff from new developments.

Table 1: South Texas Population Projections

City Name	P2000 Census	P2010 Census	P2020 Census	P2030	P2040	P2050	P2060
McAllen	106,414	129,877	142,210	179,586	209,386	241,933	275,322
Edinburg	48,465	77,100	100,243	105,237	128,358	153,611	179,517
Pharr	46,660	70,400	79,715	91,553	109,836	129,805	150,291
Mission	45,408	77,058	86,635	100,157	122,454	146,807	171,790

2.3 ECONOMY AND LAND USE

Agriculture is the dominant industry in both Hidalgo County and Willacy County. Other major industries in Hidalgo County include healthcare, soft drink bottling, meat packing, frozen food processing and canning, tourism, construction, and oil and gas field services. Willacy County currently has few significant industries other than agriculture.

SECTION 3 PROBLEM IDENTIFICATION

The primary problem in the study area is flooding due to the increasing population and development overtaxing an old and undersized existing drainage system. Sequential rounds of Plan Formulation narrowed the recommendations to the most developed and flood vulnerable areas in the NMD and RD basins. Potential solutions for the rural less-developed northern portions of the two counties, and modifications to the IBWC North / Main Floodway system were ruled out as infeasible.

The existing RD System, including outfalls, was designed in the late 1960s and was originally intended to convey agricultural runoff (from the generally northern portions of the study area) from a 9.5-year storm event through the Laguna Madre to the Gulf of Mexico. The NMD System was constructed with the intent to convey stormwater runoff from the developed portions of Hidalgo County (generally southern portions of the study area) through the Laguna Madre to the Gulf of Mexico.

3.1 STORM HISTORY

The largest and most destructive storms affecting the Lower Rio Grande Valley are generally tropical cyclones, however large non-tropical storms have also occurred. A total of 38 tropical cyclones are known to have affected the lower Texas coast during the 147-year period, 1818-1964. More recent storms which have affected the Valley include Hurricane Beulah in September 1967, Hurricane Fern in September 1971, Hurricane Caroline in August 1975, and Hurricane Allen in August 1980. (USACE, 1982)

Between 1982 and 1999, there were three Disaster Declarations for Hurricanes in Texas and one for a Tropical Storm, but no significant flooding was reported in the study area from those events. Hurricane Bret in August 1999 produced minor flooding in the Rio Grande near the Gulf of Mexico, and Hurricane Gilbert in September 1988 struck Mexico 60 miles south of the border and spawned tornadoes in the region. Hurricane Alicia in August 1983, and Tropical Storm Allison in June 1989 did not impact the region. During that time there were nine additional disaster declarations in Texas for severe storms, flooding, and tornadoes. (FEMA.gov website)

Between 2000 and 2021, Hidalgo County experienced 14 Emergency Declarations and Major Disasters for flooding with a property damage value of $201,492,500 reported to the National Oceanic and Atmospheric Administration (NOAA). In that same timeframe, Willacy County has experienced 11 total declared events with a NOAA reported property damage value of $24,246,500. The documented events for Hidalgo County include Hurricane Hanna in July 2020; Tropical Storm Alex, and Hurricane Alex in June 2010 (separate declarations); Hurricane Ike in September 2008; Hurricane Gustav in September 2002; Hurricane Dean in August 2007; Hurricane Rita in September 2005; Hurricane Dolly in July 2008; and 6 severe storm and flooding events. The documented events for Willacy include Hurricane Hanna; Tropical Storms Marco and Laura in August 2020; Tropical Storm Alex and Hurricane Alex; Hurricane Ike; Hurricane Gustav; Hurricane Dean; Hurricane Rita; Hurricane Dolly; and 2 severe storm and flooding events. Significant recent non-tropical events in the study area included Great June Floods of 2018 and 2019, with the June 2019 event setting new daily rainfall records at multiple locations in Hidalgo and Willacy Counties. Additional significant agricultural damages are documented in section 4.2.5 below. (Region 15 Lower Rio Grande Regional Flood Plan 2023)

The worst flooding in the Valley in recent history occurred during Hurricane Beulah in September 1967. A rainfall of 10 to 20 inches over a watershed already saturated by heavy August rains caused unprecedented

flooding. Surface runoff or sheet flow over the flat landscape from Beulah's rainfall flooded thousands of acres of agricultural land and several communities and resulted in property damage and crop losses estimated in tens of millions of dollars. (USACE, 1982)

This summary is provided for context. Additional details on flooding and storm damage are documented in Section 1.7.1.3 of the main report.

SECTION 4 WITHOUT-PROJECT FUTURE FLOOD CONDITIONS

Without-project condition flood damages were modeled in HEC-FDA for the years 2034 and 2084. Conditions in the Lower Rio Grande Valley will continue to digress. As the population and development increases, flows in the existing drainage channels will continue to increase as existing drainage infrastructure continues to age. Furthermore, it is anticipated that future years will bring more severe storms to the area, increasing the likelihood of flooding in the urban areas, as well as the regional agricultural lands.

Agricultural damages are significant in the area due to the high agricultural land use. Because of the limited natural channels, high water table and high salinity of the water, flood inundation in the agricultural areas is highly destructive causing significant losses. NOAA has documented agricultural losses in Hidalgo and Willacy Counties of approximately $200 Million in the past 20 years.

4.1 DELINEATION OF DAMAGE REACHES

The four watersheds (North Main Drain, Raymondville Drain, Willacy, and Delta Lake) modeled in Appendix A-1 (Engineering) were the basis for the planning area for analysis of the final array of alternatives. Each watershed was further divided into individual streams and damage reaches, as shown in Tables 2A – 2D. The streams and associated damage reaches were developed to determine the impact to regions along the existing ditch alignment for comparison between the four different alternative plans being analyzed for this study. This allowed the evaluation of portions of the stream, located upstream and downstream of the proposed improvements and to document the reduction of damages to the study areas for each alternative plan. (See FDA Damage Reaches Exhibit located in Attachment C of this Appendix.) The majority of the streams in this study have been divided into multiple damage reaches, although for shorter streams only one may be utilized. Each damage reach is defined by a beginning (downstream) and ending (upstream) cross section for the reach and an index cross section. The index cross section is located within the damage reach and is used to specify discharge-probability, stage-discharge, and stage-damage functions with uncertainty data for the alternative plan evaluations. The index station is where the available data is considered "most reliable," which is typically where a stream flow gauge or elevation gauge is present. It should be noted that an index cross section does necessarily need to be at a water surface profile cross section location. In this analysis, the damage impacts both the right and left overbank areas since the existing drainage channels do not have flood protection levees.

Table 2A: Willacy Segment Damage Reaches*

STREAM	DAMAGE REACH	BANK	DOWNSTREAM STATION	UPSTREAM STATION
Raymondville	San Perlita	Both	95954.78	100407.5
	Ray East	Both	142634.1	145587.5
	Ray West	Both	145744.9	153697.2

Willacy reaches are noncontiguous, and only represent areas where structures are present. The gaps indicate uninhabited reaches.

Table 2B: Raymondville Model Segment Damage Reaches

STREAM	DAMAGE REACH	BANK	DOWNSTREAM STATION	UPSTREAM STATION
Lateral 5	REACH 1A	Both	259880.800	267939.700
	REACH 1B	Both	254274.100	259880.800
Lateral 4	REACH 1	Both	179.181	5524.022
Lateral 3	REACH 1A	Both	245630.100	254087.200
	REACH 1B	Both	228911.400	245630.100
	REACH 1C	Both	222350.800	228911.400
Trib 1	MAIN	Both	103.778	1713.911
Trib 2	MAIN	Both	58.205	3939.517
FM 88	REACH 1	Both	1645.340	12056.290
W Hargill DR	DS1	Both	214338.900	222187.500
	DS2	Both	202313.100	214338.900
La Sal Vieja	REACH 1	Both	4385.192	19393.500
N Hargill Dr	DS	Both	201934.800	202200.200

Table 2C: Delta South Main Model Segment Damage Reaches

STREAM	DAMAGE REACH	BANK	DOWNSTREAM STATION	UPSTREAM STATION
Delta South Main	Reach 1A	Both	56706.000	72438.000
	Reach 1B	Both	29898.000	56706.000
	Reach 1C	Both	196.869	29898.000

Table 2D: North Main Drain Model Segment Damage Reaches

STREAM	DAMAGE REACH	BANK	DOWNSTREAM STATION	UPSTREAM STATION
McAllen Lateral	REACH 4	Both	317000.000	333707.000
North Main	REACH 2W1	Both	85628.000	109000.000
	REACH 2W2	Both	64591.000	85628.000
	REACH 2N1	Both	34191.000	64591.000
	REACH 2N2	Both	11971.000	34191.000
	REACH 2N3	Both	299.000	11971.000
South Main	REACH 3S1	Both	284201.000	315796.000
	REACH 3S2	Both	234280.000	284201.000
Main Floodwater	REACH 1A	Both	206000.000	233824.000
	REACH 1B	Both	182000.000	206000.000
	REACH 1C	Both	150000.000	182000.000
	REACH 1D	Both	102000.000	150000.000
	REACH 1E	Both	48000.000	102000.000
	REACH 1F	Both	0.000	48000.000

4.2 STRUCTURE INVENTORY

Tables 3A - 3D indicate the structure counts by stream and damage reach, and identify the "Damage Categories" which are used to consolidate and group different types of structures and provide a more detailed analysis of the structural damages caused by flooding in the study areas. These are broken down into:

- Residential
- Commercial
- Industrial
- Public Facilities

The commercial and industrial damage categories were combined to simplify the modeling. The residential damage category included single family, multi-family, and mobile home dwellings. The public facilities were structures operated by a government entity. As mentioned previously, the price index was set to one since all the appraisal information provided by Hidalgo County and Willacy County were current for 2023. Adjustments will be made when updated with 2025 dollar values. A listing of the Damage Categories is available upon request. For each of these damage categories, different structure types were assigned to differentiate the depth-to-damage functions for both the structure and the contents. These are structure types are referred to as Structure Occupancy Types.

Table 3A: Willacy Segment Structure Inventory

STREAM	DAMAGE REACH	RESIDENTIAL	COMMERCIAL	PUBLIC	TOTAL
Raymondville	SAN PERLITA	1466	173	45	1684
	RAY EAST	1238	242	61	1541
	RAY WEST	194	31	4	229
TOTALS		2898	446	110	3454

Table 3B: Raymondville Model Segment Structure Inventory*

STREAM	DAMAGE REACH	RESIDENTIAL	COMMERCIAL	PUBLIC	TOTAL
Lateral 5	REACH 1A	1	1		2
	REACH 1B				
Lateral 4	REACH 1				
Lateral 3	REACH 1A	1	1		2
	REACH 1B	2			2
	REACH 1C	2			2
Trib 1	MAIN				
Trib 2	MAIN				
FM 88	REACH 1	2			2
W Hargill DR	DS1	208	8	7	223
	DS2	16			16
La Sal Vieja	REACH 1	3	1		4

N Hargill Dr	DS				
TOTALS		235	11	7	253

* Several of the stream reaches in the Raymondville Model have no structures.

Table 3C: Delta South Main Model Segment Structure Inventory

STREAM	DAMAGE REACH	RESIDENTIAL	COMMERCIAL	PUBLIC	TOTAL
DELTA SOUTH MAIN	REACH 1A	162	5	5	172
	REACH 1B	110	2	2	114
	REACH 1C	299	18	4	321
TOTALS		571	25	11	607

Table 3D: North Main Drain Model Segment Structure Inventory

STREAM	DAMAGE REACH	RESIDENTIAL	COMMERCIAL	PUBLIC	TOTAL
McAllen Lateral	REACH 4	697	35	3	735
North Main	REACH 2W1	0	0	0	0
	REACH 2W2	245	10	0	255
	REACH 2N1	1333	218	18	4066
	REACH 2N2	2485	61	8	2554
	REACH 2N3	194	2	0	196
TOTALS		4954	326	29	7806

4.2.1 Summary of Structure Types and Values

The structure values were obtained from the Hidalgo County and Willacy County appraisal districts for 2023 calendar year. Hidalgo County and Willacy County provided the current appraisal values for each structure within the future flow, 500-year flood envelope. Only the improvement value was utilized for this analysis, since typically the land value would not be subject to flood damage. If, due to an error in the provided appraisal district data, the structure did not have an assigned improvement value, an average of the adjacent structure with the same occupancy type was utilized.

The structures were again revised based on 2025 appraisal values. As documented in the main report, real estate values in the region are well below national and Texas home price averages. The PDT compared the 2023 and 2025 appraised values and adjusted the structure values for the study area. The increased structure values still remain below Texas averages. These values are presented in thousands of dollars, as shown in Tables 4A - 4D below.

The PDT evaluated future structure values by evaluating depreciation vs. appreciation. Nationally, increases in construction and material costs, and real estate values have increased significantly post-Pandemic. Upon calculating the structure value over 20 years, the appreciation vs. depreciation of the original homes each increase the value of the structure by approximately 45% (long-term average). The assumption is that full market value is a proxy offsetting negative depreciation (increased value and

replacement cost). Therefore, the structure values described above were used as the depreciated value, with the understanding that future property values used in the economics would be conservative, and not overestimate benefits.

Table 4A: Willacy Model Segment Structure Inventory Value by Damage Reach ($1000)

STREAM	DAMAGE REACH	RESIDENTIAL	COMMERCIAL	PUBLIC	TOTAL
Raymondville	SAN PERLITA	$5,782.48	$1,646.15	$211.97	$7,640.60
	RAY EAST	$77,300.31	$49,647.62	$7,582.24	$134,530.20
	RAY WEST	$73,621.14	$23,879.00	$4,818.66	$102,318.80
TOTALS		$56,703.90	$75,172.77	$1,2612.87	$244,489.60

Table 4B: Raymondville Model Segment Structure Inventory Value by Damage Reach ($1000)

STREAM	DAMAGE REACH	RESIDENTIAL	COMMERCIAL	PUBLIC	TOTAL
Lateral 5	REACH 1A	74.46	6.71		$81.17
	REACH 1B				$0
Lateral 4	REACH 1				$0
Lateral 3	REACH 1A	164.84	335.40		$500.24
	REACH 1B	201.24			$201.24
	REACH 1C	153.75			$153.75
Trib 1	MAIN				$0
Trib 2	MAIN				$0
FM 88	REACH 1	86.58			$86.58
W Hargill DR	DS1	11,682.03	2,321.25	2,443.67	$16,446.95
	DS2	800.16			$800.16
La Sal Vieja	REACH 1	132.46	166.69		$299.15
N Hargill Dr	DS				$0
TOTALS		$13,295.52	$2,830.05	$2,443.67	$18,569.24

Table 4C: Delta South Main Model Segment Structure Inventory Value by Damage Reach ($1000)

STREAM	DAMAGE REACH	RESIDENTIAL	COMMERCIAL	PUBLIC	TOTAL
DELTA SOUTH MAIN	REACH 1A	$9,335.62	$1,612.37	$16,769.95	$27,717.94
	REACH 1B	$7,577.86	$733.42	$3354	$11,665.28
	REACH 1C	$14,531.38	$1,160.92	$3,166.52	$18,858.82
TOTALS		$31,444.86	$3,506.71	$23,290.47	$58,242.04

Table 4D: North Main Drain Model Segment Structure Inventory Value by Damage Reach ($1000)

STREAM	DAMAGE REACH	RESIDENTIAL	COMMERCIAL	PUBLIC	TOTAL
McAllen Lateral	REACH 4	$242323.90	$76175.02	$25701.81	$344200.70
North Main	REACH 2W1	$0	$0	$0	$0
	REACH 2W2	$16286.66	$723.59	$0	$17010.25
	REACH 2N1	$384084.80	$59946.35	$31977.29	$476008.40
	REACH 2N2	$232213	$18742.31	$31474.07	$282429.40
	REACH 2N3	$16785.62	$552.37	$0	$17337.99
TOTALS		$891694	$156139.60	$89153.17	$1136987

4.2.2 Hydrology Design Task Protocol

For Residential properties the structures were broken out between single family homes one story, single family multiple stories, mobile homes, and multi-family dwellings. (Note: basements are not considered.) The structure and contents depth to damage and standard deviation of damage tables are from the Corps of Engineers 'Economic Guidance Memorandum (EGM) 01-03' except for the mobile home which is from the 'FIA Depth-Damage Data'. Each resident is assumed to have one vehicle on site during the flooding event and the vehicle's depth to damage and standard deviation was chosen with a value of 15% of the structure value. The content's depth to damage tables were developed using 100% of the value of the structure. This ratio was not utilized for commercial and public structures. For these types of structures, it is likely any vehicles will have been relocated prior to the flooding event. However, this ratio was utilized for all residential occupancy types. For residential occupancy types a value of fifteen percent (15%) of the structure value was utilized. This value was based on the reasoning that although most residences have two vehicles, one vehicle would need to be used for the residents to evacuate the area during the flooding event.

4.2.3 Inundation Damage Functions

The economics module of the flood damage assessment section is where the stage-damage functions with uncertainty are produced to determine the flood damage reductions for the alternative plans. Using the without project flooding envelope for the projected Year 2084, 500-year storm event, a total affected area was determined. This exhibit is in Attachment C of this Appendix. This envelope delineates the area of interest, and the county tax records were used to identify the individual parcels within the limits of the project flooding envelope. Information from the Hidalgo County and Willacy County Tax Appraisals were used to determine the type of structure and value of the improvements for each parcel. The Willacy model was created by the Corps of Engineers Galveston District and provided for reference in this report. Depth-to-damage functions provide a representation of the percentage of structure damage per incremental foot of inundation. The depth-to-damage functions used for this study were obtained from various reports prepared by the USACE Galveston District.

Foundation height was based on Hidalgo and Willacy County Appraisal District descriptions, and an analysis of Google map street view using a sampling of properties throughout the study area. The property inventory is primarily made-up of older properties, and the PDT determined that slab foundations are located on average 1' above ground, and mobile structures are 2.5' above ground.

4.2.4 Agricultural Damages

Cropland is the predominant use of working lands in Hidalgo and Willacy Counties, and the northern portion of Hidalgo and northwest portion of Willacy have working lands classified as ranch lands. These counties are home to some of the most fertile farmlands in the region, so protection of farmland and ranchland is regionally important. The 2023 Lower Rio Grande Regional Flood Plan identified that Hidalgo County had the largest number and value of crop damage incidents in the LRGV in the past 20 years (61 events for $163,000,000), and Willacy was second (31 events for $137,200,000). Figures 2 and 3 show typical row crops along the existing Raymondville Drain, indicating the flat nature of the area. Left without the risk reduction of the RDP, large agricultural areas remain susceptible to flooding for extended periods. Based on the 2022 USDA Census of Agriculture County Profiles (https://www.nass.usda.gov/Publications/AgCensus/2022/Online_Resources/County_Profiles/Texas/), croplands make up 94% of agricultural lands in Hidalgo County and 95% of agricultural lands in Willacy County, confirming their vulnerability to flooding.

Figure 2 Row crops along Raymondville Drain

Figure 3 Row crops along Raymondville Drain

As a Smart Planning study, streamlined methods were used to estimate agricultural damages. Since agricultural damages were ultimately determined to be less than 10% of the overall economic benefits, and significant justification of this proposed project is ultimately social benefits, the PDT determined that the streamlined methodology was an appropriate risk-informed level of effort and is documented in the study Risk Register. A USACE Flood Impact Analysis (FIA) model was too resource intensive for a 3x3 study of a basin this large. The conservative values for agricultural damages are consistent with the level of analysis employed. As the agricultural damage reductions are assumed to be similar for the two final Alternatives, use of this streamlined method did not impact plan selection, and therefore is appropriate for this Smart Planning study.

The PDT analyzed the study area, the RD and NMD watersheds, and land use patterns to more accurately determine location of agricultural lands and their vulnerability to flooding and economic damages. Evaluation of aerial photography, Google maps and USDA agricultural resources provided a basis for the analysis. This analysis determined weighted percentages of agricultural lands in the different areas of the basin to calculate damages prevented.

In Hidalgo County, the agricultural lands are generally in the northern portions of the county, and the urbanized areas are in the southern portions. Approximately 49% of the County is agricultural, and the remainder is more urbanized. Some of the agricultural areas are in the rural northern portion of the county, outside of the RVD watershed. The majority of the populated areas in Hidalgo County are located in the southern portions of the county, primarily within the NMD and IWBC North Floodway watersheds. Approximately 95% of the RD watershed in Hidalgo County is agricultural. This agricultural area represents approximately 32% of the County's total agricultural lands, and based on analysis, the PDT concluded that 32% of the agricultural damages in Hidalgo County occur in the RD basin.

Willacy County is primarily agricultural, however most of the development in the RD basin within the County is located in towns along the drain. Therefore, the RD basin in Willacy is 75% agricultural and 25% urban. There are significant reductions in agricultural damages in Willacy County since RD drains the majority of the County. Approximately 62% of Willacy County land falls within the RVD watershed, so the assumption is that 62% of the annual agricultural damages in Willacy County occurs within the RD basin.

Table 5 Agricultural Land Use and Flood Envelope

County	Total Co Area (AC)	Area within Watershed (AC)	100 yr Flood Envelope (AC)	Total Ag. Land (AC)
Hidalgo	1,005,400	490,636	165,022	156,771
Willacy	337,984	289,398	235,094	179,997

Due to the flat topography in the LRGV, flooding in the study area is of long duration. Floodwaters inundate large agricultural areas, improved pastures, and urban areas for long periods, resulting in extensive damage to crops, properties, and structures. The USACE HEC Agriculture Damage Consequences Documentation Procedures (https://www.hec.usace.army.mil/confluence/agdocs/agriculture-damage-computation-proceedures-

43820820.html), outlines methods for computation of agricultural damages. This process was adapted for this analysis.

To estimate a crop loss rate, the PDT referred to the Seasonally Based Duration Damage flood duration curves from the above referenced USACE document, shown as Figure 4. Damage to crops depends on the location, timing of the event and the duration of the event. The timing determines if the crops are planted, and how far the crop is in the production cycle. The duration defines how much damage the crop will sustain. Based on storms documented in Section 1.7 of the main report, major floods in the LRGV are tropical-related storms and include the two ”"Great June” floods. This results in flooding of crops at the more vulnerable times of June through August. Since flood durations far exceed the 1-day and 3-day duration curves in Figure 4, damages are expected to exceed those percentages indicated on the curves. The long-duration flooding experienced in the LRGV has more lasting impacts on the agricultural fields than typical shorter-term flooding, and has larger impacts on farming schedule adjustments, increasing damage. Therefore, a weighted loss crop loss rate from flooding in the study area is assumed to be 90%.

The reduction in flood damages from the proposed RDP was determined from the detailed FDA analysis done for property damage (Table 6). In Hidalgo County, this damage reduction factor was determined to be 59%. For Willacy County, the reduction factor was 84%.

Table 6 Property Flood Damage Reduction Percentages

County	EQUIVALENT ANNUAL DAMAGE (EAD) W/O PROJECT	EQUIVALENT ANNUAL DAMAGE (EAD) WITH PROJECT	B_{IR} EAD (W/O) - EAD (W)	Percent Reduced
Hidalgo	$5,452,740	$2,237,480	$3,215,260	59%
Willacy	$8,516,230	$1,344,240	$7,171,990	84%

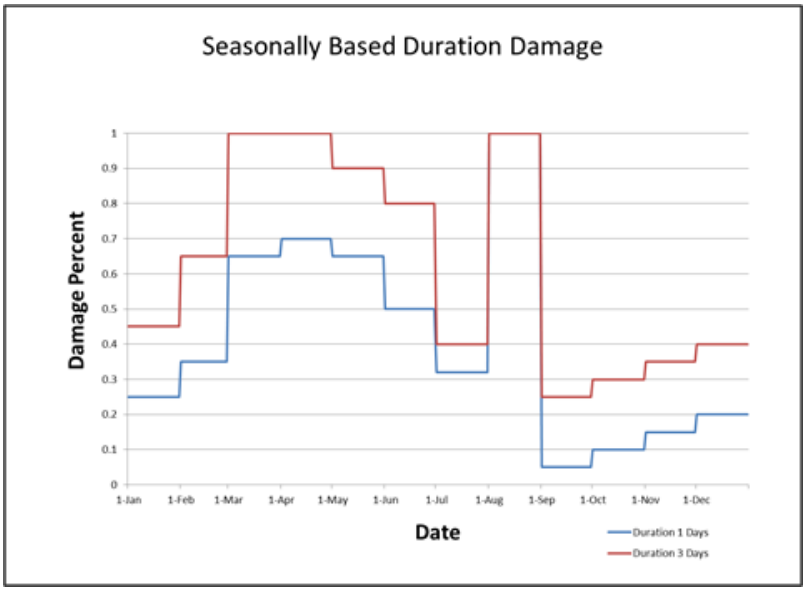

Figure 4 Seasonally Based Duration Damage (Source: USACE Agriculture Damage Computation Procedures)

The agricultural damages documented in the 2023 Lower Rio Grande Valley Regional Flood Plan, as described above, and confirmed by NOAA data, provide the best available documented evidence of flood losses in the study area. Table 7A apportions annual agricultural flood damage reduction by County. This computation is based on the 90% crop loss rate determined above, and assumes the above reductions in agricultural damages by County. Table 7B shows damages increased by 15% to account for non-structural damages to agricultural infrastructure (including emergency costs, transportation costs, utility costs and non-physical damages). Documentation on these additional benefits is included in Attachment B, Section 5.

Table 7A Computed Agricultural Damage Reductions

	20-YR Cumulative agricultural Damage	Estimated Total Annual Agricultural Damage	Estimated Crop Loss Rate (90%)	% of Agricultural Land in Watershed	Crop Loss Within Watershed (Without Project)	% Reduction in Damage	Crop Benefit Within Watershed (With Project B_{IR})
Hidalgo County	$163,000,000	$8,150,000	$7,335,000	32%	$2,343,720	59%	$1,382,795
Willacy County	$137,200,000	$6,860,000	$6,174,000	62%	$3,840,034	84%	$3,225,629

Table 7B Computed Agricultural Damage Reductions including Non-Structural Damages

	Agricultural B_{IR}	Agricultural B_{IR} * 1.15
Hidalgo County	$1,382,795	$1,590,214
Willacy County	$3,225,629	$3,709,473
TOTAL	**$4,608,424**	**$5,299,687**

By using actual documented crop loss data rather than computing theoretical computational (modeled) values which can be difficult to calibrate, the abbreviated methodology described above is assumed to provide a reliable and more justified damage estimate. Since this estimate is a small portion of the total damages, it provides acceptable accuracy consistent with a Smart Planning effort, and did not impact plan selection. Additionally, to ensure that these numbers and damage assumptions are conservative and do not add excessive or unjustified benefits, the PDT did not calculate the additional agricultural damage reduction occurring within the NMD basin.

4.2.5 Risk and Uncertainty Parameters

Uncertainty parameters were incorporated into the HEC-FDA model, as appropriate for this study. The vast majority of structures modeled utilize damage error functions. The risk and uncertainty assumptions used in this Feasibility did not impact plan selection, and therefore are appropriate for this Smart Planning study.

Within the HEC-FDA model, the option for the Defined Uncertainty for the First Floor Stage was designated as normal with an uncertainty of 0.1 feet. This value was selected based on Figure 5 (Table 9.1 of the HEC-FDA User's Manual), since the LIDAR utilized was obtained with ground control. The level of detail in this type of survey exceeds what USACE would do in a normal feasibility study, therefore this level of error is reasonable, and benefit values are conservative.

Table 9.1
Uncertainty Based on Measurement Methods

Method	Contour Interval (ft)	Error (ft)	Standard Deviation (ft)
Field survey			
Hand level	NA	± 0.2 @ 50'	0.1
Stadia	NA	± 0.4 @ 500'	0.2
Conventional level	NA	± 0.05 @ 800'	0.03
Automatic level	NA	± 0.03 @ 800'	0.02
Aerial survey			
	2'	± 0.59	0.3
	5'	± 1.18	0.6
	10'	± 2.94	1.5
Topographic map			
	2'	± 1.18	0.6
	5'	± 2.94	1.5
	10'	± 5.88	3

Figure 5: Uncertainty Based on Measurement Methods (Table 9.1 of the HEC-FDA User's Manual)

Damage error functions were most of the residential properties, which provided the vast amount of damages. The error Standard Deviation values used in the model were adapted from the Pearl River study, which were determined to be similar in nature of structures and damages. These depth damage error tables were provided by the Galveston District. A normal distribution of values was assumed.

Damage error functions for commercial or public damages were used for Willacy County, which contains the bulk (68%) of the commercial and public structures, but not for Hidalgo County. Damages for commercial and public properties were determined to be a small portion of overall damages (approximately 10%). Therefore, omitting damage distribution from those values would not impact plan selection or project feasibility. However, the benefits may be slightly lower than with a damage function, so the damage values are conservative.

The HEC-FDA model allows error for in property values. However, structure values used in the model were obtained from current (2023 certified) Willacy and Hidalgo County Assessment values, and adjusted to current year, as described in the Economics Appendix, and are therefore considered to be reliable. Additionally, the low property values in the region add an additional level of confidence that the project is feasible.

Using HEC-FDA, a stage-damage function is the relationship between a range of elevations and monetary damages based on the assigned depth-to-damage table, analysis year, stream, and damage reach per category. This process is automatically calculated by the program for each structure using both analysis years (current and mostly likely future). The module also computes a reach-stage-damage function with normal deviation of uncertainty based on input water surface profile, stage-discharge with uncertainty functions, and corresponding depth-to-damage functions.

Below is a general overview of the computation steps to calculate a stage-damage function for a given plan/analysis year combination:

- For each damage reach, HEC-FDA calculates the range of stages at the index location. The stage represents a range from “very frequent” to “very infrequent” events based on the input functions and the related uncertainty.
- For the selected alternative plan/analysis year, HEC-FDA filters the structures using the structure module assignments so that it will process only those structures which are assigned to the selected modules(s). It will also filter the structures based on the “Year-in-Service”.
- HEC-FDA processes each of the filtered structures. It transforms the tabulation stages that were determined in Step 1 from the index location to the structure. This transformation utilizes the input water surface profiles.
- HEC-FDA checks each structure to see if it has invalid data and to see if the structure is “out of the floodplain”. HEC-FDA will immediately proceed to the next structure if either case exists.
- HEC-FDA determines the damage category, structure occupancy type, and damage reach, and then computes stage-damage at each of the tabulation stages for a structure. Flood damages are computed for the structure, contents, other and total. The flood damage of each tabulations stage is then aggregated to the index locations. During the calculations, the stage-aggregated damage functions are stored in memory. After all the filtered structures are processed, the stage-aggregated damage functions are transferred and stored in the HEC-FDA study files.

4.2.6 Without-Project Expected Damages (Excluding Agricultural Damages)

Tables 8A – 8E summarize the without-project expected damages by model segment. These tables exclude agricultural damages, which are summarized in section 4.2.4.

Table 8A: Summary of Without-Project Expected Damages by Reaches ($1,000)

*W/O PROJECT (EQUIVALENT ANNUAL FLOOD DAMAGE REDUCTION [$1000]) STRUCTURAL DAMAGES ONLY				
WATERSHED	**EQUIVALENT ANNUAL DAMAGE (EAD) W/O PROJECT**	**EQUIVALENT ANNUAL DAMAGE (EAD) WITH OUT PROJECT**	**B_{IR} EAD (W/O) - EAD (W)**	**B_{IR} WITH OTHER FLOOD DAMAGE COSTS [EAD (W/O) - EAD (W)]*1.39**
WILLACY	$8,516.23	$8,516.23	$0.00	$0.00
RAYMONDVILLE DRAIN	$268.84	$268.84	$0.00	$0.00
DELTA LAKE	$5,183.90	$5,183.90	$0.00	$0.00
NORTH MAIN DRAIN	$51,683.74	$51,683.74	$0.00	$0.00
TOTAL	**$65,652.71**	**$65,652.71**	**$0.00**	**$0.00**

Table 8B: Willacy Model Segment Summary of Without-Project Expected Damages by Reaches ($1,000) Structures Only

STREAM	DAMAGE REACH	RESIDENTIAL	COMMERCIAL	INDUSTRIAL	PUBLIC	TOTAL
Raymondville	SAN PERLITA	$3060.11	$523.65	$0.00	$69.43	$1684
	RAY EAST	$3572.11	$377.81	$1.16	$82.97	$1541
	RAY WEST	$716.60	$101.28	$4.64	$6.46	$229
TOTALS		$7348.82	$1002.74	$5.80	$158.86	$3454

Table 8C: Raymondville Model Segment Summary of Without-Project Expected Damages by Reaches ($1,000) Structures Only

STREAM	DAMAGE REACH	RESIDENTIAL	COMMERCIAL	PUBLIC	TOTAL
Lateral 5	REACH 1A		$0.1		$0.1
	REACH 1B	$2.32			$2.32
Lateral 4	REACH 1				
Lateral 3	REACH 1A	$0.51			$0.51
	REACH 1B	$0.25	$0.1		$0.26
	REACH 1C				
Trib 1	MAIN				
Trib 2	MAIN				
FM 88	REACH 1	$17.18			$17.18
W Hargill DR	DS1	$9.30			$9.30
	DS2	$212.43	$3.50	$23.06	$238.99
La Sal Vieja	REACH 1	$0.15	$0.12		$0.27
N Hargill Dr	DS				
TOTALS		$242.14	$3.82	$23.06	$268.93

Table 8D: Delta Lake Summary of Without-Project Expected Damages by Reaches ($1,000) Structures Only

STREAM	DAMAGE REACH	RESIDENTIAL	COMMERCIAL	PUBLIC	TOTAL
DELTA SOUTH MAIN	REACH 1A	$3675.21	$102.54	$2.9	$3780.65
	REACH 1B	$887.65	$93.13	$4.71	$985.49
	REACH 1C	$345.30	$32.38	$40.45	$418.12
TOTALS		$4908.16	$228.05	48.05	$5184.26

Table 8E: North Main Drain Without-project Expected Annual Damages by Reaches ($1,000) Structures Only

STREAM	DAMAGE REACH	RESIDENTIAL	COMMERCIAL	PUBLIC	TOTAL
McAllen Lateral	REACH 4	$4707.16	$1120.99	$213.95	$6042.10
North Main	REACH 2W1	$0	$0	$0	$0
	REACH 2W2	$2691.07	$45.64	$0	$2736.71
	REACH 2N1	$13588.78	$2399.07	$856.14	$16844.00
	REACH 2N2	$20303.76	$897.90	$430.96	$21632.62
	REACH 2N3	$4414.22	$14.10	$0	$4428.32
TOTALS		$45704.99	$4477.70	$1501.05	$51683.75

SECTION 5 EVALUATION OF ALTERNATIVES

5.1 ORGANIZATION OF ALTERNATIVES FOR ECONOMIC EVALUATION

Three alternatives made the cut to the economic analysis round for this study. One nonstructural and two structural options were evaluated. The two structural Alternatives are shown in Figure 6.

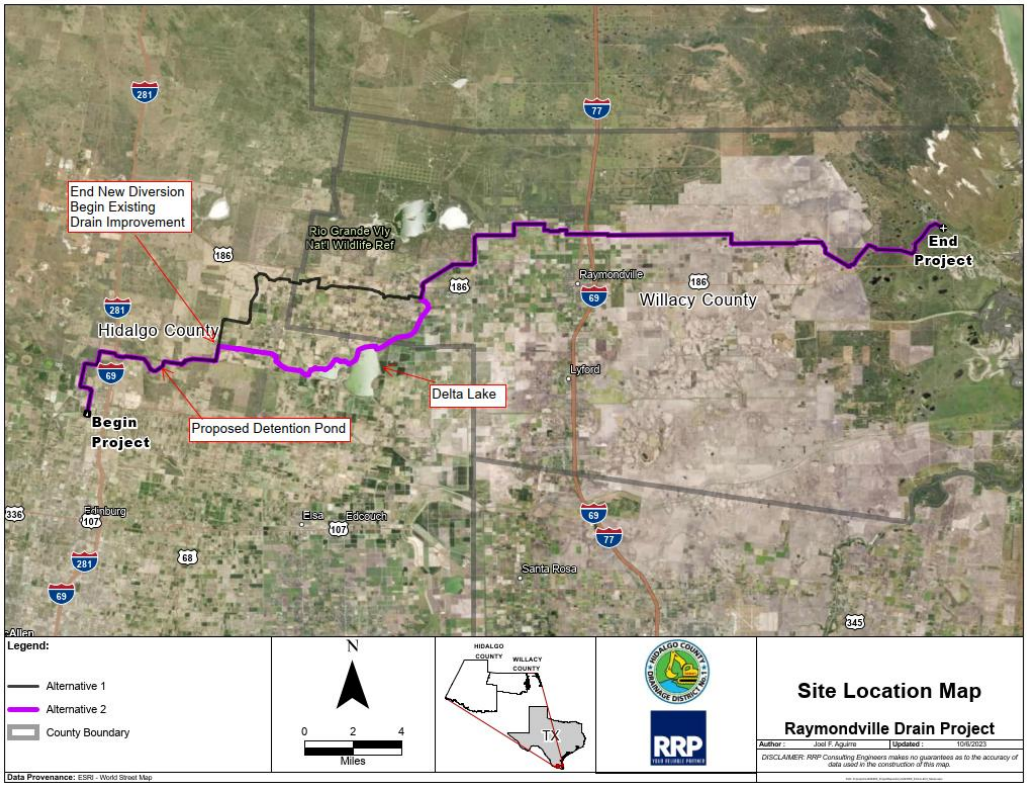

Figure 6: Final Structural Alternatives

5.2 BUYOUT ALTERNATIVE (NONSTRUCTURAL ALTERNATIVE)

5.2.1 Features

Non-structural alternatives were evaluated during the process. The first identified was removing the structures within the 4% annual chance event (25-year) and the 1% event (100-year) flooding envelope to reduce the damages. The tables below show the costs of buying-out the structures and benefits due to the removal of the properties. Table 9A shows the number of structures that would be bought-out that reside in the 4% / 25-year flooding envelope, and Table 9B shows the 1% / 100-year flooding envelope.

Table 9A: Structure Inventory Buyout Structure Summary by Sub-basin - 25-year (4%) (Structure Count)

STREAM	RESIDENTIAL	COMMERCIAL	PUBLIC	TOTAL
North Main Drain	1717	76	7	1800
Delta Lake	439	16	3	458
Raymondville Drain	39	0	2	41
Willacy (RVD)	1823	158	40	2021
TOTALS	4018	250	52	4320

Table 9B: Structure Inventory Buyout Structure Summary by Sub-basin – 100-year (1%) (Structure Count)

STREAM	RESIDENTIAL	COMMERCIAL	PUBLIC	TOTAL
North Main Drain	7450	326	30	7806
Delta Lake	571	25	11	607
Raymondville Drain	220	11	6	237
Willacy (RVD)	2899	446	110	3455
TOTALS	11,140	808	157	12,105

5.2.2 Residual Damages and Benefits

Table 10 documents damage reduction and benefits of the buyout of properties in the 4% / 25-year flooding envelope.

Table 10: Benefits and Damage Summary of 25-Year Buyout Alternative (in $1000's)

STREAM	DAMAGE REACH	WITHOUT PROJECT DAMAGES	WITH BUYOUT DAMAGES	DAMAGE REDUCTION BENEFITS
North Main Drain	All	$51,683.74	$12,059.02	$39,624.72
Delta	All	$5,183.90	$107.22	$5,076.68
Raymondville (Hildago)	All	$268.84	$120.57	$148.27
Raymondville (Willacy)	All	$8,516.23	$3,229.45	$5,286.78
TOTALS		$65,652.71	$15,516.26	$50,136.45

5.2.3 Cost Estimates

Table 11 summarizes estimated buyout costs. Costs include property purchase including various administrative costs, and demolition / restoration costs. This is based on information in Appendix A-4, Real Estate.

Table 11: Summary of Buyout Costs

	Unit Cost	Alt 3- 25-year Buyout	Alt 3- 100-year Buyout
Approximate structures impacted		4,320	12,105
Admin costs (Public relations, Survey, Title, appraisal, ROW) per structure	$7,750	$33,480,000	$93,810,000
Property Acquisition and relocation per structure	$400,000	$1,728,000,000	$4,740,000,000
Demolition and Restoration Cost per property	$61,500	$265,680,000	$729, 145,000
Condemnation costs (Total - assume 15% of properties)		$6,480,000	$18,158,000
Estimated Cost		**$2,034,000,000**	**$5,581,000,000**
OMRR&R		N/A	N/A
Est. Cost per Structure Benefitted		$471,000	$461,000

5.2.4 Buyout Alternative Recommendations

Buyouts at the 4% / 25-year and 1% / 100-year level are not economically justified as these are the costliest project alternative analyzed. The costs exceed the benefits (damages reduced), and the cost per structure benefited is in the range of 20-times greater structural alternatives examined below.

5.3 ALTERNATIVE 1 (STRUCTURAL)

5.3.1 Features

A proposed new bypass channel that diverts a portion of conveyance stormwater with a lateral gate from North Main Drain to Lateral 5 of Raymondville Drain along with channel improvements to the following streams: Lateral 5, Lateral 3, and West and North Hargill Drain of Raymondville Drain, and channel improvements continuing westward through stream Raymondville in Willacy County to the outfall at the Laguna Madre. In addition, due to the north/south alignment of the new bypass channel, storm water runoff is intercepted and diverted from North Main Drain and Delta Lake watersheds to Lateral 5 of Raymondville Drain. This Alternative is shown as the black line in Figure 4, and a more detailed description is in Section 3.7.6 of the main report.

5.3.2 Residual Damages and Benefits

Tables 12A – 12E summarize the damages and benefits for Alternative 1 by model segment. The inundation benefit (B_{ir}) has been increased by 39% to account for non-structural damages including emergency costs, transportation costs, utility costs and non-physical damages. Detailed documentation on the computation of these additional benefits is included in Attachment B, Section 5.

Table 12A: Summary of Damages and Benefits for Alt 1 by Damage Reaches ($1,000)

*ALTERNATIVE 1 (EQUIVALENT ANNUAL FLOOD DAMAGE REDUCTION [$1000])				
WATERSHED	EQUIVALENT ANNUAL DAMAGE (EAD) W/O PROJECT	EQUIVALENT ANNUAL DAMAGE (EAD) WITH PROJECT	BIR EAD (W/O) - EAD (W)	BIR WITH OTHER FLOOD DAMAGE COSTS [EAD (W/O) - EAD (W)]*1.39
WILLACY	$8,516.23	$1,344.24	$7,171.99	$9,969.07
RAYMONDVILLE DRAIN	$268.84	$46.74	222.1	$308.72
DELTA LAKE	$5,184.26	$2,206.42	$2,977.84	$4,139.20
NORTH MAIN DRAIN	$51,683.74	$38,263.15	$13,420.59	$18,654.62
AGRICULTURAL (RVD)			$4,608	$5,300*
TOTAL	**$65,653**	**$41,861**	**$28,401**	**$38,372**

** Agricultural damages increased by a factor of 15%, per paragraph 4.2.4.*

Table 12B: Willacy Model Segment Summary of Damages and Benefits for Alt 1 by Damage Reaches ($1,000)
Structures Only

STREAM	DAMAGE REACH	WITHOUT PROJECT DAMAGES	WITH ALTERNATIVE 1 DAMAGES	DAMAGE REDUCTION BENEFITS
Raymondville	SAN PERLITA	$828.98	$356.70	$472.28
	RAY EAST	$3653.19	$616.33	$3036.85
	RAY WEST	$4034.04	$371.21	$3662.86
TOTALS		$8516.23	$1344.24	$7171.99

Table 12C: Raymondville Model Segment Summary of Damages and Benefits for Alt 1 by Damage Reaches ($1,000)
Structures Only

STREAM	DAMAGE REACH	WITHOUT PROJECT DAMAGES	WITH ALTERNATIVE 1 DAMAGES	DAMAGE REDUCTION BENEFITS
Lateral 5	REACH 1A	$0.01	$0.00	$0
	REACH 1B	$2.32	$1.81	$1
Lateral 4	REACH 1	$0	$0	$0
Lateral 3	REACH 1A	$0.51	$0.21	$0
	REACH 1B	$0.26	$0.09	$0
	REACH 1C	$0	$0	$0

Trib 1	MAIN	$0	$0	$0
Trib 2	MAIN	$0	$0	$0
FM 88	REACH 1	$17.18	$17.05	$0
W Hargill DR	DS1	$9.30	$3.52	$6
	DS2	$238.99	$23.98	$215
La Sal Vieja	REACH 1	$0.27	$0.08	$0
N Hargill Dr	DS	$0	$0	$0
TOTALS		$268.84	$46.74	$222

Table 12D: Delta Lake Summary of Damages and Benefits for Alt 1 by Damage Reaches ($1,000) Structures Only

STREAM	DAMAGE REACH	WITHOUT PROJECT DAMAGES	WITH ALTERNATIVE 1 DAMAGES	DAMAGE REDUCTION BENEFITS
DELTA SOUTH MAIN	REACH 1A	$3780.65	$1513.15	$2267.49
	REACH 1B	$985.49	$213.18	$772.31
	REACH 1C	$418.12	$480.09	-$61.96
TOTALS		$5184.26	$2206.42	2977.84

Table 12E: North Main Drain Summary of Damages and Benefits for Alt 1 by Damage Reach ($1,000) Structures Only

STREAM	DAMAGE REACH	WITHOUT PROJECT DAMAGES L	WITH ALTERNATIVE 1 DAMAGES	DAMAGE REDUCTION BENEFITS
McAllen Lateral	REACH 4	$6042.10	$6042.10	$0
North Main	REACH 2W1	$0	$0	$0
	REACH 2W2	$2736.71	$2091.92	$644.79
	REACH 2N1	$16844.00	$7747.94	$9096.06
	REACH 2N2	$21632.62	$18060.99	$3571.62
	REACH 2N3	$4428.32	$4320.20	$108.11
TOTALS		$51683.75	$38263.15	$13421.00

5.3.3 Cost Estimate

To prepare the benefit-cost ratios that are to be utilized for the comparison of the alternative plans, detailed quantity and cost estimates were completed. Quantity items and the preliminary cost estimates were based on current itemized construction costs from previously developed designs. Details on development of this cost estimate is found in Appendix 2, Cost Estimate. A summary of the project construction cost and the total project costs for Alternative 1 is found in Table 13.

Table 13: Summary of Alternative 1 First Construction Costs

	ALTERNATIVE 1
Construction Cost	$ 586,870,392
5% Contingency	$ 29,343,519.60
Design During Construction	$ 7,042,444.70
Overhead (SIOH)	$ 44,015,279.40
Real Estate Cost	$ 10,758,875
Utility Relocation	$ 29,000,000
Design Fee (6%)	$ 38,212,223.52
First Cost of Construction	$ 745,242,734.22

5.4 ALTERNATIVE 2

5.4.1 Features

The primary difference between this Alternative and Alternative 1 is that starting downstream of the proposed detention basin and east of the airport, this Alternative conveys diverted flow into the Delta Lake Drain, a more southerly route passing along the north side of Delta Lake, while Alternative 1 continues northward to connect to the West Hargill Drain, with both Alternatives connecting to RD northeast of Lasara. This Alternative is shown as the purple line in Figure 4, and a more detailed description is in Section 3.7.6 of the main report.

5.4.2 Residual Damages and Benefits

Tables 14A - 14E summarize the damages and benefits for Alternative 2 by model segment.

Table 14A: Summary of Damages and Benefits for Alt 2 by Damage Reaches ($1,000)

*ALTERNATIVE 2 (EQUIVALENT ANNUAL FLOOD DAMAGE REDUCTION [$1000])				
WATERSHED	EQUIVALENT ANNUAL DAMAGE (EAD) W/O PROJECT	EQUIVALENT ANNUAL DAMAGE (EAD) WITH PROJECT	BIR EAD (W/O) - EAD (W)	BIR WITH OTHER FLOOD DAMAGE COSTS [EAD (W/O) - EAD (W)]*1.39
WILLACY	$8,516.23	$1,464.14	$7,052.09	$9,802.41
RAYMONDVILLE DRAIN	$268.84	$62.82	$206.02	$286.37
DELTA LAKE	$5,183.90	$120.00	$5,063.90	$7,038.82
NORTH MAIN DRAIN	$51,683.74	$38,263.15	$13,420.59	$18,654.62
AGRICULTURAL (RVD)			$4,608,424	$5,299,687 *
TOTAL	**$65,652.71**	**$39,910.11**	**$25,742.60**	**$41,081.90**

** Agricultural damages increased by a factor of 15%, per paragraph 4.2.4.*

Table 14B: Willacy Model Segment Summary of Damages and Benefits for Alt 2 by Damage Reaches ($1,000)

STREAM	DAMAGE REACH	WITHOUT PROJECT DAMAGES	WITH ALTERNATIVE 2 DAMAGES	DAMAGE REDUCTION BENEFITS
Raymondville	SAN PERLITA	$828.98	$683.74	$2969.44
	RAY EAST	$3653.19	$416.81	$3617.26
	RAY WEST	$828.98	$363.59	$465.38
TOTALS		$8516.23	$1464.14	$7052.09

Table 14C: Raymondville Model Segment Summary of Damages & Benefits for Alt 2 by Damage Reaches ($1,000)

STREAM	DAMAGE REACH	WITHOUT PROJECT DAMAGES	WITH ALTERNATIVE 2 DAMAGES	DAMAGE REDUCTION BENEFITS
Lateral 5	REACH 1A	$0.01	$0	$0
	REACH 1B	$2.32	$0	$0.05
Lateral 4	REACH 1	$0	$0	$0
Lateral 3	REACH 1A	$0.51	$0.02	$0.02
	REACH 1B	$0.26	$0	$0.05
	REACH 1C	$0	$0	
Trib 1	MAIN	$0	$0	

Trib 2	MAIN	$0	$0	
FM 88	REACH 1	$17.18	$17.26	-$0.07
W Hargill DR	DS1	$9.30	$5.09	$4.22
	DS2	$238.99	$37.23	$132.99
La Sal Vieja	REACH 1	$0.27	$0.27	$0
N Hargill Dr	DS	$0	$0	$0
TOTALS		$268.84	$59.87	$137.26

Table 14D Delta Lake Summary of Damages and Benefits for Alt 2 by Damage Reaches ($1,000)

STREAM	DAMAGE REACH	WITHOUT PROJECT DAMAGES	WITH ALTERNATIVE 2 DAMAGES	DAMAGE REDUCTION BENEFITS
DELTA SOUTH MAIN	REACH 1A	$3780.65	$51.99	$3728.66
	REACH 1B	$985.49	$12.38	$973.10
	REACH 1C	$418.12	$55.74	$362.38
TOTALS		$5184.26	$120.11	$5064.15

Table 14E: North Main Drain Summary of Damages and Benefits for Alt 2 by Damage Reaches ($1,000)

STREAM	DAMAGE REACH	WITHOUT PROJECT DAMAGES L	WITH ALTERNATIVE 2 DAMAGES	DAMAGE REDUCTION BENEFITS
McAllen Lateral	REACH 4	$6042.10	6042.10	0
North Main	REACH 2W1	0	0	0
	REACH 2W2	2736.71	2091.92	644.79
	REACH 2N1	16844.00	7747.94	9096.06
	REACH 2N2	21632.62	18060.99	3571.62
	REACH 2N3	4428.32	4320.20	108.11
TOTALS		$51,683.74	$38,263.15	$13,420.59

5.4.3 Cost Estimate

A summary of the project construction cost and the total project costs for Alternative 2 are found in Table 15. Details on development of this cost estimate is found in Appendix 2, Cost Estimate.

Table 15: Summary of Alternative 2 First Construction Costs

	ALTERNATIVE 2
Construction Cost	$646,809,366.07
5% Contingency	$ 32,340,468.30
Design During Construction	$ 7,761,712.39
Overhead (SIOH)	$ 48,510,702.46
Real Estate Cost	$ 11,511,575
Utility Relocation	$ 29,000,000
Design Fee (6%)	$ 41,808,561.96
First Cost of Construction	$ 817,742,386.19

SECTION 6 COMPARISON OF ALTERNATIVES

The Benefit to Cost Ratio (BCR) is simply the annualized NED benefit divided by the annualized project costs. The BCR was calculated to determine viability of the individual alternative plans and the subsequent level of federal participation for the project. A BCR below one indicates that the project costs are too high when compared to the benefits provided by the improvements. Note that in addition to economic benefits, this project provides significant Comprehensive Benefits, as documented in the main report.

Table 16 is the Summary of benefits and costs for both alternatives: Alternative 1 and Alternative 2. While both alternatives are similar, the NED Plan (preferred alternative) is Alternative 1 based on net benefits.

Table 16: Summary of Damages and Benefits ($1,000)

	ALTERNATIVE 1	ALTERNATIVE 2
First Cost of Construction	$755,256,509	$828,768,451
Interest During Construction	$99,246,908	$108,906,981
Total Investment	854,503,417	$937,675,432
Average Annual Const. Cost	$30,128,130	$33,060,614
Average Annual Increm. O&M	$1,760,611	$1,940,428
Total Average Annual Cost	$31,888,741	$35,001,042
Total Average Annual Benefits	$38,392,585	$41,081,901
Net Excess Benefits	$6,503,843	$6,080,859
BCR	1.38	1.34

SECTION 7 ATTACHMENTS

Attachment A – FDA Design Task Protocol

Attachment B - Economics Design Task Protocol

Attachment C - FDA Damage Reaches Exhibit, and the Without Project Flooding Envelope for the projected Year 2084, 500-year storm event.