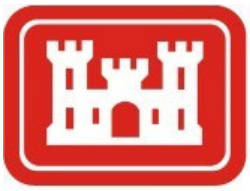
Appendix B – Economics

Lower Guadalupe Feasibility Study
(Guadalupe and Blanco Rivers), TX

Integrated Draft Feasibility Report and Environmental Impact Assessment

December 2019



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STUDY

STUDY AREA

This appendix provides a demographic description of study area and an economic analysis related to the final array of alternatives. The final array of alternatives focused on flood risk measures considered for the damage centers of New Braunfels/Seguin on the Guadalupe River south of Canyon Dam and two damage centers on the Blanco River, Wimberly and San Marcos.

New Braunfels is located in Comal County, Texas and Seguin is located in Guadalupe County, Texas, downstream of New Braunfels. Because the measure considered for economic analysis consisted of a detention upstream of both communities, and because there are several unincorporated communities on the Guadalupe between the two cities, the area was considered as one damage center with two reaches, one centered around New Braunfels and one centered around Seguin.

Both Wimberly and San Marcos lie in Hays County, Texas, with Wimberly lying upstream of San Marcos. Because of the distance between these two damage centers and that the some measures could impact only one of the damage centers, they were treated separately.

All of the damage centers lie in the Texas Hill Country, where upstream portions of the river are are steep and narrow canyons which generate flashy floods with high velocities. In the downstream extents, the terrain begins to flatten out, with a wider floodplain.

DEMOGRAPHICS

POPULATION

Table 1displays the total population, population by sex and population by race/Hispanic origin for four cities within the two damage centers, New Braunfels, Seguin, Wimberly, San Marcos, and for comparison the three counties, Comal, Guadalpue and Hays as well as the State of Texas. In the New Braunfels/Seguin damage center along the Guadalupe River, city of New Braunfels has a total population of 70,317 and is the largest community. It makes up about 55% of the population of Comal County. Seguin has a population of 27,762 and makes up about 18% of the population of Guadalupe County. In the Blanco River damage center, the city of San Marcos has a population of 59,935, which is approximately 31% of the population of Hays County. Wimberly has a population of 2,853, which is approximately 2% of the population of Hays County.

All of the cities and counties in the focused study area have an approximate 49%/51% gender distribution with females making up the larger share. This is similar to the makeup for the state, where the distribution is approximately 50%/50%.

The racial compostion of New Braunfels is 61% white, 2% Black, 34% Hispanic 1% Asian and 1% two or more races. This is similar to Comal County, with 69% white, 2% Black, 27% Hispanic, 1% Asian, and 1% two or more races. Seguin has a higher percentage of Hispanics, with 54%, followed by white, with 36%, Black, 8%, and Asian 2%.

In the Blanco River damage centers, San Marcos is 49% white, 5% Black, 42% Hispanic, 2% Asian and 2% two or more races. Wimberly is 85% white, 13% Hispanic and 1% each for other

and two or more races. Hays Conty is 55% white, 3% Black, 38% Hispanic, 1% Asian and 2 % two or more races.

By comparison, the racial makeup of the State is 42% white, 12% Black, 39% Hispanic, 4% Asian and 2% two or more races.

Table 1. Population by Sex and Race/Hispanic Origin

	2013-2017 5 Year Estimate							
Population Characteristic	**Texas**	**Comal County**	**Guadalupe County**	**New Braunfels**	**Seguin**	**Hays County**	**Wimberly**	**San Marcos**
Total	27,419,612	129,100	150,889	70,317	27,762	194,843	2,853	59,935
Male	13,616,977	63,732	74,611	33,827	13,533	96,973	1,424	28,844
Female	13,802,635	65,368	76,278	36,490	14,229	97,870	1,429	31,091
White	11,755,493	88,661	77,499	42,718	10,001	107,718	2,423	29,217
Black	3,199,022	2,547	10,668	1,563	2,103	6,784	0	3,134
Hispanic	10,673,909	34,565	56,319	23,910	15,043	73,608	371	25,075
American Indian and Alasaka Native	65,883	124	304	36	18	428	6	98
Asian	1,222,975	1,344	2,497	1,011	469	2,503	8	1,127
Native Hawaiian and other Pacific Islander	20,170	44	36	11	0	85	0	7
Other	39,153	132	433	184	16	410	24	31
Two or more races	443,007	1,683	3,133	884	112	3,307	21	1,246

Source: 2013-2017 American Community Survey 5 Year Estimate, U.S. Census Bureau

As show in Table 2, the population of Texas is expected to grow almost two fold from 2010 to 2050, an annualized growth rate of 1.6%. Comal County is projected to grow just under 4 fold to 389,584, an annualized growth rate of 3.2%. Guadalupe County is projected to almost triple, to 351,776 by 2050, an annulized growth rate of 2.5%. Hays County is projected to increase almost 5 times the 2010 popuation, reaching 746,149 by 2050, an annulized growth rate of 4%.

Table 2. Population Projections 2010-2050

	Year				
Geographic Area	**2010**	**2020**	**2030**	**2040**	**2050**
Texas	25,145,561	29,677,668	34,894,452	40,686,496	47,342,105
Comal County	108,472	147,330	204,873	282,548	389,584
Guadalupe County	131,533	170,266	221,356	280,644	351,776
Hays County	157,330	234,896	347,120	509,975	746,149

Source: Texas State Demographer, https://demographics.texas/gov

EDUCATION

The highest level of education attained are shown in Table 3. Generally, in most of the geographies, approximately 25% had attained a high school diploma, and almost 25% had some college. Most of the areas had 50-60% having education beyond the high school diploma, save

Wimberly, which had 77%, and Seguin, with only 43%. In general, the population in all three damage centers can be considered well educated.

Table 3. Highest Level of Education Attained, Population 25 Years and Older

Geographic Area	Level of Educational Attained							
	Population 25 and over	Less than 9th grade	9th to 12th grade, no diploma	High school graduate or eqivalent	Some college, no degree	Associate's degree	Bachelor's degree	Graduate degree
Texas	17,454,431	1,513,995	1,491,909	4,372,430	3,857,193	1,208,509	3,288,777	1,721,618
Comal County	89,549	3,488	3,496	22,607	20,716	7,023	21,295	10,924
New Braunfels	46,440	2,399	2,105	12,561	10,973	3,386	11,247	3,769
Guadalupe County	98,048	4,718	6,862	29,428	22,179	8,565	17,245	9,051
Seguin	17,796	1,424	2,238	6,523	3,637	1,055	1,900	1,019
Hays County	115,173	5,645	6,999	25,458	27,396	7,556	27,823	14,296
San Marcos	14,230	553	1,183	4,036	3,471	706	2,785	1,496
Wimberly	2,325	79	116	341	805	225	459	297

Source: 2013-2017 American Community Survey 5 Year Estimate, U.S. Census Bureau

EMPLOYMENT

The employment for each of the geographic areas are most concentrated in the service sectors, as shown

Table 4. With the exception of Wimberly, approximately 14% of the employment in each of the areas was in retail trade. Wimberly, consistent with higher education levels, has almost 18% of its population in the professional, scientific and management sector and 19% in the arts, entertainment, recreation and food services sector. Health care is a significant sector for Guadalupe County, New Braunfels and Seguin, capturing about 11% of the employment in each of those areas. Manufacturing was significant to Seguin, with 23% of its employed labor firce, and is also an important sector for Guadalupe County.

Table 4. Civilian Employment by Sector, Population 16 Years of Age and Over

	Employment							
Employment Sector	**Texas**	**Comal County**	**Guadalupe County**	**New Braunfels**	**Seguin**	**Hayes County**	**Wimberly**	**San Marcos**
Civilian Employed Population 16 Years of Age and Over	12,689,069	59,833	70,169	34,335	11,948	99,069	1,363	31,934
Agriculture, forestring, fishing and hunting, and mining	412,873	1,276	1,559	870	273	1,037	47	305
Construction	1,038,063	5,752	4,540	2,777	811	8,088	149	1,976
Manufacturing	1,116,657	4,096	8,317	2,834	2,729	6,486	62	1,684
Wholesale Trade	381,774	1,844	1,977	1,210	466	2,606	39	749
Retail Trade	1,454,504	7,634	9,285	4,784	1,729	13,683	99	6,099
Transportation and Warehousing, and utilities	702,367	2,527	3,481	1,417	515	3,929	27	1,379
Information	227,592	1,213	1,148	722	86	2,207	72	392
Finance and insurance, real estate and rental and leasing	839,234	3,838	4,053	1,913	426	5,390	86	1,193
Professional, scientific, and management, and adminstrative and wate management services	1,437,711	7,790	5,859	3,849	585	10,888	240	2,161
Educational services	1,208,813	5,581	6,148	2,739	915	12,774	131	4,920
Health care and social assistance	1,530,406	6,639	8,356	3,690	1,305	10,150	87	2,918
Arts, Entertainment, and recreation, and accommodation and food services	1,154,649	5,583	5,932	3,896	944	12,482	264	6,422
Other services, except public administration	663,422	3,509	3,546	2,179	668	3,925	44	935
Public administration	521,004	2,551	5,968	1,455	496	5,424	16	801

Source: 2013-2017 American Community Survey 5 Year Estimate, U.S. Census Bureau

INCOME

Income and poverly information is shown in Table 5. The median household for Texas is $57,051. Both the counties of Comal and Hays, as well as the cities of New Braunfels and Wimberly have median household incomes greater than the state, with Comal County overall having the greater median income of $73,655. Seguin, with $41,250, and San Marcos, with $24,748 had lower median incomes than the State and the remainder of the geographic areas. Per capita incomes show the same trends. Both Sequin and San Marcos had higher percentages of families below the poverty level, each with almost 18% of families. This compares to the approximately 12% for the state overall. The percent was almost half in the other areas, ranging from 6% in Wimberly to 9% in for Hays County overall.

Table 5. Income and Poverty

Geographic Area	Number of Households	Median Household Income	Per Capita Income	Percent of Families with Income in the past 12 months below the poverty level
Texas	9,430,419	$57,051	$28,985	12.4%
Comal County	47,253	73,655	35,841	6.5%
New Braunfels	25,022	64,208	29,831	6.4%
Guadalupe County	51,990	66,187	29,300	7.5%
Seguin	10,204	41,250	21,979	17.7%
Hays County	68,045	62,815	29,253	8.7%
San Marcos	22,471	34,748	19,232	17.6%
Wimberly	1,214	62,520	44,395	6.1%

Source: 2013-2017 American Community Survey 5 Year Estimate, U.S. Census Bureau

EXISTING AND FUTURE WITHOUT-PROJECT CONDITIONS

OVERVIEW

Key to alternative formulation is an understanding of the monetary damages caused by flooding and the number and makeup of damaged structures. This section provides the analysis of the number of structures in the floodplain, presents damages to these structures by frequency event under existing conditions, expected annual damages by damage reach, and a comparison of with- and without-project equivalent annual damages for initial alternatives. For this study, it was assumed that the future condition for hydrology and hydraulics is the same as the exsiting condtion, so only expected annual damages were calculated.

METHODOLOGY

The theoretical computation of flood damages is relatively simple. It is based on the depth of flooding for various flood events (exceedance probabilities), and a relationship between the depth of flooding and the estimated damages based on a percentage of the structure and content value or value of privately owned vehicles (POV). The nomenclature used in this appendix to describe the relative risk reflects the actual probability, rather than the average recurrence interval, of flood events. For example, the commonly used term “100-year frequency flood,” meaning that flood which stands a one-percent chance of being equaled or exceeded in any given one-year period, will hereafter be known as the “1-percent annual exceedance probability ACE flood.” Damages to the various structures, accumulated by frequency of events, produce a frequency-damage function. Using this frequency-damage data, an integration process calculates estimates of expected annual damages. This involves aggregating the multiplication of the mean damage between each pair of flood events by the difference in exceedance probabilities. This is then repeated for the range of flood events in each damage category.

HYDROLOGIC ENGINEERING CENTER – FLOOD DAMAGE ASSESSMENT PROGRAM

The Hydrologic Engineering Center - Flood Damage Assessment (HEC-FDA) v. 1.4.1software program is used to compute flood damages under without- and with-project conditions. The program integrates hydrologic, hydraulic, and floodplain characteristics through application of a Monte Carlo simulation method, and computes single event damages and expected annual damages (EAD), while accounting for uncertainty in the values of structures and contents. Damage susceptibility factors used by the program to estimate flood damages include: number and type of structures, structure and content values, elevation where the structure begins to sustain measurable damages, and flood depth-to-percent damage relationship.

FLOODPLAIN INVENTORY

An inventory of properties lying within the limits of the 0.2% AEP (500-year) floodplain was conducted to determine the number and type of structures, values of structures and contents, and ground and finished floor elevations (elevation where water enters the structure). Structures were initially identified and digitized in GIS using digital orthoquads as base maps. Additional information was collected through county appraisal district databases and Google Street View to determine condition and quality of the structures, number of floors, construction materials (roofing and exterior walls) and to identify the first floor elevation. Field surveys were then made to both validate the desktop data collection and fill in missing information. In addition, the survey identified the applicable relationship of flood depth to percent damage for each structure type. Last, the number of POVs susceptible to flood was estimated. The following paragraphs describe each inventory item in detail.

DEPRECIATED STRUCTURE VALUE/REPLACEMENT COST

Structure values were obtained from the Bexar County Appraisal District to use as a base value. To accurately reflect replacement cost less depreciation to the existing structures in compliance with ER-1105-2-101, values for a sample of nine commercial structures were calculated using Marshall and Swift cost estimating software, based on the information collected during a field survey. This sample represents 10 percent of residential and commercial structures in the study area. Characteristics were collected in the field included exterior wall construction, roofing materials, condition and quality. These values along with square footage taken from the appraisal information were entered into the Marshall & Swift software along with zip codes to determine the depreciated replace value. A ratio between the Marshall Swift valued sample structures and their appraisal values was then calculated to adjust all structures in the database. Residential structures including multi-family were also adjusted, based on a 10-percent sample of one- and two-story structures. Replacement cost is the cost of physically replacing (reconstructing) the structure. Depreciation accounts for deterioration that occurred prior to flooding and variations in remaining useful life of the structure. Premanufacture homes were classified as mobile residence because of similar construction and finished floor elevations. In the presentation of data that follows, this would make mobile residence values seem higher than the atypical mobile residence.

CONTENT VALUE

Content values for residential structures were not specifically collected. Residential content values are embedded in the depth to percent damage relationship (see “Depth to Percent Damage Relationships”). For non-residential structures, personal business property obtained from the

county appraisal district database was used, when available. These values represent values of equipment and inventory. Where personal business property was not available, estimates based on structure value and occupancy type are incorporated into the non-residential depth damage functions used by the Fort Worth District.

GROUND AND FIRST FLOOR ELEVATIONS

Topographic maps compiled from aerial photography served as base maps to identify flood prone properties and estimate ground elevations. First floor elevations were visually inspected for each structure. For each Monte Carlo simulation, the *first floor stage with uncertainty* is computed from the first floor stage, uncertainty distribution, and uncertainty parameters. The uncertainty parameters are the same units as for the first floor stage. The uncertainty in the first floor stage is modeled using the normal distribution with a standard deviation of 0.5 foot.

DEPTH TO PERCENT DAMAGE RELATIONSHIPS

Flood depth to percent damage relationships relate the depth of flooding relative to the structure first floor to the dollar amount of flood damages as a percent of the estimated structure value. For residential structure types, these relationships were compiled by the USACE Institute of Water Resources (IWR), based on data collected from flooding events in various parts of the United States between 1996 and 2001. Damage relationships for commercial and public structures also reflect the results of analyses of historical data collected from major flood events across the United States, and were supplemented based on the findings of subsequent economic field surveys of floodplain properties in the Fort Worth District, considering such factors as the design of the structure and nature of the structure contents. As described in EM 1110-2-1619—Risk-Based Analysis for Flood Damage Reduction Studies, there are risks and uncertanties associated to the parameters including valuation, elevation and depth-damage percentages. Uncertainties can rise from analytical errors in assigning these paramters or from the uncertaintiy of exact values when, for instance, assigning content valuation. To address uncertainties, standard deviations are used in the Monte Carlo simulations, where higher values of standard devation are used where the uncertanties of the parameters are greater. The uncertainty associated with residential structures and contents is modeled using a normal distribution with a standard deviation of 5 percent. Commercial and public structures are similarly modeled with a standard deviation of 10 percent. These values are the default values used in HEC-FDA and are used in the Forth Worth District flood risk management studies unless a greater uncertainty of the parameter values is determined to exist and a larger standard deviation warranted.

PRIVATELY OWNED VEHICLES

Damages for automobiles were estimated based on the average number of vehicles per residence characteristic of the study area and the probability of their being present at the time of a flood. An analysis was made of registered motor vehicles per occupied housing unit for counties within Metropolitan Statistical Areas (MSA) in Texas, using data from the U.S. Census and the Texas State Department of Highways and Public Transportation. The number of registered vehicles per occupied housing unit in the MSA clusters around a mean value of 2.48. Given that not all registered motor vehicles are associated with private residences and some housing units are unoccupied, an average of 2.0 vehicles per residence is assumed for this analysis. It is anticipated that 1.5 of these would be present during non-work hours (128 hours per week) and 0.5 present during work hours (40 hours per week). Therefore, the expected number of vehicles present at any given time that a flood might occur is derived as follows:

((128/168) * 1.5) + ((40/168) * 0.5)

or 1.26 vehicles per residence

Values for vehicles associated with single-family homes as well as multi-family and mobile residences were based on the national average price of new and used vehicles as reported by the U.S. Bureau of Transportation Statistics (BTS). Prices for new vehicles are calculated by subtracting CNW Marketing Research vehicle leasing data from Bureau of Economic Analysis data that combines sales and leases. Used car sales data is derived from sales from franchised dealers, independent dealers, and casual sales. The average new and used sales price also includes leased vehicles. The most recent price reported by BTS is for 2010, with a value of $10,550. This value was indexed with the used car index from the Consumer Price Index to price level to the current year. That value, multiplied by 1.26 vehicles at each structure gives a POV value of $17,080.

NEW BRAUNFELS/SEGUIN DAMAGE CENTER INVENTORY

The structure inventory summary for the New Braunfels/Seguin damage center is presented in Table 6. For the entire damage center, there are a total of 6,052 structures with a total value of structure and contents of approximately $2.5 billion. Eight-six percent of the structures are single family residential, which make up 62% of the total value. The total number of structures and value is split almost 50/50 between the two reaches.

Table 6. New Braunfels/Seguin Damage Center Inventory ($1,000, October 2017 Prices)

Reach/Structure Category	Number of Structures	Structure and Content Value
New Braunfels Reach		
Residental	2,379	$603,821
Multifamily Residential	95	466,274
Mobile Homes	35	3,349
Commercial	227	100,042
Public	0	0
Reach Total	2,736	$1,173,486
Seguin Reach		
Residental	2,837	928,821
Multifamily Residential	39	155,349
Mobile Homes	308	26,502
Commercial	131	165,182
Public	1	4,048
Reach Total	3,316	$1,279,901
Total		
Residental	5,216	1,532,642
Multifamily Residential	134	621,622
Mobile Homes	343	29,851
Commercial	358	265,224
Public	1	4,048
Total	6,052	$2,453,388

WIMBERLY AND SAN MARCOS DAMAGE CENTERS INVENTORY

The structure inventory for the Blanco River damage centers is presented in

Table 7. Wimberly and San Marcos Damage Center Inventory ($1,000, October 2017 Prices). Along the Blanco River, there were two damage centers identified, at Wimberley, Texas and San Marcos, Texas. While the Wimberley damage center is completely on the Blanco River, the San Marcos damage center sits on the confluence of the Blanco River and San Marcos River. A significant source of flooding in San Marcos is from the Blanco River and its overflows into the San Marcos basin. The rivers were divided up into two reaches on the Blanco: Reach 1, which includes the Wimberley area, and Reach 2 which which begins downstream of Wimberly and continues to the city of San Marcos. The Overlfow Reach includes those areas within the City of San Marcos that are subject to flooding from the Blanco River, both in the Blanco River basin and the San Marcos River basin. The San Marcos reach captures the reaming structures on the San Marcos River within the study area, excluding those in the Overflow Reach.

For the study area overall, there are approximately 3,600 structures, with structure and content valued at $2 billion. Sixty percent of the structures are single family residential, 17% multi-family residential, 16% mobile homes 6% commercial and 1% public. In the the Blanco River Reach 1, there were 387 structures with structure and content values of $188 million. Ninety-two percent are residential, and about 4% each for mobile homes and commercial structures.

In the Overflow Reach, there are approximately 2,500 structures with structure and contents valued at $1.5 billion. Approximatley 48% are single family residential, 24% multifamily residential, 23% mobile homes, 4% commercial and 1% public. The structures in this reach make up 69% of the total number of structures and 75% of the total value in the Blanco River/San Marcos River reaches.

Table 7. Wimberly and San Marcos Damage Center Inventory ($1,000, October 2017 Prices)

Reach/Structure Catgegory	Number of Structures	Structure and Content Value
Blanco Reach 1		
Residential	357	$184,954
Multifamily Residential	0	0
Mobile Homes	13	988
Commercial	17	2,328
Public	0	0
Reach Total	387	$188,270
Blanco Reach 2		
Residential	395	179,775
Multifamily Residential	0	0
Mobile Homes	1	55
Commercial	2	6,976
Public	1	14,714
Reach Total	399	201,521
Overflow		
Residential	1,192	274,565
Multifamily Residential	599	942,882
Mobile Homes	575	99,738
Commercial	115	139,612
Public	12	34,762
Reach Total	2,493	$1,491,559
San Marcos River		
Residential	247	34,245
Multifamily Residential	23	16,548
Mobile Homes	1	48
Commercial	66	36,832
Public	12	13,367
Total Reach	349	$101,040
Total		
Residential	2,191	673,540
Multifamily Residential	622	959,430
Mobile Homes	590	100,829
Commercial	200	185,748
Public	25	62,842
Total	3,628	$1,982,389

SINGLE EVENT DAMAGES AND EXPECTED ANNUAL DAMAGES (EADS)

The single event structure and content damages for the New Braunfels/Seguin damage center is shown in Table 10. Damages begin with the 10% annual chanche of exceedance (ACE) event, with almost $500 of damages to 37 structures, with the majority in the Seguin reach. Damages significantly increase with the 4% ACE event with a total damages of $26 million involving 480 structures, again predominantly in the Sequin reach. In the 1% ACE, there are a total of 2,715 structures with $283 million damages to structure and contents, with 78% of the structures and 74% of the damages in the Sequin reach. In the 0.2% ACE, the damages are distributed more evenly over the two reaches, with a total of 5,794 structures receiving $841 million in damages. Approximatley 44% of the structures and damages are in the New Braunfels reach and 56% of the structures and damages are in the Seguin reach.

The without project expected annual damages (EAD) for the New Braunfels/Seguin damage center is presented in Table 8. The expected annual damages for both reaches is $14 million, with 39% in the New Braunfels reach and 61% in the Seguin reach. Sixty-seven percent of the EAD are from single family residences, 14% from multi-family residences, 14% from vehicles, 2% from commercial, 2% from mobile homes and 1% from public structures.

Table 8. Without Project Expected Annual Damages for New Braunfels/Seguin, ($1,000, October 2018 prices, 2.75% interest rate)

Damage Reach	Commercial	Mult-family Residental	Mobile Homes	Public	Privately Owned Vehicles	Single Family Residential	Total
New Braunfels	$182	$1,574	$24	$0	$540	$2,071	$4,391
Seguin	57	418	275	7	1,489	7,411	9,657
Total	$239	$1,992	$299	$7	$2,029	$9,482	$14,048

The single event damages for the Wimberly/San Marcos damage centers is presented in Table 11. Damges begin in the 50% ACE event, primarily to nine mobile homes in the Overflow reach. Damages become significant with the 10% ACE, with 104 structures reciving $2 million in damages, with the majority occurring in the Overflow reach. With the 1% ACE, there are approximately 1,700 structures receiving $72 million in damages. Seventy –four percent of the damages occure in the Overflow reach. With the .02% ACE, damages are approximately $259 million, involving 2,800 structures. Fifty-four percent of those damages occure in the Overflow reach.

Table 9 displays the without project EAD for the Wimberly/San Marcos damagee centers. The total annual damages are $4.3 million, with 74% in the Overflow reach, 13% in Blanco River Reach 2, 11% in Blanco River Reach 1 (Wimberly area), and 2% in the San Marcos River reach. Single family residential structures make up 33% of the damages, multi-family residential 28%, vehicles 15%, commercial 13%, mobile homes 10% and public structures 1%.

Table 9. Without Project Expected Annual Damages for Wimberly/San Marcos, ($1,000, October 2018 prices, 2.75% interest rate)

Damage Reach	Commercial	Multi-family Residential	Mobile Homes	Public	Privately Owned Vehicles	Single Family Residential	Total
Blanco River 1	$15	$0	$1	$0	$46	$407	$469
Blanco River 2	14	0	0	37	48	485	584
Overflow	503	1,198	448	30	554	481	3,214
San Marcos River	11	4	0	1	14	35	65
Total	$543	$1,202	$449	$68	$662	$1,408	$4,332

Table 10. Single Event Damages of Structures and Content for the Lower Guadalue Damage Center ($1,000, October 2017 Prices)

Reach/ Damage Category	50% ACE		20 % ACE		10% ACE		4% ACE		2% ACE		1% ACE		0.4% ACE		0.2% ACE	
	No.	Damages	No.	Damages	No.	Damages	No.	Damages	No.	Damages	No.	Damages	No.	Damages	No.	Damages
New Braunfels																
Residential	0	$0	0	$0	1	$24	46	$1,302	212	$12,772	520	$42,467	1,368	$120,560	2,234	$184,575
Multifamily Residential	0	0	0	0	0	0	0	0	6	5,445	23	29,302	63	103,301	94	157,650
Mobile Homes	0	0	0	0	0	0	1	3	6	136	26	655	29	1,568	34	1,919
Commercial	0	0	0	0	2	19	4	261	11	583	15	1,124	84	7,668	191	21,076
Public	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reach Total	**0**	**$0**	**0**	**$0**	**3**	**$44**	**51**	**$1,566**	**235**	**$18,937**	**584**	**$73,548**	**1,544**	**$233,097**	**2,553**	**$365,219**
Seguin																
Residential	0	$0	1	$6	32	$436	404	$23,548	1,149	$92,447	1,917	$193,854	2,673	$331,118	2,790	$409,346
Multifamily Residential	0	0	0	0	0	0	2	18	11	1,299	12	7,600	33	23,785	39	40,956
Mobile Homes	0	0	0	0	2	8	20	411	114	2,478	178	7,094	278	14,706	300	18,523
Commercial	0	0	0	0	0	0	3	37	10	205	24	573	84	2,877	111	5,765
Public	0	0	0	0	0	0	0	0	0	0	0	0	1	491	1	873
Reach Total	**0**	**$0**	**1**	**$6**	**34**	**$444**	**429**	**$24,015**	**1,284**	**$96,429**	**2,131**	**$209,121**	**3,069**	**$372,976**	**3,241**	**$475,463**
Total	**0**	**$0**	**1**	**$6**	**37**	**$488**	**480**	**$25,581**	**1,519**	**$115,366**	**2,715**	**$282,670**	**4,613**	**$606,073**	**5,794**	**$840,682**

Table 11. Single Event Damages of Structures and Contents for the Blanco River Damage Centers ($1,000, October 2017 Prices)

Stream/ Reach	Damage Category	50% ACE		20% ACE		10% ACE		4% ACE		2% ACE		1% ACE		0.4% ACE		0.2% ACE	
		No.	Damages	No.	Damages	No.	Damages	No.	Damages	No.	Damages	No.	Damages	No.	Damages	No.	Damages
Blanco River																	
BR1	Residential	1	$16	2	$51	3	$332	26	$1,175	75	$6,271	112	$13,961	150	$23,529	159	$31,889
	Multifam. Res.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mobile Homes	0	0	0	0	0	0	0	0	2	0	2	16	2	51	2	118
	Commercial	0	0	0	0	0	0	1	230	2	330	2	357	2	401	2	410
	Public	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	**1**	**16**	**2**	**51**	**3**	**332**	**27**	**1,405**	**79**	**6,601**	**116**	**14,334**	**154**	**23,981**	**163**	**32,417**
BR2	Residential	0	0	0	0	0	0	1	80	10	227	144	3,565	388	38,631	395	73,270
	Multifam. Res.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mobile Homes	0	0	0	0	0	0	0	0	1	1	1	8	1	16	1	25
	Commercial	0	0	0	0	0	0	0	0	0	0	1	241	1	759	2	1,751
	Public	0	0	0	0	0	0	0	0	0	0	1	613	1	3,081	1	4,676
	Total	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**80**	**11**	**228**	**147**	**4,427**	**391**	**42,487**	**399**	**79,722**
Overflow	Residential	5	11	14	20	51	93	235	882	459	4,476	738	10,875	976	20,826	1,058	28,992
	Multifam. Res.	1	5	8	80	36	534	137	3,648	220	14,516	293	28,984	346	49,542	381	69,594
	Mobile Homes	2	364	3	517	5	759	90	1,141	299	2,311	358	4,001	438	7,423	482	9,388
	Commercial	0	0	1	2	7	139	16	542	33	1,571	52	9,702	76	23,112	95	30,860
	Public	0	0	0	0	0	0	0	0	0	0	2	21	5	1,453	5	2,074
	Total	8	380	26	619	99	1,525	478	6,213	1,011	22,874	1,443	53,583	1,841	102,356	2,021	140,908
Blanco River Total	Residential	6	27	16	71	54	425	262	2,137	544	10,974	994	28,401	1,514	82,986	1,612	134,151
	Multifam. Res.	1	5	8	80	36	534	137	3,648	220	14,516	293	28,984	346	49,542	381	69,594
	Mobile Homes	2	364	3	517	5	759	90	1,141	302	2,312	361	4,025	441	7,490	485	9,531
	Commercial	0	0	1	2	7	139	17	772	35	1,901	55	10,300	79	24,272	99	33,021
	Public	0	0	0	0	0	0	0	0	0	0	3	634	6	4,534	6	6,750
	Total	**9**	**396**	**28**	**670**	**102**	**1,857**	**506**	**7,698**	**1,101**	**29,703**	**1,706**	**72,344**	**2,386**	**168,824**	**2,583**	**253,047**

Stream/ Reach	Damage Category	50% ACE		20% ACE		10% ACE		4% ACE		2% ACE		1% ACE		0.4% ACE		0.2% ACE	
		No.	Damages	No.	Damages	No.	Damages	No.	Damages	No.	Damages	No.	Damages	No.	Damages	No.	Damages
San Marcos River Total	Residential	0	0	1	33	1	90	1	112	1	114	2	116	49	378	110	3,090
	Multifam. Res.	0	0	0	0	0	0	0	0	0	0	0	0	1	7	13	823
	Mobile Homes	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2
	Commercial	0	0	1	1	1	4	1	6	1	8	1	9	3	20	42	2,129
	Public	0	0	0	0	0	0	0	0	0	0	0	0	1	2	10	242
	Total	**0**	**0**	**2**	**34**	**2**	**94**	**2**	**118**	**2**	**122**	**3**	**125**	**55**	**407**	**176**	**6,286**
Grand Total	Residential	6	27	17	104	55	515	263	2,249	545	11,088	996	28,517	1,563	83,364	1,722	137,241
	Multifamily Residential	1	5	8	80	36	534	137	3,648	220	14,516	293	28,984	347	49,549	394	70,417
	Mobile Homes	2	364	3	517	5	759	90	1,141	302	2,312	361	4,025	442	7,490	486	9,533
	Commercial	0	0	2	3	8	143	18	778	36	1,909	56	10,309	82	24,292	141	35,150
	Public	0	0	0	0	0	0	0	0	0	0	3	634	7	4,536	16	6,992
	Total	**9**	**$396**	**30**	**$704**	**104**	**$1,951**	**508**	**$7,816**	**1,103**	**$29,825**	**1,709**	**$72,469**	**2,441**	**$169,231**	**2,759**	**$259,333**

WITH PROJECT EXPECTED ANNUAL DAMAGES, BENEFITS, RESIDUAL DAMAGES AND NET BENEFITS

For each of the damage centers, measures were identified and modeled to estimate with project benefits. Addtionally, screening level costs were developed in order to evaluate net beneifts and benefit-to-cost (BCR) rations for the measures. Those preliminary screening results are presented below.

NEW BRAUNFELS/SEGUIN DAMAGE CENTER

For the New Braunfels/Seguin Damage Center, a single structural plan was considerd for evaluation. The measure consisted of a dry detention project on Bear Creek, a tributary of the Guadalupe River, upstream of New Braunfels and downstream of Canyon Dam. A summary of with- and without project EADs and benefits is presented in Table 12. The Bear Creek detention is expected to reduce annual damages by $1.6 million, with $779 thousand in New Braunfels and $833 thousand in Seguin. This leaves residual damages of $12 million in the damage center.

A first cost for construction of the Bear Creek dry detention was estimated at $21,774 million. Using a 2.75% discount rate and amortized over 50 years, the first cost equates to an annual cost of $1.129 million, as shown in

Table 13. With $1.612 million of beneifts, the net annual benfits are estimated at $483 thousand, and a BCR of 1.43. Given a postive net benefits, this measure was moved forward for more detailed cost development as part of the tentatively selected plan.

Table 12. With- and Without Project EADs and Damages Reduced for the Bear Creek Detention ($1,000, October 2018 prices, 2.75% interest rate)

Damage Reach	Without Project	With Project	Damages Reduced	Residual Damages
New Braunfels	$4,391	$3,612	$779	$3,612
Seguin	9,657	8,824	833	8,824
Total	$14,048	$12,436	$1,612	$12,436

Table 13. Development of Annual Costs and Net Benefits for the Bear Creek Detention

Investment	
Estimated First Cost	$21,774
Economic Costs	$21,774
Annual Interest Rate	2.750%
Period of Analysis (years)	50
Construction Period (months)	24
Compound Interest Factor	24.64
Capital Recovery Factor	0.0370409
Interest During Construction	$602
Investment Costs	$22,376
Annual Charges	
Interest	$615
Amortization	$213
OMRRR($/yr)	$300
Total Annual Charges	$1,129
Annual Benefits	
Flood Damage Reduction Benefits	$1,612
Net Benefits	**$483**
Benefit-to-Cost Ratio	**1.43-to-1**

WIMBERLY/SAN MARCOS DAMAGE CENTERS

A number of structural measures were developed for the Wimberly/San Marcos damage centers. Four dry detentions were considered on the Blanco River upstream of Wimberly. These measures would primarily provide damage reduction benefits in the Wimberly area (Blanco River Reach 1) with some smaller benefits further downstream into San Marcos. Two measures were were modeled for evaluation for the Overflow reach in San Marcos. The larger included a diversion channel from the Blanco River down to the San Marcos River, largely following an existing intermittent creek called Bypass Creek. A second measure focused on a smaller subdivision called Blanco Gardens in the Overflow Reach, labeled Blanco River Bank Improvement, which includes a adding a berm and drainage channel in the immediate area of the Blanco Gardens. A summary of with- and without project EADs, damages reduced and residual damages in presented in Table 14. Three of the detentions, Blanco Detention 65, Blanco Detention 73, and the Hays2 Detention, performed similarly, with annual damaged reduced between $1.2 and $1.3 million. The smaller detention, Blanco Detention 60, did not perform as well, reducing annual damages by $991 thousand. The Blanco Bypass Channel provided the largest benefit, with a reduction in annual damages of $1.7 million. The Blanco River Bank Improvement measure had the smallest reduction in annual damages, $606 thousand, but it also focused on the smallest area.

Residual damages are still considerably high, ranging from $2.6 million to $3.7 million.

Table 14. With- and Without Project EADs and Damages Reduced for the Wimberly/San Marcos Measures ($1,000, October 2018 prices, 2.75% interest rate)

Measure	Without Project	With Project	Damaged Reduced	Residual Damages
Blanco Detention 60	$4,332	$3,341	$991	$3,341
Blanco Detention 65	4,332	3,136	1,196	3,136
Blanco Detention 73	4,332	2,998	1,334	2,998
Hays 2 Detention	4,332	3,117	1,215	3,117
Blanco River Bypass Channel	4,332	2,616	1,716	2,616
Blanco River Bank Improvement	4,332	3,726	606	3,726

As with the Bear Creek detention measure, preliminary costs were developed for preliminary screening and evaluation. Table 15 presents the first cost, annual cost, and annual net benefits for each of the measures. First costs for the detentions ranged from $53 million to $73 million. The Blanco River Bypass had a first cost of $53 million, and the Blanco River Bank Improvement measure had a first cost of $9 million. As shown in the table, all of the measures provided negative net benefits. The Blanco River Bank Improvement measure was very close to having postive net benefits, and was initially considered for moving forward for refinement. However, the City of San Marcos recived grant funding to pursure a variant of the measure on their own. Therefore none of these measures were carried forward for conseration as part of the tentatively selected plan (TSP).

Table 15. Development of Annual Costs and Net Benefits for the Wimberly/San Marcos Measures ($1,000, October 2018 prices, 2.75% Interest Rate)

Cost/Benefit Line	Blanco Detention 60	Blanco Detention 65	Blanco Detention 73	Hays 2 Dentention	Blanco River Bypass Channel	Blanco River Bank Improvement
First Cost	$53,443	$60,638	$73,013	$63,044	$52,503	$9,412
Interest During Contruction	1,476	1,675	2,017	1,742	1,450	260
Investment Cost	54,919	62,313	75,030	64,786	53,953	9,672
Annual Charges						
Interest	1,510	1,714	2,063	1,782	1,484	266
Amortization	524	595	716	618	515	92
OMRRR	300	300	300	300	300	300
Annual Charges	**2,334**	**2,609**	**3,079**	**2,700**	**2,299**	**658**
Annual FRM Benefits	**991**	**1,196**	**1,334**	**1,215**	**1,716**	**606**
Net Benefits	**-$1,343**	**-$1,413**	**-$1,745**	**-$1,485**	**-$83**	**-$52**
Benefit-to-Cost Ratio	0.42	0.46	0.43	0.45	0.75	0.92

TENTATIVELY SELECTED PLAN

The only measure carried forward following initial evaluation was the Bear Creek Detention on the Guadalupe River, addressing damages in the New Braunfels and Seguin damage centers.

More detailed cost esimates, including and an abbreviated cost and schedule risk analysis, were made. This resulted in an increase of first cost from $21.7 million to $39 million. This reduced net benefits from $483 thousand to $69 thousand, and the benefit-to-cost ratio from 1.43 to 1.04.

Table 16. Development of Annual Costs for Bear Creek Detention with Refined Costs ($1,000, October 2019 prices, 2.875% Interest Rate)

Investment	
Estimated First Cost	$39,042
Economic Costs	$39,042
Annual Interest Rate	2.875%
Period of Analysis (years)	50
Construction Period (months)	24
Compound Interest Factor	24.67
Capital Recovery Factor	0.0379481
Interest During Construction	$1,128
Investment Costs	$40,170
Annual Charges	
Interest	$1,155
Amortization	$369
OMRRR ($/yr)	$27
Total Annual Charges	$1,551
Annual Benefits	
Flood Damage Reduction Benefits	$1,620
Total Annual Benefits	$1,620
Net Benefits	**$69**
Benefit-to-Cost Ratio	**1.04-to-1**

As part of the District Quality Control review, the dam design was reviewed by dam and levee safety cadre and significant changes were recommended. The changes were adopted and costs were updated. First cost increased from $39 million $70 million. This significant increae in cost further eroded net benfits to -$1.5 million, and the benefit-to-cost ratio to 0.58. With a BCR of less than one, it was determined that no alternative would be presented to move forward with the study.

Table 17. Development of Annual Costs for Bear Creek Detention Post DQC Review and Addressing Dam and Levee Safety Review ($1,000, October 2019 prices, 2.875% Interest Rate)

Investment	
Estimated First Cost	$70,293
Economic Costs	$70,293
Annual Interest Rate	2.875%
Period of Analysis (years)	50
Construction Period (months)	24
Compound Interest Factor	24.67
Capital Recovery Factor	0.0379481
Interest During Construction	$2,031
Investment Costs	$72,324
Annual Charges	
Interest	$2,079
Amortization	$665
Operations & Maintenance ($/yr)	$27
Total Annual Charges	$2,772
Annual Benefits	
Flood Damage Reduction Benefits	$1,620
Total Annual Benefits	$1,620
Net Benefits	**-$1,152**
Benefit-to-Cost Ratio	**0.58-to-1**