

# Technical Report Notebook

## US Army Corps of Engineers

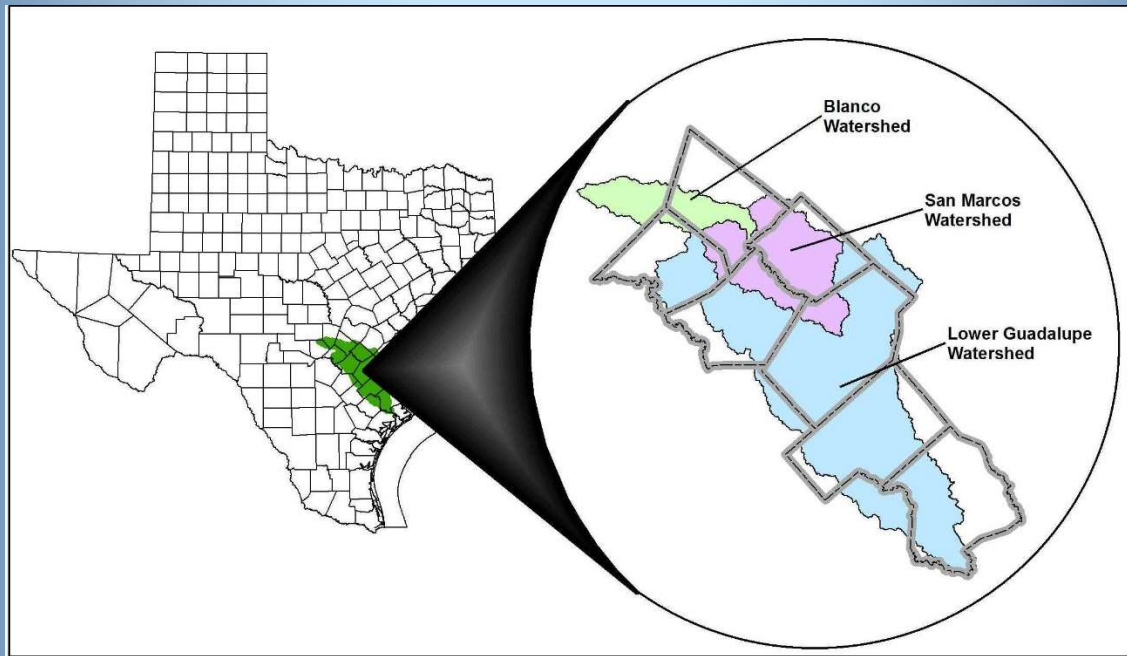
### Texas Water Development Board

### Guadalupe-Blanco River Authority

### Interim Feasibility Study – Summary Report

# Lower Guadalupe, Blanco, and San Marcos River Watersheds

## Summary Report



**Submitted to:**



**January  
2018**

# Technical Report Notebook

US Army Corps of Engineers  
Texas Water Development Board  
Guadalupe-Blanco River Authority  
Interim Feasibility Study Summary Report

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## Lower Guadalupe, Blanco, and San Marcos River Watersheds

*Submitted to:*



**US Army Corps  
of Engineers®**



*Prepared by:*



9500 AMBERGLEN BLVD, BLDG F, SUITE 125  
AUSTIN, TEXAS 78729

AVO 28411  
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## TECHNICAL REPORT NOTEBOOK GBRA INTERIM FEASIBILITY STUDY SUMMARY REPORT

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### **ANNEX 1 - PHASE 1: TECHNICAL REPORT NOTEBOOK, US ARMY CORPS OF ENGINEERS, LOWER GUADALUPE RIVER BASIN, GUADALUPE-BLANCO RIVER AUTHORITY, INTERIM FEASIBILITY STUDY – PHASE 1**

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  - Topographic Data Development Report (pdf)
  - Digital Data: Digital Elevation Model

#### **APPENDIX B. HYDROLOGIC ANALYSIS**

- B.1. GBRA IFS Phase 1 Technical Report Notebook
  - Lower Guadalupe, Blanco, and San Marcos Watersheds Hydrologic Report (pdf)
  - Digital Data: Hydrologic Model, Supporting GIS Shapefiles, and Supporting Spreadsheets
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  - Salt Branch and San Marcos Tributary Watersheds Hydrologic Report (pdf)
  - Digital Data: Hydrologic Model, Supporting GIS Shapefiles, and Supporting Spreadsheets
- B.3. Woodcreek Watersheds Technical Report Notebook
  - Hog Creek and Cypress Creek Tributary Watersheds Hydrologic Report (pdf)
  - Digital Data: Hydrologic Model, Supporting GIS Shapefiles, and Supporting Spreadsheets

#### **APPENDIX C. ROUTING HYDRAULICS ANALYSIS**

- C.1. Luling Watersheds Technical Report Notebook
  - Salt Branch and San Marcos Tributary Routing Hydraulics Report (pdf)
  - Digital Data: Routing Hydraulic Models, Reconnaissance Photos, Survey Data, Work Maps, and Supporting GIS Shapefiles
- C.2. Woodcreek Watersheds Technical Report Notebook
  - Hog Creek and Cypress Creek Tributaries Routing Hydraulics Report (pdf)
  - Digital Data: Routing Hydraulic Models, Reconnaissance Photos, Survey Data, Work Maps, and Supporting GIS Shapefiles

#### **APPENDIX D. HYDRAULIC ANALYSIS**

- D.1. GBRA Basin-Wide Technical Report Notebook
  - Lower Guadalupe, Blanco, and San Marcos Rivers Hydraulic Report (pdf)
  - Digital Data: Hydraulic Model, Reconnaissance Photos, Survey Data, Work Maps, and Supporting GIS Shapefiles

- D.2. Luling Watersheds Technical Report Notebook
  - Salt Branch, Plum Creek and San Marcos Tributary Hydraulic Report (pdf)
  - Digital Data: Hydraulic Models, Reconnaissance Photos, Survey Data, Work Maps, and Supporting GIS Shapefiles
- D.3. Woodcreek Watersheds Technical Report Notebook
  - Hog Creek and Cypress Creek Tributaries Hydraulic Report (pdf)
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## **APPENDIX E. ALTERNATIVES ANALYSIS**

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  - Luling Digital Data: Hydrologic Model, Hydraulic Models, and Supporting GIS Shapefiles
  - Woodcreek Digital Data: Hydrologic Model, Hydraulic Models, and Supporting GIS Shapefiles
  - Regional Detention Digital Data: Hydrologic Model, Hydraulic Models, Supporting GIS Shapefiles, and Supporting Spreadsheets

## **APPENDIX F. PUBLIC OUTREACH**

- F. Basin-Wide Public Outreach Report (pdf)

# **ANNEX 2 - PHASE 2: TECHNICAL REPORT NOTEBOOK, US ARMY CORPS OF ENGINEERS, LOWER GUADALUPE RIVER BASIN, GUADALUPE-BLANCO RIVER AUTHORITY, INTERIM FEASIBILITY STUDY – PHASE 2**

## **APPENDIX A. TOPOGRAPHIC DATA DEVELOPMENT**

- A. Basin-Wide Technical Report Notebook
  - Topographic Data Development Report (pdf)
  - Digital Data: Digital Elevation Model

## **APPENDIX B. HYDROLOGIC AND HYDRAULIC ANALYSIS**

- B.1. Technical Report Notebook – Engineering Analysis – Hydrology and Hydraulics
  - Cypress, Bear, Upper San Marcos, Bypass, Plum, Mays, Peach, and Spring Creek Watersheds (pdf)
  - Digital Data: Hydrologic Model, Hydraulic Model, Supporting GIS Shapefiles, and Supporting Spreadsheets
- B.2. Technical Report Notebook – Engineering Analysis – Hydrology and Hydraulics
  - Blanco and San Marcos River Confluence Unsteady Modeling

## **APPENDIX C. BREACH ANALYSIS**

- C.1. Technical Report Notebook – Engineering Analysis – Dam Breach Analysis
  - Plum Watershed NRCS Dams 14, 16, 31, 34, and 38 Report (pdf)
  - Digital Data: Hydrologic Model, Hydraulic Model, Hydrometeorologic Model, Supporting GIS Shapefiles and Inundation Mapping
- C.2. Technical Report Notebook – Engineering Analysis – Dam Breach Analysis
  - Upper San Marcos Watershed NRCS Dams 1, 2, 3, 4, and 5 Report (pdf)

- Digital Data: Hydrologic Model, Hydraulic Model, Hydrometeorologic Model, Supporting GIS Shapefiles and Inundation Mapping

#### **APPENDIX D. ALTERNATIVES ANALYSIS**

- D. Technical Report Notebook – Alternative and Benefit-Cost Analysis
  - Guadalupe, Blanco, and San Marcos River Watersheds Including City of Kyle, City of Lockhart, City of Seguin, Victoria County and City of Waelder
  - Digital Data: Hydrologic Models and Hydraulic Models

#### **APPENDIX E. PUBLIC OUTREACH**

- E. Lower Guadalupe River Food Risk Management Interim Feasibility Study Public Meeting Agenda and Notes.

### **ANNEX 3 - PHASE 3: GUADALUPE-BLANCO RIVER AUTHORITY – FLOOD PROTECTION PLANNING STUDY – PHASE 3 FINAL REPORT**

Final Report Engineering Analysis – Hydrology, Hydraulics, and Alternatives for Cypress Creek Tributary 1, Smith Creek, Loneman Creek, Wilson Creek, Plum Creek Tributary 3, Plum Creek Tributary 4, and Hays County Approximate Study Streams

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## **PROJECT INTRODUCTION**

This report summarizes and compiles engineering work submitted for the Guadalupe-Blanco River Authority (GBRA) Interim Feasibility Study (IFS) Phases 1 through 3, the Interagency Flood Risk Management (InFRM) Hydrology Report for the San Marcos River Basin and the US Army Corps of Engineers (USACE) Tentatively Selected Plan. The multiple reports, models, analysis, mapping and supporting data from this multi-phase effort are included in ANNEX 1 through 5 of this report.

The USACE Lower Guadalupe River Basin IFS is located within the GBRA jurisdictional area. The GBRA partnered with the USACE and the Texas Water Development Board (TWDB) and local communities in this multi-year effort. The IFS was funded through a USACE Feasibility Cost Share Agreement, a TWDB Flood Protection Planning Grant, and local funds. GBRA is the Local sponsor with Comal County, Hays County, Caldwell County, Gonzales County, Victoria County, City of San Marcos, City of Kyle, City of Lockhart, City of Seguin, City of Waelder, City of Wimberly, Plum Creek Conservation District, and York Creek Improvement District contributing the local funds.

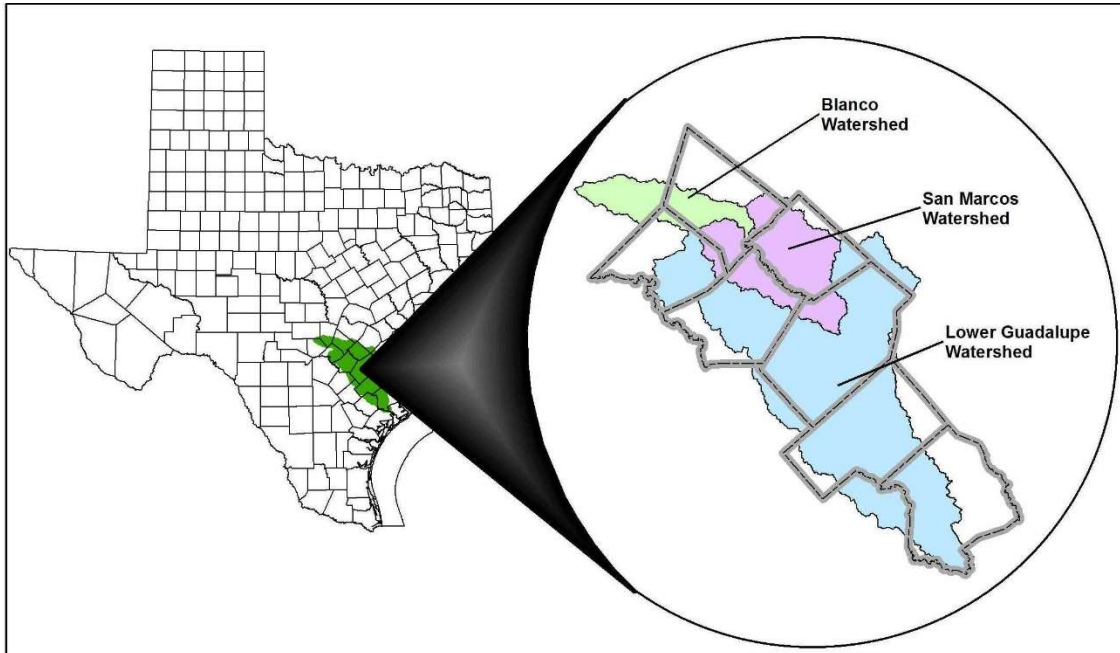
### **Phase 1 GBRA Interim Feasibility Study**

Phase 1 consists of the development of existing conditions hydrology, floodplain hydraulics, plan formulation, environmental constraints, and economics for the Lower Guadalupe, Blanco, and San Marcos Rivers as well as selected streams in Luling and Woodcreek, Texas.

See **ANNEX 1** of this summary report for all detailed reports and supporting data submitted for Phase 1.

The Lower Guadalupe River basin has a drainage area of approximately 4,530 square miles between Canyon Dam and the confluence of the Guadalupe and San Antonio Rivers. Approximately 18 operational United States Geological Survey (USGS) discharge gages and 11 National Weather Service (NWS) forecast points are located within the Lower Guadalupe River basin. The basin-wide hydrologic analysis consisted of a new calibrated hydrology model for the Lower Guadalupe River basin and frequency flows developed from a USACE basin-wide gage analysis. Hydrologic analysis for the Luling and Woodcreek watersheds consisted of new hydrologic models that include additional detail from the basin-wide hydrologic analysis.

Hydraulic analyses on the Guadalupe River, Blanco River, and San Marcos River, and selected streams in Luling and Woodcreek were developed for approximately 450 miles of stream including approximately 320 miles of new analysis. See Figure 1 for a general location map of the Lower Guadalupe River, Blanco River and San Marcos River basins.



**Figure 1 – Lower Guadalupe, Blanco and San Marcos Watersheds**

The types of hydraulic studies performed for this study include:

- With Survey Study – This is a new detailed study (or restudy of current effective detailed studies). Final hydraulics for "with survey" studies include survey data, flood profiles of the 50%, 20%, 10%, 4%, 2%, 1%, 0.4%, and 0.2% annual chance exceedance (ACE) events, and base flood elevations.
- Without Survey Study – Final hydraulics for "without survey" studies do not include survey data, but do include flood profiles of the 50%, 20%, 10%, 4%, 2%, 1%, 0.4%, and 0.2% ACE events.
- Incorporated Study – These studies are existing detailed studies of the Guadalupe River developed during the FEMA Map Mod program in Comal, Guadalupe, and Victoria Counties.

See Table 1 for an outline of the study streams, their study type and mileage. All analysis conducted for this study is in accordance with the Guidelines and Specifications of Flood Hazard Mapping Partners dated April 2003.

**Table 1. Phase 1 Study Streams**

Group	Stream Name	Stream Length (Miles)		
		With Survey	Without Survey	Incorporated Study
Basin-wide	Guadalupe River			
	Segment 1: Victoria			74.41
	Segment 2: Dewitt	65.08		
	Segment 3: Gonzales	102.80		
	Segment 4: Lower Guadalupe			26.45
	Segment 5: Middle Guadalupe			15.94
	Segment 6: Upper Guadalupe			14.52
	San Marcos River	76.93		
	Blanco River		51.16	
Luling	Salt Branch			
	Upstream of Reservoir	2.40		
	Downstream of Reservoir	5.48		
	San Marcos Tributary	0.75		
	Plum Creek	4.69		
Woodcreek	Hog Creek	1.98		
	Cypress Creek	3.58		
	Cypress Creek Tributary 1	1.20		
	Cypress Creek Tributary 2	1.48		
<b>Total Phase 1</b>		<b>266.37</b>	<b>51.16</b>	<b>131.32</b>
<b>Grand Total Phase 1</b>		<b>448.85</b>		

## **Phase 2 GBRA Interim Feasibility Study**

Phase 2 consists of the development of existing hydrology, floodplain hydraulics, dam breach analysis, plan formulation, environmental constraints, and economics for selected streams within the Bear Creek, Cypress Creek, Mays Creek, Peach Creek, Plum Creek, Spring Creek, Bypass Creek, and Upper San Marcos Watersheds.

See **ANNEX 2** of this summary report for all detailed reports and supporting data submitted for Phase 2.

The Phase 2 study consists of approximately 1,078 square miles of hydrologic study area and includes 28 Natural Resource Conservation Service (NRCS) detention structures.

Hydraulic analyses have been developed for approximately 271 miles of stream including about 14 miles of detailed study that required field surveys to be incorporated into the hydraulic models and 257 miles of limited detail study without surveys. Table 2 outlines the Lower Guadalupe River Basin Interim Feasibility Study Phase 2 study streams, their hydraulic study type, and stream mileage.



Table 2. Phase 2 Study Streams

Stream Name	Stream Length (Miles)		
	With Survey	Without Survey	Total Study
<b>Tier 1</b>			
Bear Creek	0	7.94	7.94
Bypass Creek	4.34	2.25	6.59
Cypress Creek		15.09	15.09
Dry Bear Creek		5.87	5.87
Purgatory Creek	2.56	9.21	11.77
San Marcos River	3.05	5.59	8.64
Sink Creek		11.7	11.7
Unnamed Creek 46		0.93	0.93
Willow Springs Creek	4.2	0.99	5.19
<b>Tier 2</b>			
Boggy Creek		4.35	4.35
Brushy Creek		15.26	15.26
Brushy Creek Trib 1		6.27	6.27
Brushy Creek Trib 1A		1.08	1.08
Bunton Branch		10	10
Clear Fork Plum Creek		5.69	5.69
Elm Creek		14.42	14.42
Mebane Creek		2.93	2.93
Plum Creek		50.19	50.19
Plum Creek Trib 1		1.96	1.96
Plum Creek Trib 2		0.8	0.8
Plum Creek Trib 3		1.2	1.2
Porter/Andrews Branch		10.07	8.18
Town Branch		4.09	4.09
Unnamed Creek 84		1.53	1.53
Unnamed Creek 87		3.76	3.76
<b>Tier 3</b>			
Baldrige Creek and Tribs		5.03	5.03
Mays Creek		3.38	3.38
Peach Creek		37.62	37.62
Spring Creek		19.56	19.56
<b>Total Phase 2</b>	<b>14.15</b>	<b>258.76</b>	<b>271.02</b>

Dam breach analysis was completed for Plum Creek Watershed NRCS Dams 14, 16, 31, 34 and 38 and Upper San Marcos Watershed NRCS Dams 1, 2, 3, 4 and 5.

### **Phase 3 GBRA Interim Feasibility Study**

Phase 3 consists of the development of existing hydrology, floodplain hydraulics, plan formulation, environmental constraints, and economics for selected streams within the Cypress Creek Trib. 1, Loneman Creek, Plum Creek Trib. 3, Plum Creek Trib. 4, and Wilson Creek watersheds, as well as floodplain hydraulics for Guadalupe-Blanco Approximate Study Streams.

See **ANNEX 3** of this summary report for the detailed report and supporting data submitted for Phase 3.

The Phase 3 study consists of approximately 23.4 square miles of hydrologic study area and includes two Natural Resource Conservation Service (NRCS) detention structures.

Hydraulic analyses have been developed for approximately 224 miles of stream including about 21 miles of detailed study that required field surveys to be incorporated into the hydraulic models and 203 miles of approximate study without surveys. Table 3 outlines the Lower Guadalupe River Basin Flood Protection Planning Study Phase 3 study and approximate study streams, their hydraulic study type, and stream mileage.

**Table 3. Phase 3 Study Streams**

	With Survey	Without Survey	Total Study
<b>Detailed Study Streams</b>			
Cypress Creek Trib. 1	1.32	0	1.32
Loneman Creek	8.08	0	8.08
Plum Creek Trib. 3	1.04	0	1.04
Plum Creek Trib. 4	3.55	0	3.55
Smith Creek	2.68	0	2.68
Wilson Creek	4.49	0	4.49
<b>Approximate Study Areas</b>			
Brushy Creek	0	10.96	10.96
Cypress Creek	0	19.25	19.25
Elm Creek	0	8.77	8.77
Halifax Creek	0	17.98	17.98
Lower Blanco River	0	14.51	14.51
Lower Plum Creek	0	7.76	7.76
Lower Sink Creek	0	23.77	23.77
Middle Blanco River	0	13.24	13.24
Purgatory Creek	0	9.76	9.76
Upper Blanco River	0	17.50	17.50
Upper Plum Creek	0	14.19	14.19
Upper Sink Creek	0	17.39	17.39
Wimberley	0	16.68	16.68
York Creek	0	10.84	10.84
	<b>21.16</b>	<b>202.60</b>	<b>223.76</b>

### **US Army Corps of Engineers Lower Guadalupe Interim Feasibility Study – Tentatively Selected Plan Report Summary**

See **ANNEX 4** of this summary report for the complete Tentatively Selected Plan (TSP) Report Summary.

The US Army Corps of Engineers Lower Guadalupe Interim Feasibility Study – Tentatively Selected Plan Report Summary is a single-purpose study to address flood risk management issues. The scope of the study is to investigate the hydrologic and

hydraulic conditions of the Blanco and Guadalupe Rivers within the study area, and to determine if there is a Federal Interest in implementing alternatives to address flood risk.

The Guadalupe River Basin study area is comprised of the Guadalupe and Blanco River Basins, Texas, under the stewardship of the GBRA. The study area includes the Guadalupe River from Canyon Lake Dam downstream to Victoria, Texas, the San Marcos River from the headwaters to its confluence with the Guadalupe River near Gonzales, Texas, and the Blanco River from the confluence with the San Marcos River upstream through Blanco County.

Eleven damage centers were identified as possibly benefiting from risk reduction measures. These damage centers were screened and three damage centers (Wimberley, San Marcos, and New Braunfels) were identified as having the greatest potential for a justifiable Federal project.

### **Interagency Flood Risk Management (InFRM) Hydrology Report for the San Marcos River Basin**

This study, conducted by the USACE in coordination with the Federal Emergency Management Agency (FEMA), US Geological Survey (USGS), and the National Weather Service (NWS) is a detailed hydrological analysis of the San Marcos River Basin.

See **ANNEX 5** of this summary report for the InFRM Hydrology Report for the San Marcos River Basin.

## **TOPOGRAPHIC DATA DEVELOPMENT**

The primary source of topographic data used in this study was developed from the 2006-2011 Capital Area Council of Governments (CAPCOG) & Texas Water Development Board / Texas Natural Resources Information System (TNRIS) LiDAR data. This LiDAR data was used to generate FEMA-compliant terrain datasets for hydrologic and hydraulic modeling. **ANNEX 1 – Phase 1 Appendix A** includes a detailed report and supporting data that explains the terrain development methodologies and results.

## **HYDROLOGIC ANALYSIS**

All hydrologic analysis performed for this study was developed using USACE Fort Worth District methodology. This methodology consists of using a Block and Uniform loss rate combined with Snyder's Unit hydrograph approach. The hydrologic models are simulated using HEC-HMS. Detailed hydrologic reports, models and supporting data for all studied areas are included in **ANNEX 1 – 3 and 5**.

## **HYDRAULIC ANALYSIS**

Hydraulic analysis consisted of the development of new hydraulic simulations along the streams identified in Tables 1, 2 and 3. This study also incorporated existing hydraulic models created during FEMA's Map Modernization project in Comal, Guadalupe, and Victoria Counties. Hydraulic simulations were developed using HEC-RAS version 4.1.0. The types of hydraulic studies performed for this study were "with survey" or "without survey." The "with survey" study type is a detailed study that incorporated newly obtained survey data. The "without survey" study type is a limited detailed study that

only incorporated hand measurements of the hydraulic features. Detailed hydraulic reports, models and supporting data for all studied areas are included in **ANNEX 1 – 3**.

### **ALTERNATIVE DEVELOPMENT AND BENEFIT-COST ANALYSIS**

This study analyzed conceptual mitigation alternatives to reduce flooding impacts along the studied streams. Both structural and non-structural alternatives were considered. The newly updated hydrologic and hydraulic analyses allowed for the identification of damage centers. Conceptual mitigation alternatives were developed including a conceptual layout, preliminary estimate of probable cost, and benefit to cost comparison. Detailed reports and supporting data explaining the methodologies, assumptions and results for the alternatives development and benefit-cost analysis are included in **ANNEX 1 – 4**.

### **PUBLIC OUTREACH**

In accordance with the TWDB Flood Protection Planning Grant requirements, public/stakeholder coordination meetings were conducted at all phases of the study. The goal of these meetings was to gather public, community and stakeholder input throughout the duration of the project and to provide project results once analysis was complete.

### **PROJECT CLOSING**

A public meeting is scheduled for January 26, 2018 to discuss the Interim Feasibility Study and to deliver this Summary Report to the Texas Water Development Board.

## TECHNICAL REPORT NOTEBOOK GBRA INTERIM FEASIBILITY STUDY

### LIST OF ACRONYMS AND ABBREVIATIONS

ACE	Annual Chance of Exceedance
ac-feet	acre-feet
cfs	cubic feet per second
CMP	Corrugated Metal Pipe
CN	Curve Number
Cp	Snyder Peaking Coefficient
DEM	Digital Elevation Model
DTM	Digital Terrain Model
FEMA	Federal Emergency Management Agency
FIS	Flood Insurance Study
ft	feet/foot
GBRA	Guadalupe-Blanco River Authority
GIS	Geographic Information System
GPS	Global Positioning System
HEC	Hydrologic Engineering Center (U.S. Army Corps of Engineers)
HMS	Hydrologic Modeling System
IC	Impervious Cover
LiDAR	Light Detection and Ranging
NAD	North American Datum
NAVD	North American Vertical Datum
NRCS	Natural Resources Conservation Service
NLCD	National Land Cover Database
QC/QAQC	Quality Control/Quality Assurance Quality Control
RAS	River Analysis System
RCP	Reinforced Concrete Pipe
RS/XS	HEC-RAS River Station
SCS	Soil Conservation Service (now Natural Resources Conservation Service)
SIR	Scientific Investigations Report
sq. mi.	square mile
SSURGO	Soil Survey Geographic
TCEQ	Texas Commission of Environmental Quality
THC	Texas Historical Commission
TNRIS	Texas Natural Resource Information Service
Tp	Time to peak
TPWD	Texas Parks and Wildlife Department
TR	Technical Reference
TRN	Technical Report Notebook
TWDB	Texas Water Development Board
TxDOT	Texas Department of Transportation
USACE	U.S. Army Corps of Engineers
USBR	U.S. Bureau of Reclamation
USFWS	U.S. Fish and Wildlife Service

USGS	U.S. Geological Survey
WSEL	Water Surface Elevation
WSS	Web Soil Survey