FLOOD PROTECTION PLAN FOR PORTIONS OF SALADO, CIBOLO AND LEON CREEKS

CH2M HILL

San Antonio, Texas

August 1989

CH2M HILL
Engineers
Planners
Economists
Scientists

August 11, 1989

TEX27068.A0.09

Mr. R.L. Tomasini
Director of Public Works
Bexar County Public Works Department
Bexar Courthouse
San Antonio, Texas 78205

Dear Mr. Tomasini:

Subject: Bexar County Flood Protection Plan for Portions of Salado, Cibolo and Leon Creeks Final Report

CH2M HILL is pleased to submit the attached 30 copies of the final report as part of the contract deliverables described in our contract dated February 1, 1989. We appreciate your guidance and input as the report was being developed and look forward to working with you again.

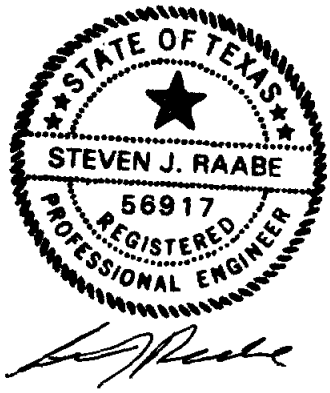
Sincerely,

CH2M HILL

Steven J. Raabe, P.E.
Project Manager

SANR1/038.50
Attachment

FLOOD PROTECTION PLAN FOR PORTIONS OF SALADO, CIBOLO AND LEON CREEKS



CH2M HILL

San Antonio, Texas

August 1989

EXECUTIVE SUMMARY

INTRODUCTION

Bexar County received a matching grant from the Texas Water Development Board on June 16, 1988, to develop a flood protection plan for segments of several creeks in Bexar County. The study area encompasses Reach 1 of Cibolo Creek (25 miles long) from the Guadalupe County line to the corporate limits of Universal City, Reach 1 of Leon Creek (3 miles long) from the corporate limits of San Antonio to Quintana Road, Reach 3 of Leon Creek (13 miles long) from the corporate limits of San Antonio to the end of the reach, and Reach 1 of Salado Creek (3 miles long) from the San Antonio River to the corporate limits of San Antonio. These creek reaches were identified in the Corps of Engineers Section 22 Study of High Flood Hazard Areas of the unincorporated areas of Bexar County dated September 1986. Bexar County and CH2M HILL entered into a contract on February 1, 1989, for CH2M HILL to develop the flood protection plan. The following report is the result of the study performed by CH2M HILL.

FLOOD PROBLEMS AND DAMAGES

Flood problems in the study area were classified as life-safety hazards or property damage hazards. High life safety hazard locations were defined as those areas on roadways or near structures that met one or both of the following criteria:

- 100-year flood depths exceed 2 feet
- The product of the 100-year flood depth and velocity is 4 or greater (for example, water moving at 2 feet per second and 2 feet deep).

High life-safety hazard areas were identified at the following locations:

- Salado Creek Reach 1
  - Residential development upstream of Southton Road
  - Residential development at Old Corpus Christi Highway
  - Portions of Southton Road and Old Corpus Christi Highway
- Cibolo Creek Reach 1
  - Mobile home park upstream of Schaeffer Road
  - Developed area downstream of FM 78
  - Road crossings at Uhlrich, Trainer Hale, Weir, Lower Seguin Roads and FM 78
- Leon Creek Reach 1
  - Houses and mobile home parks near Somerset Road and IH 35
  - Mobile home park and meat packing plant at New Laredo Highway
  - Road crossings at IH 35 mainlanes and frontage roads, Somerset Road and New Laredo Highway
- Leon Creek Reach 3
  - Commercial development at IH 10 and Boerne Stage Road
  - Road crossings at Old Camp Bullis Road, Camp Bullis Road, Louis Drive, Dominion Drive, IH 10 frontage roads, Boerne Stage Road, Huntress Lane and Scenic Loop Road

SELECTED PLAN

The major features of the selected plan include both structural and non-structural components. Structural alternatives were considered on certain segments of the study reaches where non-structural alternatives were recommended. these alternative components were described and costs estimated so if certain economic considerations change, these structural components could be pursued.

Table 1 summarizes the selected plan's proposed improvements, location and total cost. Total costs include easements, construction, acquisition, relocation, administration, engineering and maintenance over a 50-year projected service life.

Table 1
SELECTED PLAN SUMMARY OF IMPROVEMENTS

Location	Improvements	Total Cost
Salado Creek Reach 1 - Lower Segment	Replace Southern Pacific R.R. Bridge	$ 571,000
Salado Creek Reach 1 - Upper Segment	Clear and Reshape Channel	$ 904,000
Cibolo Creek Reach 1 - Lower Segment	Non-Structural Plan	$ 490,000
Cibolo Creek Reach 1 - Upper Segment	Non-Structural Plan	$ 210,000
Leon Creek Reach 1 - Lower Segment	Clear and Reshape Channel	$1,621,000
Leon Creek Reach 1 - Upper Segment	Non-Structural Plan	$1,836,000
Leon Creek Reach 3 - Lower Segment	Non-Structural Plan	$ 25,000
Leon Creek Reach 3 - Middle Segment	Non-Structural Plan	$ 404,000
Leon Creek Reach 3 - Upper/Middle Segment	Non-Structural Plan	$ 654,000

Damages, costs of improvements, and benefit-cost ratios for the selected plan are presented in Table 2. Dollar values in Table 2 are shown as present-worth values. The present-worth value is the amount of money that would have to be on

deposit in 1989 to pay for flood damages or capital improvements that would be paid for over a number of years in the future. The present-worth value of baseline damages, therefore, is the money that would have to be in the bank, earning interest, in 1989 to pay for the projected damages for all floods over the next 50 years.

Table 2
SUMMARY OF SELECTED PLAN

Reach Segment	Plan	Present Worth Baseline Damages (Dollars)	Present Worth Cost of Improvements (Dollars)	Benefit-Cost Ratio
Salado Creek Reach 1--Lower Segment	1	$ 81,000	$ 571,000	0.14
Salado Creek Reach 1--Upper Segment	1	70,000	904,000	0.08/0.37[1]
Cibolo Creek Reach 1--Lower Segment	2	332,000	490,000	0.68
Cibolo Creek Reach 1--Upper Segment	2	126,000	210,000	0.60
Leon Creek Reach 1--Lower Segment	1	493,000	1,621,000	0.30/1.46[1]
Leon Creek Reach 1--Upper Segment	2	636,000	1,836,000	0.35
Leon Creek Reach 3--Lower Segment	2	59,000	25,000	2.36
Leon Creek Reach 3--Middle Segment	2	182,000	404,000	0.45
Leon Creek Reach 3--Upper/Middle Segment	2	207,000	654,000	0.32

Note 1--assumes R.O.W. is donated

The present-worth cost of improvements is the cost of building the improvements in 1989 and of providing operation and maintenance over the next 50 years. All dollar values are in 1989 dollars; 8 percent was used as an interest rate to develop present-worth values, and no adjustment has been made for future inflation or deflation.

All costs were converted to present-worth values to provide a common basis for comparing benefits and costs with a benefit/cost ratio. The benefit/cost ratio was calculated by dividing the dollar damages that would be relieved because of plan implementation by the cost of the plan itself. A ratio of 1.0 or more indicates that the benefits of a plan are anticipated to equal or exceed the project cost. Conversely, if a benefit/cost ratio is less than 1.0,

benefits attributable to a plan are estimated to be less than project cost.

The improvements included in the benefit/cost ratio calculation also provide health and safety benefits to the general public. For instance, when a new channel is constructed, not only will that channel reduce the flooding of residential houses, it will also improve the health and safety of the neighborhood during and after the flood. By improving the quality of life in the neighborhood, it will generally increase property values and resident well being. Benefits such as these are not given a dollar value, and as such, are not included in the benefit/cost calculation.

Table 3 shows a summary of improvements by implementation priority.

Table 3
SELECTED PLAN SUMMARY OF IMPROVEMENTS
BY IMPLEMENTATION PRIORITY

Priority	Study Reach	Improvement
1	All Study Reaches	Replace low water crossings, add warning signs, install railroad type gates, develop a barricade plan and detour plan
2	All Study Reaches	Plan 2--nonstructural plan
3	Leon Creek Reach 3--Lower Segment	Construct drainage channels to carry off-site runoff through or around Mobile City Estates mobile home park between Camp Bullis Road and Raymond Russell Park

Priority	Study Reach	Improvement
4	Leon Creek Reach 1--Lower Segment	LC1-L1--creek shaping
5	Salado Creek Reach 1--Lower Segment	SC1-L1--replace Southern Pacific Railroad bridge
6	Salado Creek Reach 1--Upper Segment	SC1-U1--creek shaping

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FIGURES

FIGURES (Continued)

Section 1

Hydrology

Section 1
HYDROLOGY

INTRODUCTION

The 100-year flow rates used in the study were obtained from the Federal Emergency Management Agency (FEMA) Flood Insurance Studies for Bexar and Guadalupe Counties and from the City of San Antonio Drainage Department regulations. No original hydrology was developed for any of the stream watersheds as part of the scope of work on this project due to budget and time constraints.

FLOW RATE DETERMINATION

SALADO CREEK REACH 1

The study reach for Salado Creek Reach 1 begins at its confluence with the San Antonio River in southeastern Bexar County and extends upstream to Interstate Loop 410 (IH 410). The reach is 3.9 miles long. The United States Army Corps of Engineers (Corps of Engineers) issued a Floodplain Information Study of Salado Creek in 1969 which listed the intermediate flood (100-year) flow rate for the study reach to be 46,300 cubic feet per second (cfs). The June 15, 1983, FEMA Flood Insurance Study for the City of San Antonio listed the 100-year flow rate at Loop 13 upstream at the study reach to be 80,000 cfs. The City of San Antonio Drainage Department issued the results of an internal hydrologic analysis of the Salado Creek watershed on June 23, 1987. This analysis modeled the effects of 12 flood control dams built in the upper reaches of the watershed. This analysis was based on ultimate development conditions on the watershed. The 100-year flow rate for the study reach was 69,000 cfs. The flow rate used in this study was the 69,000 cfs developed by the City of San Antonio Drainage Department since it is the most recent and was developed with all the flood control dams in place in the upper reaches of the watershed. The previous studies

did not model all of the dams that are presently in existence.

CIBOLO CREEK REACH 1

The study reach for Cibolo Creek Reach 1 begins at the Bexar-Wilson County line and extends upstream to Farm to Market Road 78 (FM 78) in eastern Bexar County for a total length of approximately 25 miles. The Corps of Engineers issued a Floodplain Information Study in 1973 for Cibolo Creek from Interstate Highway 10 (IH 10) to upstream of FM 78. The intermediate flood (100-year) flow rate for the reach from IH 10 to approximately 4,000 feet downstream of FM 78 was 67,000 cfs and 75,300 cfs for the remainder of the study reach. The Guadalupe County and Bexar County Flood Insurance Studies used the flow rates developed in the 1973 Corps of Engineers Floodplain Information Study for the stream reach from IH 10 to FM 78. There are no published flow rates for the stream reach from the Bexar-Wilson County Line to IH 10.

A group of landowners and residents of the Buffalo Bend area retained a consultant to develop a revised flow rate and floodplain for Cibolo Creek to support their opposition of a proposed landfill near Schaeffer Road and Cibolo Creek. The report issued by R.J. Brandes Company in January 1988, indicated a 100-year flow rate of approximately 130,000 cfs for Cibolo Creek near Schaeffer Road. FEMA and the Fort Worth District of the Corps of Engineers are considering a restudy of Cibolo Creek because of the discrepancy between flow rates and concern by the Guadalupe County Commissioners Court with the end result being a new regulatory floodplain and flow rates. The revised maps and report are scheduled to be issued in approximately 3 years. Cibolo Creek crosses the Edwards Aquifer recharge zone just upstream of the study reach and significant amounts of water are lost by infiltration into the Edwards Aquifer (Corps of Engineers Report 1973). Representatives for the Corps of Engineers and FEMA recognize the complexity of the hydrology of Cibolo Creek over the Edwards Aquifer recharge zone and are planning to do a comprehensive analysis as part of the restudy.

CH2M HILL considers such a complex hydrologic analysis to be outside the budget capacity and time schedule for this project. CH2M HILL also recommends that the results of this study for Cibolo Creek should be reevaluated when the FEMA restudy is completed. The CH2M HILL study will use the existing regulatory flow rates of 67,000 cfs and 75,300 cfs for Cibolo Creek from IH 10 to FM 78 because the Brandes report is preliminary in nature and has not been accepted by FEMA or Bexar County.

LEON CREEK REACH 1

The study reach for Leon Creek Reach 1 begins at the corporate limits of the City of San Antonio just upstream of IH-410 to Quintana Road in southwestern Bexar County for a total length of approximately 3 miles. FEMA performed a detailed study of this reach of Leon Creek in 1977 for the Flood Insurance Study of Bexar County and the 100-year flow rate of 85,000 cfs was used in the FEMA backwater model. The City of San Antonio performed a detailed hydrologic analysis of Leon Creek in 1983. The analysis was based on ultimate development conditions on the watershed. The flow rate developed for this study reach was 86,232 cfs. The CH2M HILL study used the FEMA 100-year flow rate of 85,000 cfs since it wasn't significantly different from the City of San Antonio flow rate and thereby facilitated the calibration of the CH2M HILL backwater model to the FEMA model.

LEON CREEK REACH 3

The study reach for Leon Creek Reach 3 begins at the corporate limits of the City of San Antonio near IH 10 and Loop 1604 to the most upstream end of the reach in northwest Bexar County for a total length of 16.0 miles. The only published flow rate for this reach of Leon Creek is from the internal hydrologic analysis performed by the City of San Antonio Drainage Department in 1983. The flow rates developed in the analysis were based on ultimate development conditions on the watershed. These flow rates, which will be used in the CH2M HILL study, are 33,765 cfs from the

lower end of the reach to IH 10 at Leon Springs and 24,633 cfs from Leon Springs to the Leon Creek crossing of Boerne Stage Road.

Section 2

Existing Flood Plains

Section 2
EXISTING FLOOD PLAINS

INTRODUCTION

A planning level hydraulic analysis was conducted for selected segments of the study reaches to determine the water surface profile for the 100-year flood event. The flood plains and profiles were plotted for the existing 100-year flood event to determine the extent of flood damage. This section describes the conveyance characteristics of the study reaches; the hydraulic analysis of the channels and bridges; and the results of the analysis.

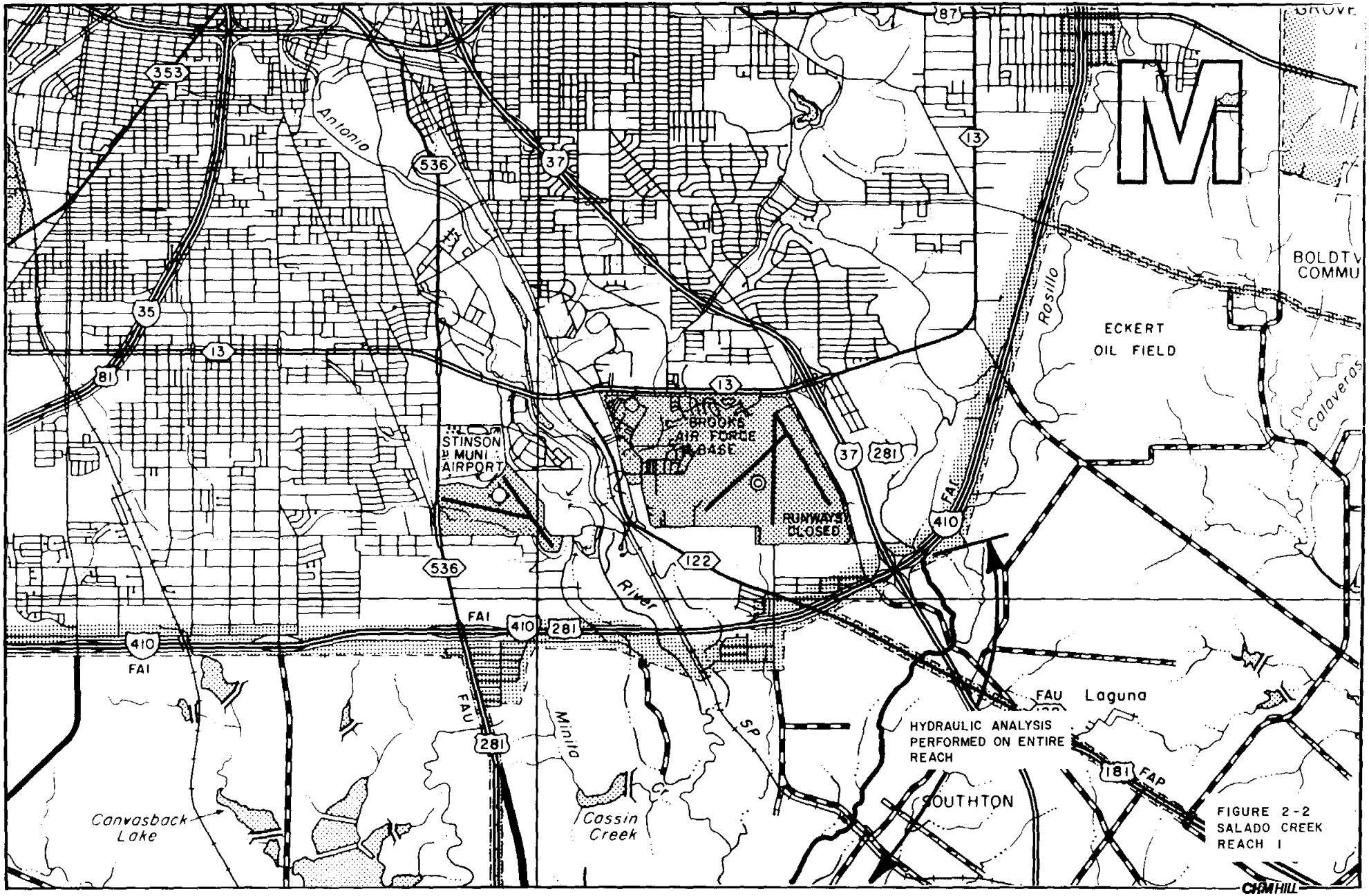
DRAINAGEWAY DESCRIPTION

The study reaches are located in the unincorporated areas of Bexar County as shown in Figure 2-1. The study reaches are predominantly undeveloped. However, each reach has localized concentrations of development where flooding and flood damages occur. A hydraulic analysis was conducted on two of the study reaches in their entirety and on selected segments of the other two reaches where existing development created flood hazards. These reaches will have both structural and non-structural plans developed for flood protection. The segments of the study reaches where no hydraulic analysis was conducted will only have a non-structural plan developed for flood protection.

SALADO CREEK REACH 1

A hydraulic analysis was conducted on the entire length of Salado Creek Reach 1 from its confluence with the San Antonio River to IH 410 as shown in Figure 2-2. This reach is 3.7 miles long. The average slope through the reach is 0.26 percent. The reach is through predominantly vacant or agricultural land with concentrations of development at Southton Road and Old Corpus Christi Highway. The creek channel has extremely thick stands of trees and underbrush

FIGURE 2-1
BEXAR COUNTY
FLOOD PROTECTION
PLAN
STUDY REACHES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Calaveras
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MUNI
AIRPORT
BROOKS
AIR FORCE
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RUNWAYS
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River
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Laguna
HYDRAULIC ANALYSIS
PERFORMED ON ENTIRE
REACH
SP
Milla
Cassin
Creek
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Lake
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FIGURE 2-2
SALADO CREEK
REACH I
CH2MHILL

while the overbank areas are clear to moderately wooded. The creek has not been channelized and is in its natural state, however, there have been several instances of filling in the channel at various locations along the reach. Creek flows are conveyed through several road crossings and one railroad crossing by bridges. There are no culverts on this reach of Salado Creek. Table 2-1 lists the crossings for Salado Creek Reach 1.

Table 2-1
SALADO CREEK REACH 1
EXISTING ROADWAY CROSSING STRUCTURES

Structure Location	Type of Crossing	Owner
Southern Pacific Railroad at Southton Road	Twelve-Span Bridge	Southern Pacific
Southton Road	Three-Span Bridge	Bexar County
Spur 122	Six-Span Main Bridge with a Six-Span Relief Channel Bridge	Texas Department of Highways & Public Transportation
IH 37	Ten-Span Bridge	Texas Department of Highways and Public Transportation
Old Corpus Christi Highway	Four-Span Bridge	Bexar County

CIBOLO CREEK REACH 1

A hydraulic analysis was conducted on a segment of Cibolo Creek Reach 1 from approximately 2.3 miles downstream of Schaeffer Road to FM 78. This reach is 7.5 miles long. Structural plans to reduce flooding will be considered for this segment of the study reach. The remainder of the study reach from the Bexar-Wilson County Line to 2.3 miles downstream of Schaeffer Road will only have a non-structural

plan considered. This segment of the study reach is 17.5 miles long. Figure 2-3 shows the limits of the study reach. This study is only considering flooding hazards and damageon the Bexar County side of Cibolo Creek since Cibolo Creek is the boundary between Bexar and Guadalupe Counties.

The average slope for the reach segment from the Bexar-Wilson county line to 2.3 miles downstream of Schaeffer Road is 0.13 percent. The average slope of the reach segment from 2.3 miles downstream of Schaeffer Road to FM 78 is 0.16 percent. The study reach is through predominantly vacant or agricultural land on the Bexar County side of Cibolo Creek with concentrations of development at Schaeffer Road and FM 78. The creek channel is moderately to thickly wooded with trees and underbrush while the overbank areas are clear to moderately wooded. The creek has not been channelized and is in its natural state with the exception of two gravel mining operations near Schaeffer Road and downstream of FM 78parallel to FM 1518. Creek flows are conveyed through several bridges and culverts crossing Cibolo Creek. Many of these bridges and culverts are low water crossings. Table 2-2 lists the crossings for Cibolo Creek Reach 1.

Table 2-2
CIBOLO CREEK REACH 1
EXISTING ROAD CROSSING STRUCTURES

Structure Location	Type of Crossing	Owner
FM 2538	Five-Span Bridge	Texas Department of Highways and Public Transportation
Uhlrich Road	Culvert/Low Water Crossing	Bexar/Guadalupe County
Trainer Hale Road	Culvert/Low Water Crossing	Bexar/Guadalupe County
IH 10 Mainlanes	Two Seven-Span Bridges	Texas Department of Highways and Public Transportation
IH 10 West Bound Frontage Road	Seven-Span Bridge	Texas Department of Highways and Public Transportation

Structure Location	Type of Crossing	Owner
Weir Road	Culvert/Low Water Crossing	Bexar/Guadalupe County
Lower Seguin Road	Culvert/Low Water Crossing	City of Schertz
Schaeffer Road	Culvert/Low Water Crossing	Bexar/Guadalupe County
Pecan Grove Mobile Home Park	Four-Span Bridge	Private
FM 78	Twelve-Span Bridge	Texas Department of Highways and Public Transportation

LEON CREEK REACH 1

A hydraulic analysis was conducted on the entire length of Leon Creek Reach 1 from upstream of IH 410 to Quintana Road as shown in Figure 2-4. This reach is 3.0 miles long. The average slope through the reach is 0.15 percent. The reach is through predominantly vacant or agricultural land with concentrations of development at Somerset Road, IH 35 and the reach between Loop 353 (New Laredo Highway) and Quintana Road. The creek channel has thick stands of trees and underbrush while the overbank areas are clear to moderately wooded. The creek has not been channelized and is in its natural state, however, there have been significant occurrences of filling in the flood plain and channel throughout the study reach, particularly along the reach segment between Loop 353 (New Laredo Highway) and Quintana Road. Creek flows are conveyed through several road crossings by bridges and culverts. Table 2-3 lists the crossings for Leon Creek Reach 1.

LEON CREEK REACH 3

A hydraulic analysis was conducted on a segment of Leon Creek Reach 3 from Old Camp Bullis Road to the Leon Creek crossing at Boerne Stage Road. Structural plans to reduce flooding will be considered for this segment of the study reach. The reach segment from the downstream crossing of IH 10 to Old Camp Bullis Road and the reach segment from Boerne Stage Road to the most upstream end of the reach will have only a non-structural plan considered. Figure 2-5 shows the limits of the study reach.

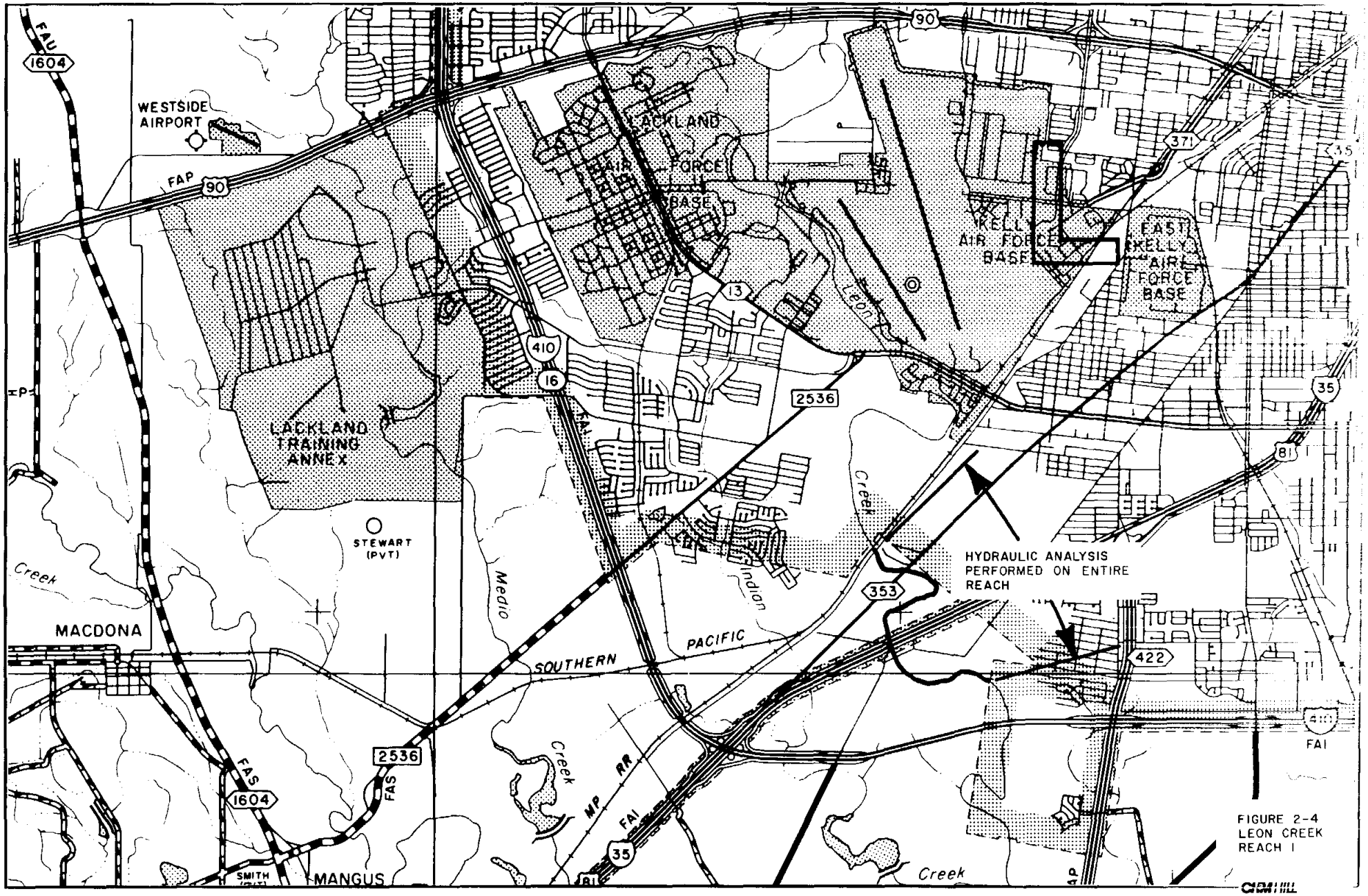


FIGURE 2-4
LEON CREEK
REACH I

Table 2-3
LEON CREEK REACH 1
EXISTING ROADWAY CROSSING STRUCTURES

Structure Location	Type of Crossing	Owner
Somerset Road	Four-Span Bridge	City of San Antonio/Texas Development of Highways and Public Transportation
IH 35 Frontage Road	Two-Three Multiple Box Culverts/Low Water Crossings	Texas Department of Highways and Public Transportation
IH 35 Mainlanes	Two Six-Span Bridges	Texas Department of Highways and Public Transportation
Loop 353 (New Laredo Highway)	Eight-Span Main Channel Bridge and a Five-Span Relief Channel Bridge	Texas Department of Highways and Public Transportation
Quintana Road	Seven-Span Bridge	Bexar County

The reach segment from the downstream crossing of IH 10 to Old Camp Bullis Road is 1.3 miles long and has an average slope of 0.36 percent. The reach segment from Old Camp Bullis Road to the Leon Creek Crossing at Boerne Stage Road is 6.9 miles long and has an average slope of 0.39 percent. The reach segment from Boerne Stage Road to the most upstream end of the reach is 6.1 miles long and has an average slope of 0.69 percent. The reach is bounded by moderate to high development fromIH 10 on the downstream end of the reach to Boerne Stage Road. The reach segment upstream of Boerne Stage Road isthrough either agricultural land or acreage lot developments. The creek channel and overbanks are unimproved and moderately wooded with the exceptions of the stream segment adjacent to the Dominion Development. This stream segment has been cleared of underbrush and landscaped as part of the Dominion Golf Course. Creek flows are conveyed through several road crossings and one railroad crossing by bridges and culverts. Table 2-4 lists the crossings for Leon Creek Reach 3.

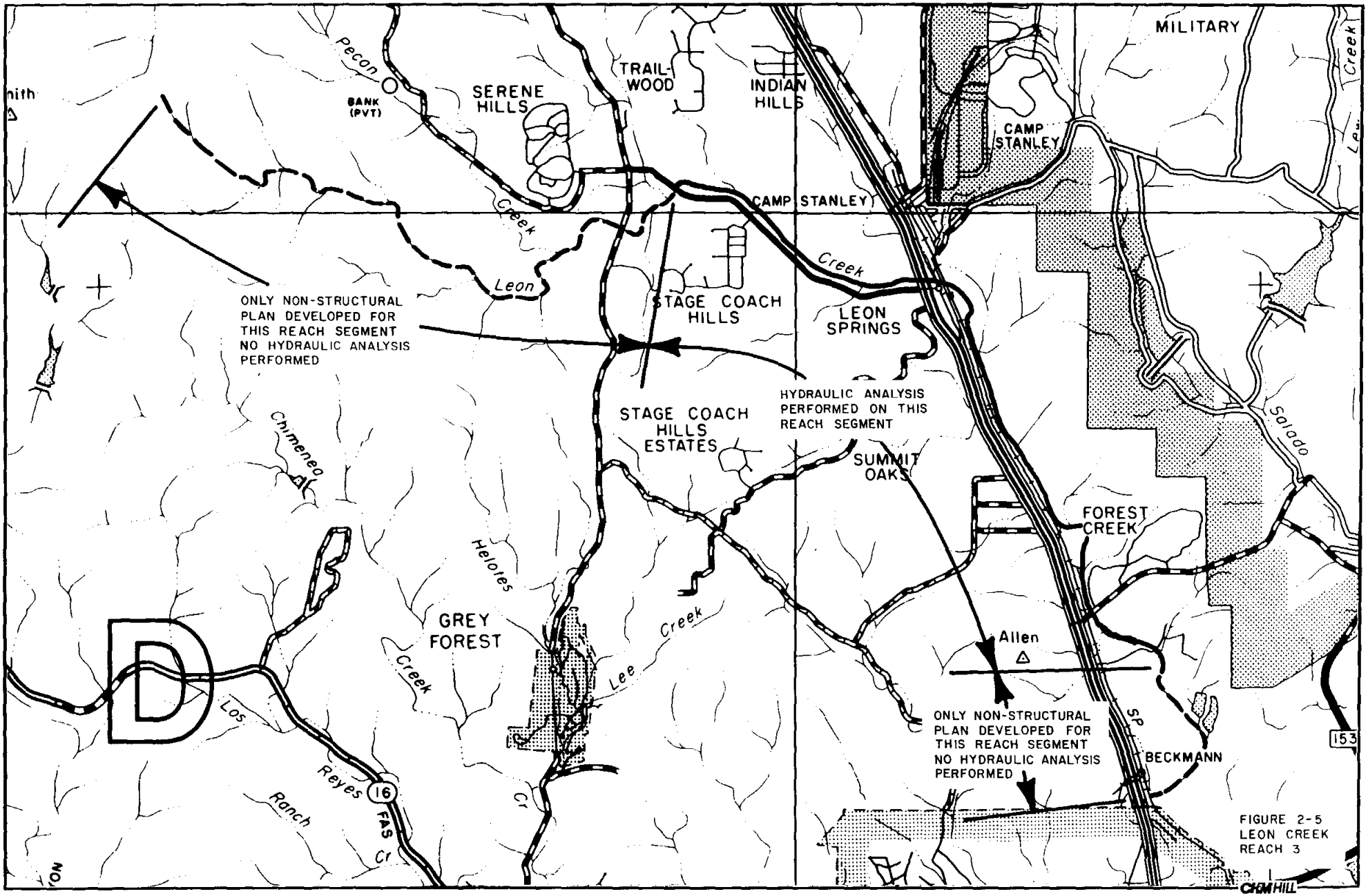


FIGURE 2-5
LEON CREEK
REACH 3

Table 2-4
LEON CREEK REACH 3
EXISTING ROADWAY CROSSING STRUCTURES

Structure Location	Type of Crossing	Owner
Old Camp Bullis Road	Culvert/Low Water Crossing	Bexar County
Camp Bullis Road	Three-Span Bridge	Bexar County
Louis Drive (Raymond Russell Park)	Culvert/Low Water Crossing	Bexar County
Mission Burial Park (Private Road)	Culvert/Low Water Crossing	Mission Burial Park
Dominion Drive	Three-Span Bridge	Dominion
Private Road South of Leon Springs	Culvert/Low Water Crossing	Private
Southern Pacific Railroad	Fourteen-Span Bridge	Southern Pacific Railroad
IH 10 Northbound Frontage Road	Four-Span Bridge	Texas Department of Highways and Public Transportation
IH 10 Mainlanes	Two Three-Span Bridges	Texas Department of Highways and Public Transportation
IH 10 Southbound Frontage Road	Three-Span Bridge	Texas Department of Highways and Public Transportation
Boerne Stage Road at Unnamed Tributary	Culvert/Low Water Crossing	Bexar County
Boerne Stage Road at Unnamed Tributary	Culvert/Low Water Crossing	Bexar County
Boerne Stage Road at Leon Creek	Nine-Span Bridge	Bexar County
Scenic Loop Road	Seven Span Bridge	Bexar County
Huntress Lane	Culvert/Low Water Crossing	Bexar County

HYDRAULIC ANALYSIS

CHANNEL HYDRAULICS

The Corps of Engineers HEC-2 water surface profile program (1985 micro-version) was used to delineate creek profiles along the longitudinal axis of each creek. This program utilizes the creek flow rates and physical characteristics of the creeks. The program uses the standard step method of determining water surface profiles.

Data input includes channel geometry, channel roughness (Manning's "n"), and channel slope. Channel cross-sections were digitized from aerial photography dated February 1987 by Williams-Stackhouse, Inc., for Salado Creek Reach 1, Cibolo Creek Reach 1 and Leon Creek Reach 3. The FEMA backwater model for Leon Creek Reach 1 was converted to HEC-2 format and used in this study. The locations of the cross sections used in the hydraulic analysis are shown on Figures 7-1 through 7-12. Channel roughness characteristics of each creek segment were determined from field observations. Manning's "n" values were determined from descriptions given in Chow (1959), the USGS publication by Barnes (1967) and the HEC publication by Thomas (1975).

BRIDGE AND CULVERT HYDRAULICS

Bridge and culvert descriptions and dimensions were determined from field measurements and "as-built" plans. Bridge structures were modelled using the bridge routines in HEC-2. Culverts in the study reaches were generally low water crossings that were greatly inundated by the 100-year flood. Because of the magnitude of inundation of the culvert and the high probability of debris blockage, the majority of the flow was over the road section and the flow through the culvert barrels was relatively minor. The culverts were modeled as conventional cross-sections describing the top of road profile as a channel dam. The backwater was calculated by the standard step method with flow through the culvert barrels considered to be insignificant.

FLOOD PLAIN DELINEATION

The 100-year existing condition flood plains for each creek reach are shown on Figures 7-1 through 7-12. Tables 2-5 through 2-8 summarize the 100-year discharges and water surface elevations computed at each cross-section in the HEC-2 analysis. The tables list information based on existing channel conditions.

The depth of flooding within flood plain areas can be determined from the flood plain maps by subtracting the ground surface elevation from the water surface elevation as given by the water surface profiles. The flood plain map is a plan view delineation of the profile, and flood elevations should be determined from the profiles. Due to the limitations of the plan view mapping, an onsite survey is recommended for any individual structure or property that may be subject to detailed evaluation for possible flood hazard. Such an elevation should include more detailed HEC-2 cross-sections than used in this study and a field survey to obtain actual elevations and locations. This study is intended as a planning document and as such has accuracy limitations that make it inappropriate for use in more detailed applications, such as for final design of any flood mitigation work.

Table 2-5
SALADO CREEK REACH 1 FLOOD PLAIN INFORMATION
UNDER EXISTING CHANNEL CONDITIONS

Location	Cross Section	Discharge (cfs)	100-Year Water Surface Elevation (ft)
Confluence with San Antonio River	.5	69000	500.00
	1.0	69000	502.72
	2.0	69000	505.06
	3.0	69000	509.79
Southern Pacific Railroad	5.0	69000	514.98
	5.5	69000	514.99
Southton Road	7.0	69000	515.37
	8.0	69000	518.11
	9.0	69000	520.72
	10.0	69000	526.24
	11.5	69000	528.97
Spur 122	11.0	69000	528.84
	13.0	69000	529.04
	13.5	69000	529.00
	14.0	69000	532.20
IH 37	16.0	69000	532.22
	17.0	69000	533.17
Old Corpus Christi Highway	19.0	69000	533.62
	21.0	69000	536.11

Table 2-6
CIBOLO CREEK REACH 1 FLOOD PLAIN INFORMATION
UNDER EXISTING CHANNEL CONDITIONS

Location	Cross Section	Discharge (cfs)	100-Year Water Surface Elevation (ft)
	1.0	67000	659.00
	2.0	67000	660.38
	3.0	67000	663.93
	4.0	67000	666.95
	5.0	67000	668.00
Schaeffer Road	6.0	67000	668.92
	7.0	67000	674.87
	8.0	67000	680.48
	9.0	67000	683.67
	10.0	67000	689.22
	11.0	67000	693.57
	12.0	67000	695.26
	13.0	67000	696.24
	14.0	67000	697.02
	15.0	67000	697.57
	16.0	67000	698.33
	17.0	67000	700.98
	18.0	67000	705.25
	19.0	75300	708.41
	20.0	75300	709.74
	21.0	75300	710.19
	22.0	75300	710.25
Downstream of FM 78	23.0	75300	712.41

Table 2-7
LEON CREEK REACH 1 FLOOD PLAIN INFORMATION
UNDER EXISTING CHANNEL CONDITIONS

Location	Cross Section	Discharge (cfs)	100-Year Water Surface Elevation (ft)
IH 410	1.0	85000	593.38
	2.0	85000	594.24
	3.0	85000	595.06
	4.0	85000	596.29
	5.0	85000	597.77
	6.0	85000	599.88
	7.0	85000	601.58
	8.0	85000	602.36
IH 35	9.0	85000	603.23
	10.0	85000	603.67
	11.0	85000	506.68
	12.0	85000	608.82
	13.0	85000	613.62
New Laredo Highway	14.0	85000	616.08
	15.1	85000	616.37
	15.2	85000	617.42
	15.3	85000	618.04
Downstream of Quintana Road	16.0	85000	619.45

Table 2-8
LEON CREEK REACH 3 FLOOD PLAIN INFORMATION
UNDER EXISTING CHANNEL CONDITIONS

Location	Cross Section	Discharge (cfs)	100-Year Water Surface Elevation (ft)
	1.0	33765	1053.14
Old Camp Bullis Road	2.0	33765	1058.15
	3.0	33765	1063.97
	4.0	33765	1066.04
Camp Bullis Road	6.0	33765	1068.31
	7.0	33765	1069.31
Raymond Russell Park	8.0	33765	1073.48
Raymond Russell Park	9.0	33765	1077.07
	10.0	33765	1093.48
	11.0	33765	1101.01
	11.8	33765	1105.38
Dominion Drive	11.9	33765	1105.43
	12.0	33765	1105.81
	13.0	33765	1113.89
	14.0	33765	1116.60
	15.0	33765	1120.41
	16.0	33765	1122.64
	17.0	33765	1131.86
Southern Pacific Railroad	18.0	33765	1131.43
	18.5	33765	1133.65
	19.0	33765	1133.74
	19.5	24533	1133.76
IH 10 Northbound Frontage Road	21.0	24533	1134.61
	22.0	24533	1134.61
IH 10 Mainlanes	22.5	24533	1136.80
	24.0	24533	1137.68
IH 10 Southbound Frontage Road	26.0	24533	1138.00
	27.0	24533	1139.68
	28.0	24533	1149.83
	29.0	24533	1159.99
	30.0	24533	1174.98
	31.0	24533	1181.51
Downstream of Boerne Stage Road	32.0	24533	1192.63

Section 3

Flood Problems and Damages

Section 3
FLOOD PROBLEMS AND DAMAGES

INTRODUCTION

This section outlines the history of flooding and projected flooding problems based on the 100-year design flood. The projected problems are based on existing channel conditions. Also included is an estimate of projected flood damages in dollars. The projected flood damages were used as the base condition to determine benefit/cost ratios for proposed improvements outlined in Section 6.

HISTORY OF FLOODING

SALADO CREEK REACH 1

Salado Creek has flooded many times in the past. The flood of October 1913 is the greatest known flood by local residents since 1853 (Corps of Engineers Report, 1969). The September 1921, September 1946, and August 1960 floods were about equal in magnitude to each other but reached flood heights somewhat less than the October 1913 flood. Other significant floods occurred in May 1958, May 1965, December 1965, January 1968, September 1973, September 1978, and June 1986.

CIBOLO CREEK REACH 1

The flood of 1889 was considered to be the greatest flood on record according to one local resident who was born in 1869. He was not living in the area during the October 1913 flood and could not comment on its magnitude (Corps of Engineers Report 1973). The 1973 flood is the greatest flood on record since the installation of the Selma stream gage. The stage height at the Selma gage for the 1973 flood was 0.2 feet higher than the estimated gage height of the 1889 flood. The May 1972 flood produced gage heights estimated to about 1.7 feet below the 1889 flood. Other significant floods occurred in October 1913, September 1952, May 1957,

June 1957, May 1958, September 1964, May 1965, October 1965 and June 1985.

LEON CREEK REACHES 1 AND 3

Very little information is available on past floods on Leon Creek. There are no USGS stream gages on Leon Creek prior to 1985. Local residents interviewed by the Corps of Engineers in 1971 indicated that the floods of September 1921 and September 1946 were believed to be the most significant floods in the preceding 40 years. Another significant flood occurred in May 1958. More recent significant flooding occurred in June 1986 and June 1987. No information was available to compare those floods to the ones that occurred in September 1921 and September 1946.

PROJECTED FLOODING PROBLEMS

Flood problems have been classified as one of two types:

- Life-safety hazards
- Property damage hazards

Flood problems that do not fall into either of these two categories are considered as nuisance flooding and are beyond the scope of this report.

LIFE-SAFETY HAZARDS

High hazard areas meet either one or both of the following criteria:

- Depths of 100-year flood exceed 2 feet
- The product of 100-year flood depth and velocity is 4 or greater

Additional hazards will exist during a flood. Common hazards include water in basements, electrified water, swift and deep water in channels, swift water entering storm

sewers, fires and explosions caused by electricity and gas, and numerous other hazards.

The study reaches include many low water crossings. The low water crossings have been rated as to hazard according to the criteria in Table 3-1. The low water crossings are listed in Table 3-2 along with their hazard rating classifications. Table 3-3 lists the low water crossings with their total hazard rating.

Table 3-1
LOW WATER CROSSING HAZARD RATING CRITERIA

Roadway Class Hazard Rating

Class	Hazard Rating
Interstate Highway System	4
State Highway System	3
County Road System	2
Private Road	1

Traffic Volume Hazard Rating

Volume	Hazard Rating
High	3
Medium	2
Low	1

Flood Water Inundation Hazard Rating

Inundation Depth (ft.)	Hazard Rating
>10	3
5-10	2
<5	1

Table 3-2
LOW WATER CROSSING HAZARD CLASSIFICATIONS

Location	Owner	Roadway Class	Traffic Volume	Inundation Depth (ft.)
Salado Creek Reach 1				
Southton Road	Bexar County	County	Medium	10
Old Corpus Christi Highway	Bexar County	County	Medium	10
Cibolo Creek Reach 1				
FM2538	Texas Dept. of Highways and Public Transportation	State	High	15
Uhlrich Road	Bexar/Guadalupe County	County	Low	25
Trainer Hale Road	Bexar/Guadalupe County	County	Low	25
Weir Road	Bexar/Guadalupe County	County	Low	20
Lower Seguin Road	City of Schertz/Guadalupe County	County	Medium	25
Pecan Grove	Private	Private	Low	20
Schaeffer Road	Bexar/Guadalupe County	County	Medium	20
FM 78	Texas Dept. of Highways and Public Transportation	State	High	15
Leon Creek Reach 1				
Somerset Road	City of San Antonio/ Texas Dept. of Highways and Public Transportation	County	Medium	<5
IH 35 Mainlanes	Texas Dept. of Highways and Public Transportation	Interstate	High	<5
IH 35 Frontage Road	Texas Dept. of Highways and Public Transportation	Interstate	High	20
New Laredo Highway	Texas Dept. of Highways and Public Transportation	State	High	<5
Quintana Road	Bexar County	County	Medium	<5
Leon Creek Reach 3				
Old Camp Bullis Road	Bexar County	County	Medium	5
Camp Bullis Road	Bexar County	County	High	<5
Louis Drive (Raymond (Russell Park)	Bexar County	County	Low	20
Mission Burial Park	Mission Burial Park	Private	Low	20
Dominion Drive	Dominion Development	Private	High	5
Private Road South of Leon Springs	Private	Private	Low	15
IH 10 Frontage Roads	Texas Dept. of Highways and Public Transportation	Interstate	High	<5
Boerne Stage Road @ Unnamed Tributary	Bexar County	County	High	10
Boerne Stage Road @ Unnamed Tributary	Bexar County	County	High	10
Huntress Lane	Bexar County	County	Medium	15
Scenic Loop Road	Bexar County	County	Medium	10

Table 3-3
LOW WATER CROSSING HAZARD RATING

Location	Roadway Class Hazard Rating	Traffic Volume Hazard Rating	Flood Water Inundation Hazard Rating	Total Hazard Rating
Salado Creek Reach 1				
Southton Road	2	2	2	6
Old Corpus Christi Highway	2	2	2	6
Cibolo Creek Reach 1				
FM 2538	3	3	3	9
Uhlrich Road	2	1	3	6
Trainer Hale Road	2	1	3	6
Weir Road	2	1	3	6
Lower Seguin Road	2	2	3	7
Schaeffer Road	2	2	3	7
FM 78	3	3	3	9
Pecan Grove	1	1	3	5
Leon Creek Reach 1				
Somerset Road	2	2	1	5
IH 35 Mainlanes	4	3	1	8
IH 35 Frontage Road	4	3	3	10
New Laredo Highway	3	3	1	7
Quintana Road	2	2	1	5
Leon Creek Reach 3				
Old Camp Bullis Road	2	2	3	7
Camp Bullis Road	2	3	1	6
Louis Drive (Raymond Russell Park)	2	1	3	6
Mission Burial Park	1	1	3	5
Dominion Drive	1	3	2	6
Private Road South of Leon Springs	1	1	3	5
IH 10 Frontage Roads	4	3	1	8
Boerne Stage Road @ Unnamed Tributary	2	3	2	7
Boerne Stage Road @ Unnamed Tributary	2	3	2	7
Huntress Lane	2	2	3	7
Scenic Loop Road	2	2	2	6

PROPERTY DAMAGE HAZARDS

Estimates of property damage were computed for existing flood plain development by comparing flood elevations to structure elevations and by using established guidelines for depth versus damage relationships. Appendix A includes the methodology used to determine damages. Appendix D includes the structure finished floor and flood elevations for structures subject to flooding in each respective reach.

Table 3-4 summarizes the results of the damage analysis for the detailed study reaches. The table shows the damages projected for the 100-year design flood. Also shown are the expected average annual damages, which were computed by calculating the area under the curve representing the 100-year and zero-damage level floods for each reach. The average annual damages represent the projected costs that will be incurred from all levels of flooding over a long period. The calculation assumes that over a 100-year period, each study reach will have one 100-year flood, one 99-year flood, one 98-year flood, and so on. A typical curve is shown in Figure 3-1.

Present worth costs shown in Table 3-4 represent the amount of money that would have to be on deposit at 8 percent interest to pay out money annually for 50 years to pay for average flood damages. The present worth figure is compared to the present worth cost of flood control improvements in Section 6 to determine benefit/cost ratios.

DESCRIPTION OF PROJECTED FLOOD PROBLEMS BY REACH

SALADO CREEK REACH 1
LOWER SEGMENT
(San Antonio River to 500 Feet Upstream of Southton Road)

The 100-year flood plain for this reach segment is shown on Figure 7-1. The major flooding problems occur at Southton Road where the Southern Pacific Railroad Bridge creates a backwater effect which is projected to inundate the residential development upstream of Southton Road with depths from

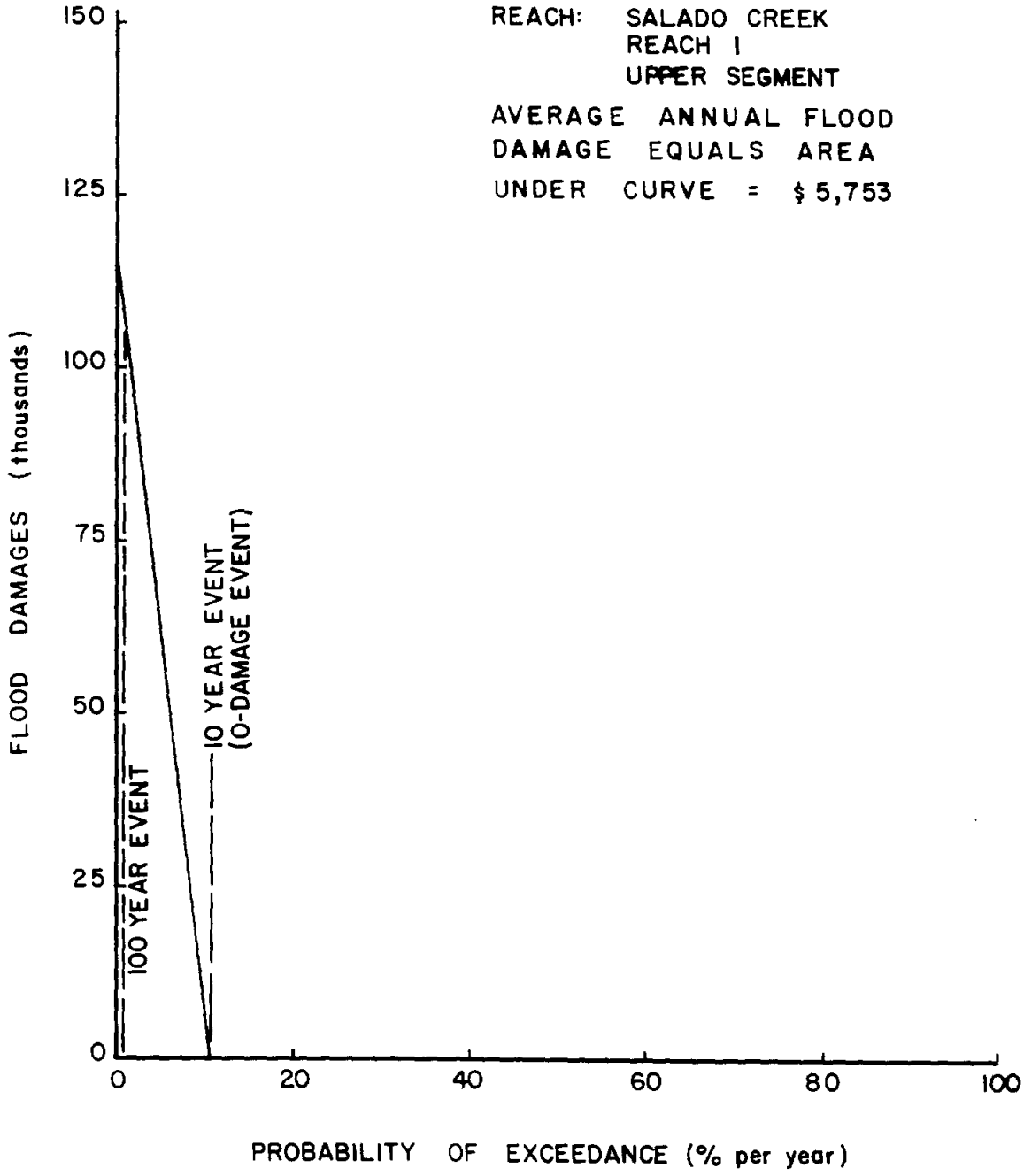


FIGURE 3 - 1
FLOOD DAMAGE VS.
PROBABILITY OF EXCEEDANCE
SALADO CREEK REACH 1, UPPER SEGMENT
BEXAR COUNTY FLOOD
PROTECTION STUDY

Table 3-4
PROPERTY DAMAGE SUMMARY

Detailed Analysis Reach Segment	100-Year Damages (Dollars)	Average Annual Damages (Dollars/Year)	Present Worth of Damages Over 50 Year at 8% (Dollars)
Salado Creek Reach 1 - Lower Segment	$121,000	$ 6,650	$ 81,000
Salado Creek Reach 1 - Upper Segment	105,000	5,750	70,000
Cibolo Creek Reach 1 - Lower Segment	493,000	27,120	332,000
Cibolo Creek Reach 1 - Upper Segment	188,000	10,330	126,000
Leon Creek Reach 1 - Lower Segment	732,000	40,280	493,000
Leon Creek Reach 1 - Upper Segment	945,000	51,990	636,000
Leon Creek Reach 3 - Lower Segment	88,000	4,900	59,000
Leon Creek Reach 3 - Middle Segment	271,000	14,910	182,000
Leon Creek Reach 3 - Upper Segment	37,000	2,030	25,000

1 to 7 feet. The backwater elevation is high enough that the water spills over the drainage divide at Blue Wing Road into an adjacent creek. Southton Road is expected to be overtopped by 10 feet except the bridge, which will be perched above the 100-year water surface.

SALADO CREEK REACH 1
UPPER SEGMENT
(500 Feet Upstream of Southton Road to IH 410)

The 100-year flood plain for this reach segment is shown on Figures 7-1 and 7-2. The major flooding problems are projected to occur at Old Corpus Christi Highway. The 100-year flood plain is very wide through this reach segment. The Spur 122 and IH 37 bridges are projected to be above the 100-year water surface but Old Corpus Christi Highway is expected to be overtopped by 10 feet at a culvert south of the main channel bridge. Several residential and one commercial properties are expected to be inundated by up to 4¼ feet by the 100-year flood at Old Corpus Christi Highway.

CIBOLO CREEK REACH 1
LOWER SEGMENT
(2.3 Miles Downstream of Schaeffer Road to 1.3 Miles Upstream of Schaeffer Road)

The 100-year flood plain for this reach segment is shown on Figures 7-3 and 7-4. Schaeffer Road is expected to be overtopped by approximately 20 feet. The residential houses and mobile homes in the trailer park north of Schaeffer Road are expected to flood to depths of 1 to 4 feet. The majority of residential structures are mobile homes and sit higher above ground than conventional homes. The depth of water above ground in the trailer park ranged from 1 to 7 feet.

CIBOLO CREEK REACH 1
UPPER SEGMENT
(1.3 Miles Upstream of Schaeffer Road to FM 78)

The 100-year flood plain for this reach segment is shown on Figures 7-5 and 7-6. The major flooding problems occur at or just downstream of FM 78. FM 78 is expected to be overtopped by approximately 15 feet. The residential structures just downstream of FM 78 are expected to be inundated with depths of flooding ranging from 0 to 3 feet. The commercial structure on FM 78 is expected to be flooded to a depth of 6 feet.

LEON CREEK REACH 1
LOWER SEGMENT
(Corporate Limits of San Antonio to 2,000 Feet Downstream of New Laredo Highway)

The 100-year flood plain for this reach segment is shown on Figures 7-7 and 7-8. The mainlanes of IH 35 north of the bridge are expected to be overtopped by 4 feet. The bridge will be above the 100-year flood. The IH 35 frontage roads are expected to be overtopped by 20 feet. The residential houses and mobile homes at Somerset Road are expected to be flooded to depths of 2.5 to 4 feet. The mobile homes just upstream of IH 35 are expected to be flooded to a depth of 0.5 feet. The residential homes just upstream of IH 35 are expected to be flooded to a depth of 4.9 feet.

LEON CREEK REACH 1
UPPER SEGMENT
(2,000 Feet Downstream of New Laredo Highway to Quintana Road)

The 100-year flood plain for this reach segment is shown on Figure 7-8. New Laredo Highway is expected to be overtopped by 3 feet. The mobile home park between New Laredo Highway and Quintana Road is expected to be flooded to depths of 5 to 10 feet. The meat packing plant on New Laredo Highway is expected to be flooded to a depth of 4 feet.

LEON CREEK REACH 3
LOWER SEGMENT
(Old Camp Bullis Road to the Southern Pacific Railroad)

The 100-year flood plain for this reach segment is shown on Figures 7-9 to 7-11. Old Camp Bullis Road is expected to be overtopped by approximately 5 feet. Camp Bullis Road is expected to be overtopped by 3.5 feet. Dominion Drive is expected to be overtopped by 5 feet. One commercial structure on Camp Bullis Road is expected to be flooded by 0.1 feet of water and two abandoned mobile homes are also expected to be flooded by 0.6 and 4 feet, respectively, of water near Camp Bullis Road. The Mobile City Estates mobile home park bordered by IH 10 and Camp Bullis Road has experienced flooding in the past. The hydraulic analysis of Leon Creek indicated the flooding is not due to the 100-year flood on Leon Creek. A site investigation determined that the mobile home park had been built in two existing drainageways which discharge from culverts under IH 10 into the mobile home park. Texas Department of Highways and Public Transportation records indicate the 50-year discharge for these drainageways to be approximately 500 cfs each. This study considers this to be a local drainage problem and not flooding from the 100-year flood on Leon Creek.

LEON CREEK REACH 3
MIDDLE SEGMENT
(Southern Pacific Railroad to IH 10 Southbound Frontage Road)

The 100-year flood plain for this reach segment is shown on Figure 7-11. The Southern Pacific Railroad bridge and the IH 10 northbound frontage road bridge produce backwater effects that impact the commercial properties in this reach segment. The Southern Pacific Railroad is expected to be overtopped by 1.4 feet. The IH 10 northbound and southbound frontage roads are expected to be overtopped by 3 feet and 4 feet respectively. Boerne Stage Road is expected to be inundated to a depth of 4 feet. Several commercial properties along the IH 10 northbound frontage road are expected to be flooded by 1 to 2 feet of water.

LEON CREEK REACH 3
UPPER SEGMENT
(IH 10 Southbound Frontage Road to Boerne Stage Road Bridge)

The 100-year flood plain for this reach segment is shown on Figures 7-11 and 7-12. Boerne Stage Road is expected to be overtopped near IH 10 by 1.8 feet and by 1 to 3 feet near the Boerne Stage Road bridge. Two residential structures approximately 3,500 feet upstream of IH 10 are expected to be flooded to a depth of 1 foot. There has been significant filling in the flood plain at this location.

Section 4

Plan Development

Section 4
PLAN DEVELOPMENT

INTRODUCTION

This section describes the development of alternative plans for stormwater management in the four study reaches. Alternative measures were screened and recommendations for further analysis are presented.

SCREENING PROCESS

To facilitate the screening of drainage improvements, the four study reaches were divided into segments based on location of existing concentrations of development and flooding. These segments are as follows:

1. Salado Creek Reach 1--Lower Segment (San Antonio River to 500 feet upstream of Southton Road)

2. Salado Creek Reach 1--Upper Segment (500 feet upstream of Southton Road to IH 410)

3. Cibolo Creek Reach 1--Lower Segment (2.3 miles downstream of Schaeffer Road to 1.3 miles upstream of Schaeffer Road)

4. Cibolo Creek Reach 1--Upper Segment (1.3 miles upstream of Schaeffer Road to FM 78)

5. Leon Creek Reach 1--Lower Segment (corporate limits of San Antonio to 2,000 feet downstream of New Laredo Highway)

6. Leon Creek Reach 1--Upper Segment (2,000 feet downstream of New Laredo Highway to Quintana Road)

7. Leon Creek Reach 3--Lower Segment (Old Camp Bullis Road to the Southern Pacific Railroad)

8. Leon Creek Reach 3--Middle Segment (Southern Pacific Railroad to IH 10 southbound frontage road)

9. Leon Creek Reach 3--Upper Segment (IH 10 southbound frontage road to Boerne Stage Road bridge)

Each segment was evaluated for drainage problems which were described in Section 3 of this report. The following drainage improvements were considered for solutions to the identified problems.

- Maintaining the existing channel configuration
- Improving the drainageway in a naturally landscaped configuration following the general historic channel alignment
- Lining channels to reduce right-of-way requirements
- Relocating channels to routes other than the historic alignment, if the relocation does not create additional flood hazards
- Constructing detention, retention, or recharge ponds
- Constructing levees to contain expected high flows
- Installing, removing, or replacing structures at specific problem areas
- Floodproofing individual structures
- Implementing flood plain management regulations
- Implementing flood warning systems, public information programs, and evacuation plans

- Acquiring property within the 100-year flood plain and relocating occupants

- Considering other alternatives, such as floodwalls, berms, and site-specific improvements

The preceding drainage improvements were evaluated and screened for each reach. This process resulted in a preferred list of improvements for each reach based on lowest cost, acceptable land and structure acquisition requirements, and engineering constraints.

COMPREHENSIVE PLAN FORMULATION

Following the segment-by-segment analysis of drainage improvements, the entire study reaches were evaluated by using the list of preferred improvements for each reach to develop comprehensive plans that would address identified flood problems for the entire study length. Existing basin conditions also were evaluated and assumptions were made on which conditions would remain and become a part of the comprehensive plans.

The general approach to 100-year flood reduction in the study reaches is threefold:

- First, undersized roadway crossings and open channels would be improved and enlarged. The objectives of these improvements are to reduce backwater elevations, roadway overtopping, channel overbank flooding, and channel erosion.

- The second general approach to flooding would require clearing of brush and sloping the creek channel to enlarge the conveyance capacity of the channel and make maintenance easier.

- Third, a flood plain management approach is considered. This approach would not require structural improvements, and may include flood warning, flood

plain regulations and ordinances, and flood-proofing and relocating individual structures.

ALTERNATIVE PLANS

Based on the screening process and the identified flood problems, two comprehensive plans were developed. The plans represent practical, cost-effective alternatives for further analysis. One of the plans is a structural plan requiring capital improvements to the channel and roadway crossings. The second plan is a nonstructural plan and does not include capital improvements. The plan relies on flood plain management and flood warning for damage reduction.

Given the large contributing watershed, the large resulting runoff volume and the lack of suitable detention sites, detention alternatives were not considered.

The plans are as follows:

- Plan 1--This plan calls for the conveyance of the 100-year flood within the improved or reshaped channel with improved roadway crossings. The improved or reshaped channel would be grass-lined.

- Plan 2--This includes flood plain management with no structural improvements. It is included as a base from which to evaluate Plan 1, and as a viable alternative. In addition to active flood plain regulation and management, structure relocation, floodproofing, and flood warning programs are recommended to mitigate hazards along the study reaches. Flood plain regulation and management could involve prohibiting development in the flood plain and/or establishing criteria for flood plain development.

SUMMARY

Plans 1 and 2 as described were presented to the County for review. The presentation included a description of each plan component. Based on county review and further analyses, the proposed plans were modified and are presented in Section 5.

Section 5

Preliminary Design

Section 5
PRELIMINARY DESIGN

INTRODUCTION

This section presents the preliminary designs for the comprehensive plans introduced in Section 4. The plans from Section 4 were revised to incorporate County review comments and more detailed design analysis. The preliminary designs developed in this section were then used as a basis for the plan evaluations and selection described in Section 6.

PLAN SUMMARIES

Plan 1 provides protection from the 100-year flood by containing the flood in an improved channel section or by lowering the 100-year water surface below the first floor elevations of the structures in the flood plain by bridge widening and creek shaping. Three creek segments have two variations of Plan 1 presented for evaluation. Plan 2 recommends nonstructural improvements for mitigating 100-year flood damages on each creek segment.

A nomenclature to distinguish between each proposed alternative on each study reach segment was developed. The creek name and reach number is the first part of the designation and the reach segment and plan number is the second part of the designation. For example, Plan 1 on the Lower Segment of Salado Creek Reach 1 would be designated SC1-L1.

PLAN 1--STRUCTURAL APPROACH

The major components of Plan 1 for each reach segment are summarized below. Plan 2 is identical for all study reaches and will be presented in detail after the presentation of Plan 1 for all the reach segments.

Salado Creek Reach 1--Lower Segment
SC1-L1

Replace the Southern Pacific Railroad bridge with a longer bridge to increase the conveyance of the 100-year flood through the structure. The new bridge will be 280 feet long with a 120-foot bottom width and 2H:1V side slope channel section under the bridge.

Salado Creek Reach 1--Upper Segment
SC1-U1

Clear the underbrush and small trees in the channel and reshape the channel from just upstream of Southton Road to IH 410. The reshaped channel will be root-plowed, raked and sodded with improved grasses. The large trees will remain. Maintenance will be required by mowing twice a year to control brush and saplings.

Cibolo Creek Reach 1--Lower Segment
CC1-L1a

Construct an improved channel with a 250-foot wide bottom and 4H:1V side slopes on a 0.19 percent grade from 1000 feet downstream of Schaeffer Road to 6800 feet upstream of Schaeffer Road. Construct a levee from 1000 feet downstream of Schaeffer Road to 1300 feet upstream of Schaeffer Road to protect the mobile home park. The levee will have a 10-foot top width and 3H:1V side slopes.

Cibolo Creek Reach 1--Lower Segment
CC1-L1b

Construct an improved cutoff channel with a 250-foot wide bottom and 4H:1V side slopes on a 0.19 percent grade. This channel will cut across the oxbow at Crescent Bend. Construct an improved channel with a 250-foot wide bottom and 4H:1V side slopes on a 0.19 percent grade from 1000 feet downstream of Schaeffer Road to 6800 feet upstream of Schaeffer Road. No levee is required.

Leon Creek Reach 1--Lower Segment
LC1-L1

Clear the underbrush and small trees in the channel and reshape the channel from the corporate limits of San Antonio near IH 410 to New Laredo Highway. The reshaped channel will be root-plowed, raked and sodded with improved grasses. The large trees will remain. Maintenance will be required by mowing twice a year to control brush and saplings.

Leon Creek Reach 1--Upper Segment
LC1-U1a

Remove the fill that has been placed between the existing creek channel and the mobile home subdivision between New Laredo Highway and Quintana Road.

Leon Creek Reach 1--Upper Segment
LC1-U1b

Remove the fill that has been placed between the existing creek channel and the mobile home subdividion between New Laredo Highway and Quintana Road. Replace the New Laredo Highway Relief Bridge with a new 400-foot long bridge. Construct an improved channel with a 285-foot wide bottom and 3H:1V side slopes through the new bridge to the existing channel. This improved channel will cut across the existing oxbow downstream of New Laredo Highway.

Leon Creek Reach 3--Middle Segment
LC3-M1

Replace the Southern Pacific Railroad bridge with a new 325-foot long bridge. Replace the IH 10 northbound frontage road bridge with a new 210-foot long bridge. Widen the creek channel from downstream of the Southern Pacific Railroad bridge to the IH 10 mainlanes. Deepen the existing creek channel to a uniform grade through the IH 10 mainlanes to the IH 10 southbound frontage road. This plan prevents flood damage to structures but Boerne Stage Road remains inundated by the 100-year flood plain.

Leon Creek Reach 3--Upper/Middle Segment
LC3-UM1

Replace the Southern Pacific Railroad bridge with a new 325-foot long bridge. Replace both IH 10 frontage road bridges with new 210-foot long bridges. Widen and deepen the existing creek channel to a uniform grade from the Southern Pacific Railroad bridge to the IH 10 southbound frontage road. Widen IH 10 mainlane bridge opening by building new vertical abutement walls with a 185-foot wide channel through the bridges. Build a berm between Boerne Stage Road and Leon Creek from the Southern Pacific Railroad bridge to the IH 10 southbound frontage road bridge. Construct an improved 150-foot bottom width 3H:1V side slope channel from 5200 feet upstream of IH 10 to the Boerne Stage Road bridge.

PLAN 2--NONSTRUCTURAL APPROACH

Plan 2 should be implemented on all of the study reaches including the reach segments where no hydraulic analysis was conducted. These nonstructural recommendations could also be implemented on the creek segments where a structural plan is recommended until the structural plan is implemented and the area is removed from the flood plain.

Plan 2 includes the following:

- Broaden the existing flood warning program
  - Coordinate efforts with upstream jurisdictions where possible
  - Coordinate with National Weather Service, Corps of Engineers, and other agencies to receive existing warning data
  - Install rain gauges and stream gauges in upstream areas to be checked by volunteers and/or County employees

- Review emergency response program in accordance with State and FEMA guidelines. Special attention should be given to developing a plan to barricade low water crossings and warn people in mobile homes.

- Develop emergency access routes into hazardous areas. The routes would be used by police, fire, and public works and ambulance crews.

- Provide annual notification of flood hazard to floodplain residents. This is especially important for people who rent houses or mobile homes and may not be aware of historic flood events. Permanent residents will benefit by the reminder of things they may have forgotten. The notification would include information on purchasing flood insurance and any County programs to help reduce flood damage. The address of structures in the 100-year flood plain are listed in Appendix D.

- Improve floodplain management to reduce the number of people moving into floodplain areas and reduce dumping and filling in the floodplain. Enforce FEMA requirements including special flood zone tie-downs for mobile homes.

- Provide a voluntary pre-flood proofing program for permanent residential structures with projected 100-year water levels up to a maximum of 3 feet above first floor elevations. Floodproofing will be customized for each house and may include berms, walls, water-tight closures on windows and doors, waterproof walls, and additional techniques as outlined in FEMA floodproofing manuals. Certain types of structures may not lend themselves to floodproofing. Floodproofing is not recommended where the product of the depth and the velocity at adjacent ground levels exceeds 4. For example, a depth of 3 feet and a velocity of

1.3 feet per second would be allowed, but a depth of 2 feet and a velocity of 3 feet per second would not be allowed. Tests conducted for a study by the City of Boulder, Colorado, showed that where the product of the depth and velocity exceed 4, a pedestrian may have difficulty standing in flood water.

- Provide a voluntary pre-flood relocation/ acquisition program for permanent residential structures where 100-year flood depths exceed 3 feet above first floor elevations or where the product of the depth and the velocity exceeds 4 on adjacent ground.

- Provide a voluntary pre-flood relocation/ acquisition program for mobile homes where the product of the 100-year depth and velocity exceeds 4 at adjacent ground levels.

- Provide a mandatory post-flood relocation/ acquisition program for any permanent structure that has been flooded by more than 3 feet or has incurred "substantial damage" as defined by FEMA.

- Provide a mandatory post-flood relocation/ acquisition program for any mobile home that has received flood water above the first floor elevation.

- Improve channel maintenance to include more debris pickup and selective clearing of vegetation on a regularly schedule basis.

Section 6

Plan Evaluation and Selection

Section 6
PLAN EVALUATION AND SELECTION

INTRODUCTION

This section presents the evaluation and comparison of the alternative plans described in Section 5. The benefit/cost procedure is discussed as the basis for an economic analysis of each plan, and estimated plan costs and benefits are summarized. In addition, a matrix analysis that compares all project objectives on a commensurate basis is presented, and one of the alternative plans is selected as a final plan.

BENEFIT/COST PROCEDURE

The benefit/cost procedure compares a proposed plan's potential reduction in flood damages to the estimated cost of the plan. The procedure uses only those benefits and costs to which dollar values can be directly computed. For this reason, a procedure whereby all project benefits (economic and noneconomic) are compared on a commensurate basis is also presented.

DEVELOPMENT OF PLAN COSTS

Opinions of cost were developed for the alternative plans based on 1989 unit costs developed from bid tabulations, suppliers' quotations, and information supplied by local contractors, and cost-estimating service publications.

The alternative plan costs were developed from the preliminary designs presented in Section 5. The cost opinion for each plan comprises the following four categories:

- Right-of-way acquisition costs
- Construction costs, including insurance

- Engineering, inspection, legal, fiscal, and administrative costs

- Operation and maintenance costs

The following are descriptions of each cost category.

Right-of-Way Acquisition Costs

Right-of-way cost requirements will apply where proposed drainage facilities will require new right-of-way (not already county owned). Right-of-way costs do not include title search costs.

Construction Costs

This category includes the construction costs for materials and labor for drainage improvements. These costs were estimated by preparing planning level quantity takeoffs and by multiplying the quantities by the appropriate unit costs. Unit costs are summarized in Table 6-1.

Construction costs include an additional 25 percent allowance for items not directly accounted for in the quantity takeoffs. Such items include unexpected subsurface conditions, sheet piling for restricted trench widths, dewatering of the construction area, traffic control, temporary roadways and special fabrications. A 5 percent allowance for mobilization, bonds, and insurance for the contractor is included in the 25 percent.

Engineering, Inspection, Legal, Fiscal, and Administrative Costs

A 25 percent allowance was used for this cost. The allowance is intended to include professional engineering services, permits, or legal requirements pertaining to right-of-way and acquisition costs. The 25 percent allowance is based on total construction.

Maintenance Costs

Unit maintenance costs were obtained from discussions with the USDA Soil Conservation Service and the Denver Regional Area Urban Drainage and Flood Control District (UDFCD). These costs are summarized in Table 6-1.

Cost Summaries for Each Plan

Opinions of cost for each alternative plan are shown in Appendix B. The opinions of cost shown in Appendix B and any resulting conclusions on project financial or economic feasibility or funding requirements have been prepared for guidance in project evaluation and implementation from the information available at the time the opinion was prepared. The final costs of the project and resulting feasibility will depend on actual labor and material costs, competitive market conditions, actual site conditions, final project scope, implementation schedule, continuity of personnel and engineering, and other variable factors. As a result, the final project costs will vary from the opinions of cost presented in this document. Because of these factors, project feasibility, benefit/cost ratios, risks, and funding needs must be carefully reviewed before making specific financial decisions or establishing project budgets to help ensure proper project evaluation and adequate funding.

DEVELOPMENT OF PLAN BENEFITS

Project benefits were estimated using techniques published by the Denver Regional Area UDFCD. The procedure starts with the average annual flood damage for each reach, without any improvements, as described in Section 3. The average annual flood damage is represented by the area beneath the baseline condition damage versus return period curve. This curve represents the baseline condition for comparing the effect of each alternative plan. An adjusted damage versus return period curve is then plotted for each alternative plan and compared to the baseline curve. The annual flood control benefit is the reduction in average annual damages

Table 6-1
PLANNING LEVEL UNIT COSTS

Item	Cost
Capital Items	
Excavation--On Site Disposal	$1.70/yd^3
Excavation--Load and Haul	3.00/yd^3
Excavation--Confined and/or Rock, Load and Haul	4.00/yd^3
Compacted fill--Available on Site	1.00/yd^3
Clear Brush, Shape, and Vegetate	780/acre
Concrete Abatement Walls	350/yd^3
Bridge--Railroad	100/ft^2
Bridge--Highway	50/ft^2
Right-of-Way[1]	6,750/acre
Floodproofing/Relocation	
Mobile Home--Rented Space Relocation	1,000/ea
Mobile Home--Owned Lot Relocation	5,000/ea
Residential--Protection	5,000/ea
Residential--Relocation	60,000/ea
Annual Maintenance	
Structural Maintenance	1% of construction cost
Channel Maintenance	50/acre

[1]Right-of-Way costs obtained from Bexar County Urban Renewal Agency as 90% of property value ($7,500/acre).

from the baseline damages and represents the potential benefit that would be realized if the alternative plan were implemented.

BENEFIT/COST RATIOS

The benefit/cost ratio was calculated by dividing the potential benefit of the plan by the estimated cost of the plan. A benefit/cost ratio greater than 1 indicates that the benefits of a plan are anticipated to exceed the project cost. Conversely, a benefit/cost ratio less than 1 indicates that the benefits of a plan are not anticipated to exceed project cost. The benefit/cost ratio was used in this study to compare the relative economic feasibility of each plan and was one of several criteria used for plan comparison.

SUMMARY OF BENEFIT/COST RESULTS

A summary of the results of the benefit/cost procedure is shown in Table 6-2. Table 6-2 lists plan costs, damages, and benefit/cost ratios. However, all of the alternatives have noneconomic advantages and disadvantages that were not evaluated in the economic analysis. To evaluate the noneconomic differences between all plans, a matrix analysis was developed to assess all plan objectives.

MATRIX ANALYSIS

This subsection will describe an approach for analyzing both the tangible (reduction in flood damages) and intangible benefits of each plan.

PLAN OBJECTIVES

The performance of each alternative plan was evaluated for its ability to satisfy certain county and community objectives. These objectives have been classified and prioritized as follows:

Table 6-2
BENEFIT/COST SUMMARY
PRESENT WORTH VALUES

Alternative Plan		Capitalized (Present Worth) Flood Damage (Dollars)	Present Worth Cost of Improvements (Dollars)	Benefit Cost Ratio
Creek/ Reach	Segment/ Plan			
SC1	L1	81,000	571,000	0.14
SC1	L2	81,000	615,000	0.13[3]
SC1	U1	70,000	904,000	0.08[1]
SC1	U2	70,000	299,000	0.23[3]
CC1	L1a	332,000	4,994,000	0.07
CC1	L1b	332,000	6,882,000	0.05
CC1	L2	332,000	490,000	0.68[3]
CC1	U1	126,000	210,000	0.60[3]
LC1	L1	493,000	1,621,000	0.30[2]
LC1	L2	493,000	1,100,000	0.45[3]
LC1	U1a	636,000	819,000	-
LC1	U1b	636,000	4,255,000	0.15
LC1	U2	636,000	1,836,000	0.35[3]
LC3	L1	59,000	25,000	2.36[3]
LC3	M1	182,000	1,195,000	0.15
LC3	M2	182,000	404,000	0.45[3]
LC3	UM1	207,000	3,874,000	0.05
LC3	UM2	207,000	654,000	0.32[3]

Note 1: Benefit Cost Ratio = 0.37 if right-of-way is donated
Note 2: Beneift Cost Ratio = 1.46 if right-of-way is donated
Note 3: Costs assume 100 percent participation in voluntary floodproofing and acquisition programs

1. Reduce flood hazard to human life (Hazard)

2. Reduce flood damages to public and private property (Damage)

3. Provide sound fiscal guidelines and funding for plan implementation (Fiscal)

4. Provide sound legal, and administrative stormwater management guidelines for plan implementation (Legal)

5. Enhance property values and encourage quality neighborhood development (Development)

6. Increase recreational opportunities and open space (Recreation)

7. Improve stormwater quality and mitigate other environmental effects (Environment)

For purposes of this master plan, these objectives are defined and quantified as follows:

1. Hazard--The reduction of hazards pertains to human life, injury, and related health hazards because of floods. Hazards to humans are high where roadways are overtopped and velocities are high. Section 3 defines high hazard areas where 100-year depths exceed 2 feet or the product of depth and velocity exceeds 4. The ability of each plan to reduce potential hazards at these locations is measured by the reduction in high hazard areas. A ranking of 10 would indicate the best reduction in high hazard areas and a ranking of 1 the lowest reduction.

2. Damage--The reduction in flood damages to public and private properties is obtained from the benefit/cost analysis. The ability of each plan to reduce flood damages is measured by the dollar value of flood reduction with the plan in place. Operation and maintenance costs are included in the discussion of drainage

improvement costs necessary for flood damage reduction. A ranking for each plan is derived from the ratio of the plan's predicted benefits to the sum of all possible benefits for the design storm. A high ranking is best.

3. Fiscal implications include the magnitude of capital investment required to implement each plan and drainage improvement funding sources available to the County.

4. Legal--Each plan is evaluated in terms of its legal, fiscal, and administrative implications. The legal implications of each alternative plan are evaluated on how well the plan is structured to avoid potential litigious situations, such as acquisition of residential structures. Administrative issues relate to dealing with public opinion, organization/personnel, and support systems. Each plan is evaluated for how well these issues can be managed. Legal and administrative implications are subjectively rated on a scale of 1 to 10, where 1 is poor performance and 10 is excellent performance.

5. Development--Each plan is evaluated for its ability to enhance property values and its effect on the quality of neighborhood development. These real estate issues are subjectively ranked on a scale of 1 to 10, where 1 is poor performance and 10 is excellent performance.

6. Recreation--Each plan is evaluated for its effect on open space and recreational opportunities. The plan's effectiveness for creating recreational facilities is based on the cumulative area of open space and are subjectively rated of 1 to 10, where 1 is poor performance and 10 is excellent performance.

7. Environment--Each plan is evaluated for its effect on stormwater quality and other environmental concerns. Environmental issues are evaluated according to the type of drainage facilities recommended for each plan

and are subjectively rated on a scale of 1 to 10, where 1 is poor performance and 10 is excellent performance.

RELATIVE WEIGHT OF OBJECTIVES

In order to rank the importance of comparative factors, relative weights have been assigned to each of the above criteria based on professional judgement. A larger weight indicates a higher importance. Therefore, a plan objective with a high weight will contribute toward a greater proportion of the total plan score than will a lower weighted objective. Table 6-3 shows the numerical weight assigned to each objective.

Table 6-3
PLAN OBJECTIVE WEIGHTS

Objective	Weight
1. Hazard	10
2. Damage	9
3. Fiscal	8
4. Legal	3
5. Development	2
6. Recreation	2
7. Environment	1

PLAN SCORING MATRIX

A matrix to compare the relative score of each plan is shown in Table 6-4. The total score of each plan sums up the product of the ranks and weights of each plan's objectives. The rankings are relative to each other. Table 6-4 also includes each plan's cost and benefit/cost. The cost,

benefit/cost, and total score of each plan were considered before selecting a plan.

PLAN COMPARISON DISCUSSION

The alternative plans are compared in this subsection according to the merits of each plan. The selected plan is presented following the plan comparison discussion.

COSTS AND BENEFIT/COST RATIOS

Plan 1 (structural alternative) provides for flood conveyance of the 100-year flood event. Plan 2 (nonstructural alternative) generally has the most favorable benefit/cost ratio. Because Plan 2 entails no decrease in flood water elevation, significant damages and life-safety hazards will still occur. Therefore, comparison of benefit/cost ratios between Plan 2 and Plan 1 cannot be made on a commensurate basis.

HAZARD

Plan 1 provides the greatest level of protection of human life from flood hazards. The protection provided by Plan 2 is less reliable because it depends on flood warning measures and emergency blockades at stream crossings.

DAMAGE

The damage reduction for Plan 1 provides for 100-year protection. Plan 2 reduces 100-year damages by flood warning, flood plain management, property acquisition, and flood-proofing. Damages not related to structures such as to streets and utilities would still occur under Plan 2. Although the damage reduction is similar for each of these plans, other issues related to the implementation of each plan should be considered.

Table 6-4
PLAN SCORING MATRIX

Alternative Plan	Capitalized Flood Damage (Dollars)	Present Worth Cost (Dollars)	Benefit Cost Ratio	Objectives/Weighted Ratings														Total[4] Score
				Hazard/10		Damage/9		Fiscal/8		Legal/3		Develop-ment/3		Recre-ation/2		Environ-ment/1		
				Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	
SC1-L1	81,000	571,000	0.14	9	90	10	90	4	32	8	24	10	20	2	4	1	1	261
SC1-L2	81,000	615,000 [3]	0.13	7	70	8	72	3	24	5	15	4	8	4	8	3	3	200
SC1-U1	70,000	904,000	0.08[1]	8	80	9	81	2	16	6	18	6	12	2	4	8	8	219
SC1-U2	70,000	299,000 [3]	0.23	7	70	8	72	5	40	5	15	4	8	2	4	3	3	212
CC1-L1a	332,000	4,994,000	0.07	10	100	6	54	2	16	9	27	10	20	2	4	1	1	222
CC1-L1b	332,000	6,882,000	0.05	10	100	6	54	1	8	9	27	10	20	2	4	1	1	214
CC1-L2	332,000	490,000 [3]	0.68	7	70	8	72	7	56	5	15	4	8	10	20	3	3	244
CC1-U2	126,000	210,000 [3]	0.60	7	70	8	72	6	48	5	15	4	8	6	12	3	3	228
LC1-L1	493,000	1,621,000	0.30[2]	5	50	8	72	3	24	8	24	6	12	2	4	8	8	194
LC1-L2	493,000	1,100,000 [3]	0.45	7	70	8	72	5	40	5	15	4	8	6	12	3	3	220
LC1-U1a	636,000	819,000	-	2	20	2	18	3	24	8	24	1	2	2	4	1	1	93
LC1-U1b	636,000	4,255,000	0.15	10	100	6	54	2	16	4	12	6	12	2	4	1	1	199
LC1-U2	636,000	1,836,000 [3]	0.35	7	70	8	72	5	40	5	15	4	8	10	20	3	3	228
LC3-L2	59,000	25,000 [3]	2.36	7	70	8	72	10	80	5	15	4	8	2	4	3	3	252
LC3-M1	182,000	1,195,000	0.15	7	70	6	54	2	16	6	18	6	12	2	4	1	1	175
LC3-M1	182,000	404,000 [3]	0.45	7	70	8	72	5	40	5	15	4	8	2	4	3	3	212
LC3-UM1	207,000	3,874,000	0.05	10	100	6	54	1	8	4	12	10	20	2	4	1	1	199
LC3-UM2	207,000	654,000 [3]	0.32	7	70	8	72	5	40	5	15	4	8	2	4	3	3	212

Note 1: Benefit Cost Ratio = 0.37 if right-of-way is donated
Note 2: Benefit Cost Ratio = 1.46 if right-of-way is donated
Note 3: Costs assume 100 percent participation in voluntary flood proofing and acquisition programs
Note 4: Total Possible Score = 360

LEGAL (AND ADMINISTRATIVE)

Plan 1 recommends the conveyance of peak flood discharges. This plan depends upon the natural conveyance of the drainageway, and modified conveyance and structural drainage facilities within the drainageway. The purposes of this plan is to reduce the potential for flood hazards and damages. Therefore, these plans are not expected to cause greater liability to the County.

An additional legal precaution regarding these plans is the maintenance of the natural or historic watercourse along the creeks to avoid potential damages to those not within the historic path of stormwater runoff. Obstructions within the conveyance facilities, if not removed by the County, could divert flows to areas adjacent to the drainageways.

Plan 2 recommends nonstructural measures to mitigate potential flood hazards and damages. This plan depends upon the enforcement of local drainage policies and ordinances, which if developed within a legal framework, should allow the County to implement drainageway planning while reducing potential liability. Plan 2, however, does not resolve roadway overtopping, which could create a liability to the County. Plan 2 also relies on flood warning, which has a higher risk of not being successful.

The administrative issues related to the implementation of either of the plans are similar and include finance, organization and personnel, and support systems.

DEVELOPMENT

Alternative Plan 1 may enhance property values by improving the appearance of the drainageway and by reducing the frequency of flooding of structures in the flood plain. Plan 2 will not encourage future development and, therefore, is not expected to enhance property values. The quality of neighborhood development should improve with any of the plans, by either preventing development within the regulatory flood plain or by acquiring flood-damaged structures.

RECREATION

Recreation benefits would be included with Plan 2. The areas that are acquired from relocated residents could be developed into parks. Plan 1 provides the least recreational potential of the plans.

ENVIRONMENT

The environmental impacts of each plan will vary with the type of drainage facilities recommended with each plan. Generally, each plan may provide environmental benefits. An important environmental concern is water quality. A principal cause of poor water quality is sediment carried by urban stormwater runoff. Urbanization tends to increase sediment production because of more frequent and larger volumes of stormwater runoff. Probable causes of sediment are site development and channel erosion. Sediment production from channel erosion will be managed by channel stabilization as recommended in Plan 1. Sediment production from site development also can be managed by enforcing onsite erosion control practices.

SALADO CREEK REACH 1
LOWER SEGMENT

Plan 1 (structural) and Plan 2 (nonstructural) have relatively low benefit-cost ratios. However, if the County is successful in negotiating significant cost participation to enlarge the railroad bridge from Southern Pacific Railroad, the benefit-cost ratio for the County's share of the project would increase for Plan 1. Plan 1 would lower the 100-year water surface upstream of the Southern Pacific Railroad bridge enough to prevent the spillover of flood water into the adjacent creek watershed near Blue Wing Road. Plan 2 reduces flood damage by floodwarning, property acquisition and floodproofing. It does not reduce the 100-year water surface so flood water would continue to spill over into the adjacent watershed near Blue Wing Road.

The selected plan for this reach segment is Plan 1 (SC1-L1).

SALADO CREEK REACH 1
UPPER SEGMENT

Plan 1 (structural) has a benefit-cost ratio of 0.08. However, if the right-of-way would be donated to the County the benefit-cost ratio would increase to 0.37. A number of people indicated in the questionnaire that was sent out that they would be willing to donate right-of-way or easements for channel improvements and maintenance. See Appendix C for results of Questionnaire. Plan 2 (non-structural) has a benefit-cost ratio of 0.23. Plan 1 would lower the 100-year water surface to below the first floor elevation of structures presently being flooded, however, it will not remove the structures from the 100-year flood plain. Plan 1 would stabilize the creek channel and prevent additional channel erosion which was indicated by questionnaire responses to be a problem in this reach segment.

The selected plan for this reach segment is Plan 1 (SC1-U1). If significant easement donations cannot be acquired, the County could implement Plan 2 (SC1-U2).

CIBOLO CREEK REACH 1
LOWER SEGMENT

Plan 1 was developed into two subplans ("a" and "b") reflecting different levels of structural improvements to the reach segment. The benefit-cost ratios for Plans 1a and 1b are 0.07 and 0.05 respectively. The benefit-cost ratio for Plan 2 is 0.68. Although there were other considerations in the selection of a best plan for this reach segment the difference in implementation costs and benefit-cost ratios between Plans 1 and 2 is so significant that the selection is based on economics. Also, the controversy over the magnitude of the "actual" 100-year flowrate for this reach of Cibolo Creek was a factor in the decision.

The selected plan for this reach segment is Plan 2 (CC1-L2).

CIBOLO CREEK REACH 1
UPPER SEGMENT

A structural plan was not developed for this reach segment because after considering the grade of the 100-year water surface below the developed area, the channel characteristics and the amount of flood damage projected to occur, it was determined that a feasible structural alternative could not be developed. Therefore, only a nonstructural plan was considered. It has a benefit-cost ratio of 0.60.

The selected plan for this reach segment is Plan 2 (CC1-U2).

LEON CREEK REACH 1
LOWER SEGMENT

Plan 1 (structural) has a benefit-cost ratio of 0.30, however, if the right-of-way would be donated to the County the benefit-cost ratio would increase to 1.46. Plan 2 (nonstructural) has a benefit-cost ratio of 0.45. Plan 1 would lower the 100-year water surface to below the first floor elevations of structures presently being flooded; however, it will not remove the structures from the 100-year flood plain. Plan 1 would stabilize the creek channel and prevent additional channel erosion.

The selected plan for this reach is Plan 1 (LC1-L1). If significant easement donations cannot be acquired then the County could implement Plan 2 (LC1-L2).

LEON CREEK REACH 1
UPPER SEGMENT

Plan 1 was developed into the two subplans ("a" and "b") reflecting different levels of structural improvements to the reach segment. Plan 1a proposed removing some fill to restore the channel between New Laredo Highway and Quintana Road to its original condition. It does not significantly reduce flood depths but does provide flood protection for a lesser frequency than the 100-year flood. The determination of the exact frequency and resulting damage reduction was

not calculated so a benefit-cost ratio was not determined for this subplan. Plan 1b proposes improvements to significantly reduce damage from the 100-year flood and has a benefit-cost ratio of 0.15. Plan 2 has a benefit cost ratio of 0.35.

The selected plan for this reach segment is Plan 2 (LC1-U2). If a significant cost participation for the New Laredo Highway bridge lengthening could be negotiated with the Texas Department of Highways and Public Transportation, then the County may want to reconsider Plan 1b (LC1-U1b).

LEON CREEK REACH 3
LOWER SEGMENT

A structural plan was not considered for this reach segment because the flood damage caused by the 100-year flood on Leon Creek was not very severe. Plan 2 (nonstructural) had a benefit-cost ration of 2.36 and consisted of relocations and flood proofing.

The selected plan for this reach segment is Plan 2 (LC3-L2).

LEON CREEK REACH 3
MIDDLE SEGMENT

Plan 1 (structural) has a cost-benefit ratio of 0.15. This plan would not remove Boerne Stage Road from the 100-year flood plain. Plan 2 (nonstructural) has a benefit-cost ratio of 0.45. Plan 1 required modifications to bridges and channels that are owned and maintained by the Texas Department of Highways and Public Transportation and the Southern Pacific Railroad. Cost participation for Plan 1 could be pursued from these two entities.

The selected plan for this reach segment is Plan 2 (LC3-M2). If significant cost participation could be negotiated with Southern Pacific Railroad and Texas Department of Highways and Public Transportation then the County could implement Plan 1 (LC3-M1).

LEON CREEK REACH 1
UPPER AND MIDDLE SEGMENT

Plan 1 (structural) has a benefit-cost ratio of 0.05. The primary objective of Plan 1 in this reach segment is to remove Boerne Stage Road from the 100-year flood plain. Therefore, the primary benefit of Plan 1 will not be reflected in the benefit-cost ratio. Plan 2 (nonstructural) has a benefit-cost ratio of 0.32. The majority of the costs associated with Plan 1 are related to modifications or replacement of bridges in the IH 10-Boerne Stage Road intersection. Also, the structural improvements proposed for the Leon Creek Reach Middle Segment (LC3-M1) are included in this alternative so this would be an extension of LC3-M1. After discussions with the County it was determined that the intangible benefits of Plan 1 did not compensate for the cost of the structural improvements and Plan 1 would not be pursued until the intangible benefits were perceived to be more important.

The selected plan for this reach segment is Plan 2 (LC3-UM2).

SUMMARY

Based on the benefit-cost analysis, the matrix analysis, and the plan comparison discussion, the plans shown in Table 6-5 are selected. Section 7 presents the selected plans in detail.

Table 6-5
SELECTED PLAN SUMMARY

Reach Segment	Selected Plan
Salado Creek Reach 1--Lower Segment	SC1-L1
Salado Creek Reach 1-Upper Segment	SC1-U1
Cibolo Creek Reach 1--Lower Segment	CC1-L2
Cibolo Creek Reach 1--Upper Segment	CC1-U2
Leon Creek Reach 1--Lower Segment	LC1-L1
Leon Creek Reach 1--Upper Segment	LC1-U2
Leon Creek Reach 3--Lower Segment	LC3-L2
Leon Creek Reach 3--Middle Segment	LC3-M2
Leon Creek Reach 3--Upper-Middle Segment	LC3-UM2

Section 7

Selected Plan

Section 7
SELECTED PLAN

INTRODUCTION

This section describes the selected plan for each creek segment. Issues such as operation and maintenance, soils, utilities, traffic, environment, and administrative considerations that relate directly to implementing this plan are discussed.

SELECTED PLAN SUMMARY

Plan 1 (structural) was selected for Salado Creek Reach 1 Upper and Lower Segments and Leon Creek Reach 1 Lower Segment. Plan 2 (nonstructural) was selected for Cibolo Creek Upper and Lower Segments, Leon Creek Reach 1 Upper Segment and Leon Creek Reach 3 Upper, Middle and Lower Segments. Plan 2 (nonstructural) will also be implemented on the reach segments of Cibolo Creek Reach 1 and Leon Creek Reach 3 where a hydraulic analysis was not performed.

Damages, costs of improvements and benefit-cost ratios for the selected plan are presented in Table 7-1. The benefit-cost ratio does not include the benefits attributed to decreased life-safety hazards.

SELECTED PLAN DESCRIPTION

The major components of the Selected Plan are summarized below. The structural components of the Selected Plan are listed first, followed by the nonstructural components. Figures 7-1 through 7-12 (at the end of this section) show the plan and profiles of the reach segments where a hydraulic analysis was conducted.

Table 7-1
SUMMARY OF SELECTED PLAN

Reach Segment	Plan	Present Worth Baseline Damages (Dollars)	Present Worth Cost of Improvements (Dollars)	Benefit-Cost Ratio
Salado Creek Reach 1--Lower Segment	1	$ 81,000	$ 571,000	0.14
Salado Creek Reach 1--Upper Segment	1	70,000	904,000	0.08/0.37[1]
Cibolo Creek Reach 1--Lower Segment	2	332,000	490,000	0.68
Cibolo Creek Reach 1--Upper Segment	2	126,000	210,000	0.60
Leon Creek Reach 1--Lower Segment	1	493,000	1,621,000	0.30/1.46[1]
Leon Creek Reach 1--Upper Segment	2	636,000	1,836,000	0.35
Leon Creek Reach 3--Lower Segment	2	59,000	25,000	2.36
Leon Creek Reach 3--Middle Segment	2	182,000	404,000	0.45
Leon Creek Reach 3--Upper/Middle Segment	2	207,000	654,000	0.32

Note 1--assumes R.O.W. is donated

SALADO CREEK REACH 1--LOWER SEGMENT
SC1-L1

Replace the Southern Pacific Railroad bridge with a longer bridge to increase the conveyance of the 100-year flood through the structure. The new bridge will be 280 feet long with a 120 feet bottom width, 2H:1V side slope channel section under the bridge.

SALADO CREEK REACH 1--UPPER SEGMENT
SC1-U1

Clear the underbrush and small trees in the channel and reshape the channel from just upstream of Southton Road to IH 410. The reshaped channel will be root-plowed, raked and sodded with improved grasses. The large trees will remain. Maintenance will be required by mowing twice a year to control brush and saplings.

LEON CREEK REACH 1--LOWER SEGMENT
LC1-L1

Clear the underbrush and small trees in the channel and reshape the channel from the corporate limits of San Antonio near IH 410 to New Laredo Highway. The reshaped channel will be root-plowed, raked and sodded with improved grasses. The large trees will remain. Maintenance will be required by mowing twice a year to control brush and saplings.

Plan 2 is to be implemented on Leon Creek Reach 1--Upper Segment, Cibolo Creek Reach 1--Upper and Lower Segments and Leon Creek Reach 3--Upper, Middle and Lower Segments and the reach segments where no hydraulic analysis was conducted. These nonstructural recommendations could also be implemented on the creek segments where a structural plan is recommended until the structural plan is implemented and the area is removed from the flood plain.

Plan 2 includes the following:

- Broaden the existing flood warning program
  - Coordinate efforts with upstream jurisdictions where possible
  - Coordinate with National Weather Service, Corps of Engineers, City of San Antonio, and other agencies to receive existing warning data
  - Install rain gauges and stream gauges in upstream areas to be checked by volunteers and/or County employees
- Review emergency response program in accordance with State and FEMA guidelines. Special attention should be given to developing a plan to barricade low water crossings and warn people in mobile homes.

- Develop emergency access routes into hazardous areas. The routes would be used by police, fire, and public works and ambulance crews.

- Provide annual notification of flood hazard to floodplain residents. This is especially important for people who rent houses or mobile homes and may not be aware of historic flood events. Permanent residents will benefit by the reminder of things they may have forgotten. The notification would include information on purchasing flood insurance and any county programs to help reduce flood damage. The address of structures in the 100-year flood plain are listed in Appendix D.

- Improve floodplain management to reduce the number of people moving into floodplain areas and reduce dumping and filling in the floodplain. Enforce FEMA requirements including special flood zone tie-downs for mobile homes.

- Provide a voluntary pre-flood proofing program for permanent residential structures with projected 100-year water levels up to a maximum of 3 feet above first floor elevations. Floodproofing will be customized for each house and may include berms, walls, water-tight closures on windows and doors, waterproof walls, and additional techniques as outlined in FEMA floodproofing manuals. Certain types of structures may not lend themselves to floodproofing. Floodproofing is not recommended where the product of the depth and the velocity at adjacent ground levels exceeds 4. For example, a depth of 3 feet and a velocity of 1.3 feet per second would be allowed, but a depth of 2 feet and a velocity of 3 feet per second would not be allowed. Tests conducted for a study by the City of Boulder, Colorado, showed that where the product of the depth and velocity exceed

4, a pedestrian may have difficulty standing in flood water.

- Provide a voluntary pre-flood relocation/ acquisition program for permanent residential structures where 100-year flood depths exceed 3 feet above first floor elevations or where the product of the depth and the velocity exceeds 4 on adjacent ground.

- Provide a voluntary pre-flood relocation/ acquisition program for mobile homes where the product of the 100-year depth and velocity exceeds 4 at adjacent ground levels.

- Provide a mandatory post flood relocation program for any structure that has been flooded by more than 3 feet or has incurred "substantial damage" as defined by FEMA.

- Provide a mandatory post-flood relocation/ acquisition program for any mobile home that has received flood water above the first floor elevation.

- Improve channel maintenance to include more debris pickup and selective clearing of vegetation on a regularly scheduled basis.

PLAN COSTS

Table 7-2 summarizes the Selected Plan cost opinions for each recommended improvement. Plan costs are comprised of construction, engineering, right-of-way, and operation and maintenance costs. Each of these costs categories is described in Section 6.

OPERATION AND MAINTENANCE

The operation and maintenance considerations for the selected plan are summarized in Table 7-3.

Table 7-2
OPINION OF COSTS
SELECTED PLAN

Component/Location	Cost
REACH: Salado Creek 1--Lower Segment (SC1-L1)	
1. Replace existing South Pacific Railroad (280' x 12")	$ 336,000
2. Excavation to Accommodate Bridge	10,560
3. Contingency	69,312
4. Mobilization, Bonds, Insurance	17,328
5. Engineering, Inspection, Legal, Administration	86,640
6. Maintenance	50,867
7. Right-of-Way	0
SC1-L1 TOTAL	$ 570,716
REACH: Salado Creek 1--Upper Segment (SC1-U1)	
1. Clear, Shape, and Vegetate Channel (15,400' x 300')	$ 82,680
2. Contingency	16,536
3. Mobilization, Bonds, Insurance	4,134
4. Engineering, Inspection, Legal, Administration	20,670
5. Maintenance (106 acres)	64,837
6. Right-of-Way (106 acres)	715,500
SC1-U1 TOTAL	$ 904,357
REACH: Leon Creek 1--Lower Segment (LC1-L1)	
1. Clear, Shape, and Revegetate from IH 410 to New Laredo Highway (190 acres)	$ 178,000
2. Contingency	29,640
3. Mobilization, Bonds, Insurance	7,410

Table 7-2
(Continued)

Component/Location	Cost
REACH: Leon Creek 1--Lower Segment (LC1-L1) (Continued)	
4. Engineering, Inspection, Legal, Administration	37,050
5. Maintenance (190 acres)	116,218
6. Right-of-Way (190 acres)	1,282,500
LC1-L1 TOTAL	$1,621,018
REACH: Leon Creek 1--Upper Segment (LC1-U2)	
Relocate 56 Mobile Homes	$ 92,000
Relocate 23 Structure	1,380,000
Relocate 3 Commercial Structures	364,400
LC1-U2 TOTAL	$1,836,400
REACH: Cibolo Creek 1--Lower Segment (CC1-L2)	
Relocate 23 Mobile Home	$ 115,000
Floodproof 3 Structures	15,000
Relocate 6 Structures	360,000
CC1-L2 TOTAL	$ 490,000
REACH: Cibolo Creek 1--Upper Segment (CC1-U1)	
Relocate 3 Mobile Homes	$ 15,000
Floodproof 2 Structures	10,000
Relocate 2 Structures	120,000
Relocate 1 Commercial Structure	65,250
CC1-U1 TOTAL	$ 210,250

Table 7-2
(Continued)

Component/Location	Cost
REACH: Leon Creek 3--Lower Segment (LC3-L1)	
Relocate 1 Mobile Homes	$ 5,000
Floodproof 2 Commercial Structures	20,000
LC1-L1 TOTAL	$ 25,000
REACH: Leon Creek 3--Middle Segment (LC3-M2)	
Relocate 2 Structures	$ 120,000
Relocate 3 Commercial Structures	253,700
Floodproof 3 Commercial Structures	30,000
LC3-M2 TOTAL	$ 403,700
REACH: Leon Creek--Upper Segment (LC3-UM2)	
Floodproof 2 Structures	$ 10,000
Relocate 4 Structures	240,000
LC3-M2 Total	403,700
LC3-UM2 TOTAL	$ 653,700

Table 7-3
OPERATION AND MAINTENANCE SUMMARY
SELECTED PLAN

Item	Facility	Level of Effort Required[a]
Erosion Control	Channel (Natural)	Moderate
	Channel (Lined)[b]	Moderate
Debris and Sediment Removal	Channel (Natural)	Moderate
	Channel (Lined)	Moderate
Rehabilitation[c]	Channel (Natural)	Negligible
	Channel (Lined)	Minor
Weed Control	Channel (Natural)	Moderate
	Channel (Lined)	Minor
Mowing	Channel (Natural)	Negligible
	Channel (Lined)	Minor
General Inspection	Channel (Natural)	Minor
	Channel (Lined)	Moderate

[a]Level of effort required for rehabilitation does not indicate frequency but does show general scope of rehabilitation.
[b]Grass-lined (slope and bank).
[c]Negligible--In accordance with citizen request or as problem arises.

Minor--Annually minimum.

Moderate--Two to three times per year minimum and after significant rainfall.

Major--More than three times per year.

An operation and maintenance (O&M) program is an integral part of this plan. An O&M program is needed to fund the upkeep of drainage facilities and to ensure that drainage facilities will function as intended in a flood. An O&M program should include controlling erosion and sedimentation, removing debris, repairing structures, planting and reseeding grassed areas, stabilizing channels, and maintaining access to the channels. An effective maintenance program must consist of regular activities, including inspection, testing,enforcement, cleaning, rehabilitation, and protection. Selected Plan O&M actions should include the following:

- Remove debris and sediment from fences, debris fins, culverts, and channels.
- Control vegetation by mowing grass and thinning trees and shrubs selectively.
- Repair and protect against bank failures and scour holes.
- Cut grass in grass-lined channels.
- Inspect drainage facilities and report flood plain encroachments.

WATER QUALITY IMPROVEMENTS

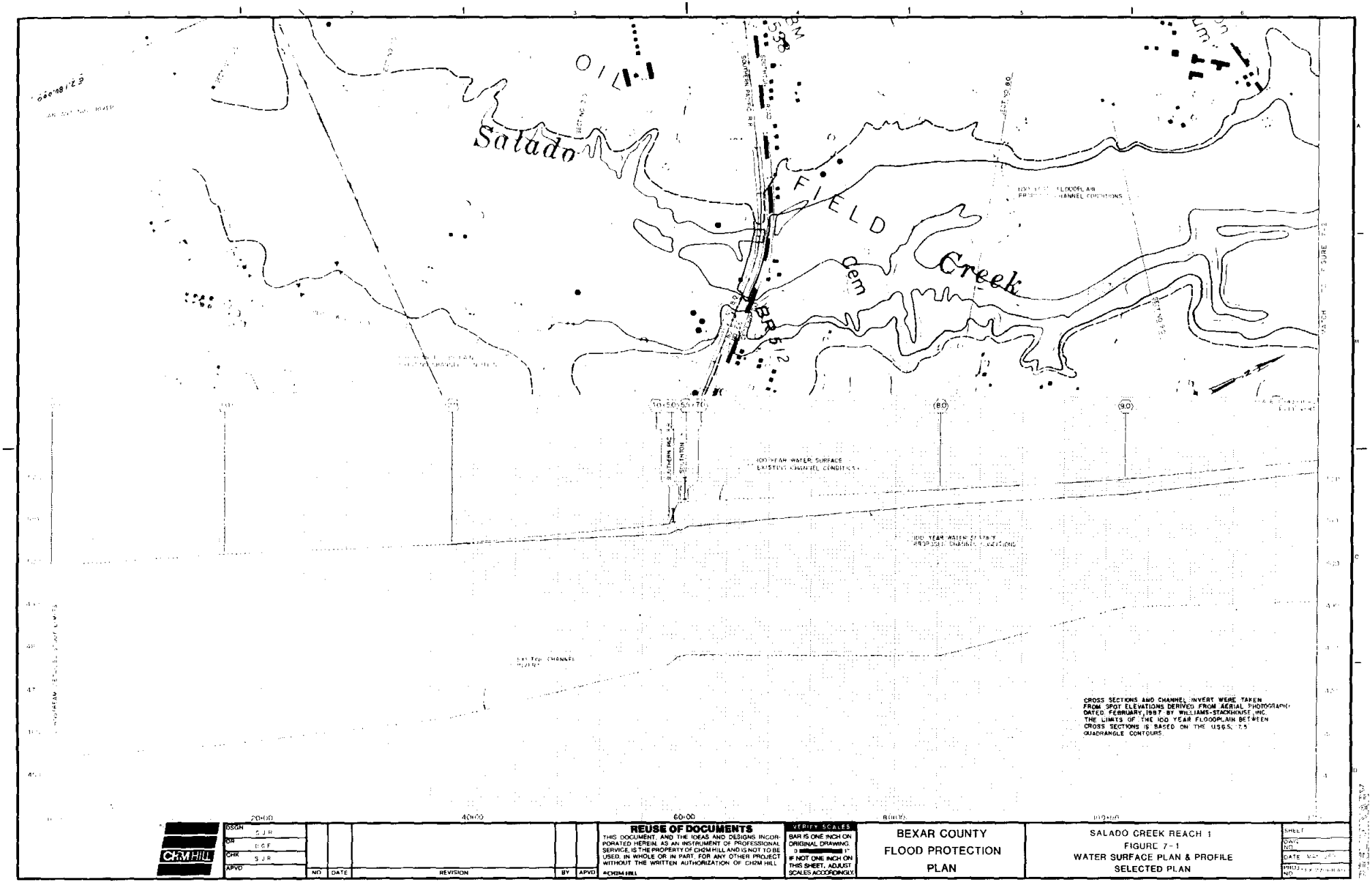
The selected plan will provide water quality benefits within the study reaches. One source of poor water quality is sedimentation, which can be caused from site and channel erosion. Sediment production from channel erosion will be managed by channel stabilization, as recommended in the selected plan. Erosion from site development can be managed by enforcing onsite erosion control practices.

EASEMENTS

The selected plan will require that the County obtain additional drainage easements. These easements are needed so that the County has legal jurisdiction over the drainageways, especially for channel enlargement and maintenance operations. Since it is likely that easement costs will vary widely, it is recommended that the easement cost assumptions made for this plan be carefully reviewed when planning drainage improvements.

SOILS

This plan was prepared without a thorough investigation into the soil conditions along the drainageways. The County should be aware of the effect of unusual soil conditions on construction activities. If difficult soil conditions, such as rock, are encountered, it is likely that the construction costs presented in Table 7-2 would be higher.



CH2M HILL

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DR	B.G.F.
CHK	S.J.R.
APVD	

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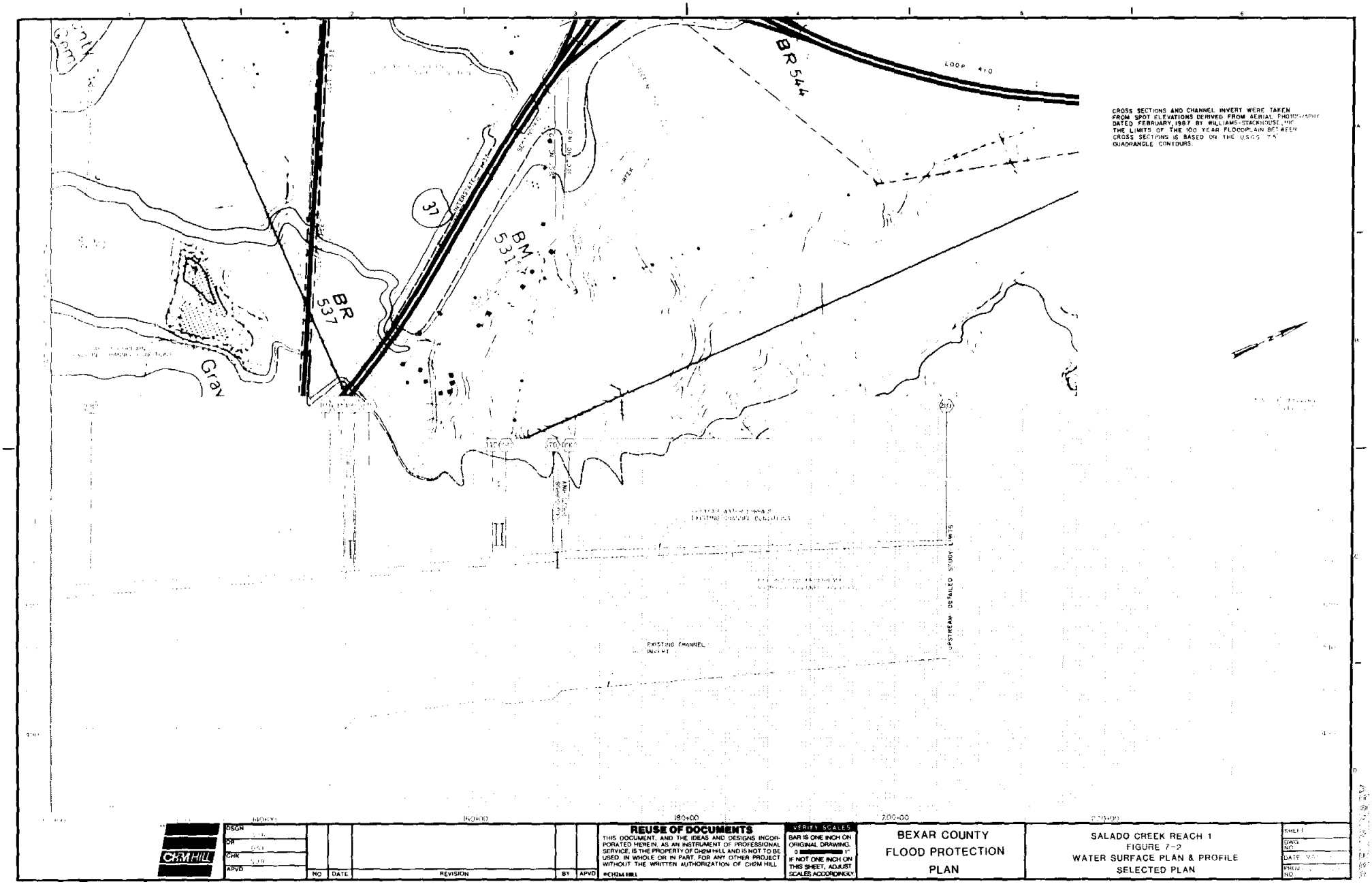
BEXAR COUNTY
FLOOD PROTECTION
PLAN

SALADO CREEK REACH 1
FIGURE 7-1
WATER SURFACE PLAN & PROFILE
SELECTED PLAN

SHEET	
DWG NO.	
DATE	
PROJ NO.	



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FLOOD PROTECTION
PLAN

SALADO CREEK REACH 1
FIGURE 7-2
WATER SURFACE PLAN & PROFILE
SELECTED PLAN

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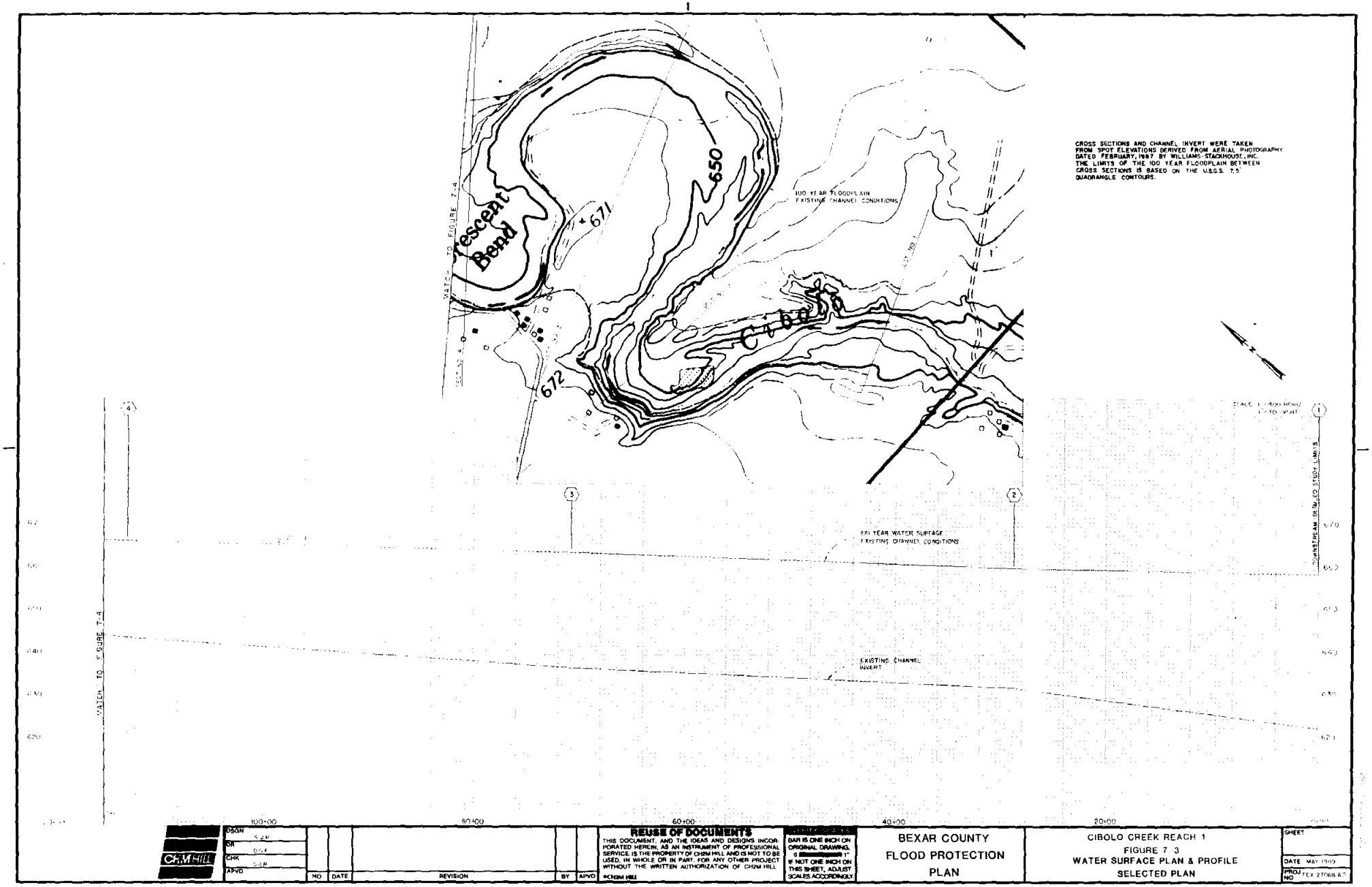
DATE
PROJ. NO.



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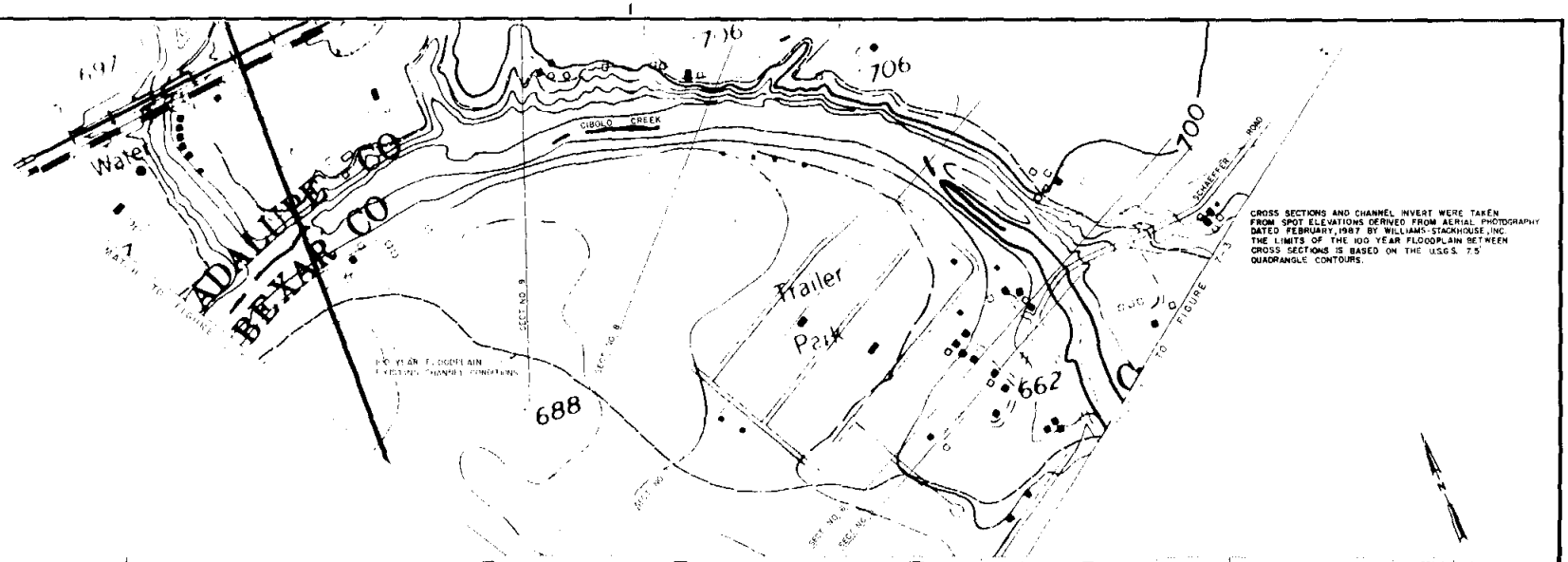
BEXAR COUNTY
FLOOD PROTECTION
PLAN

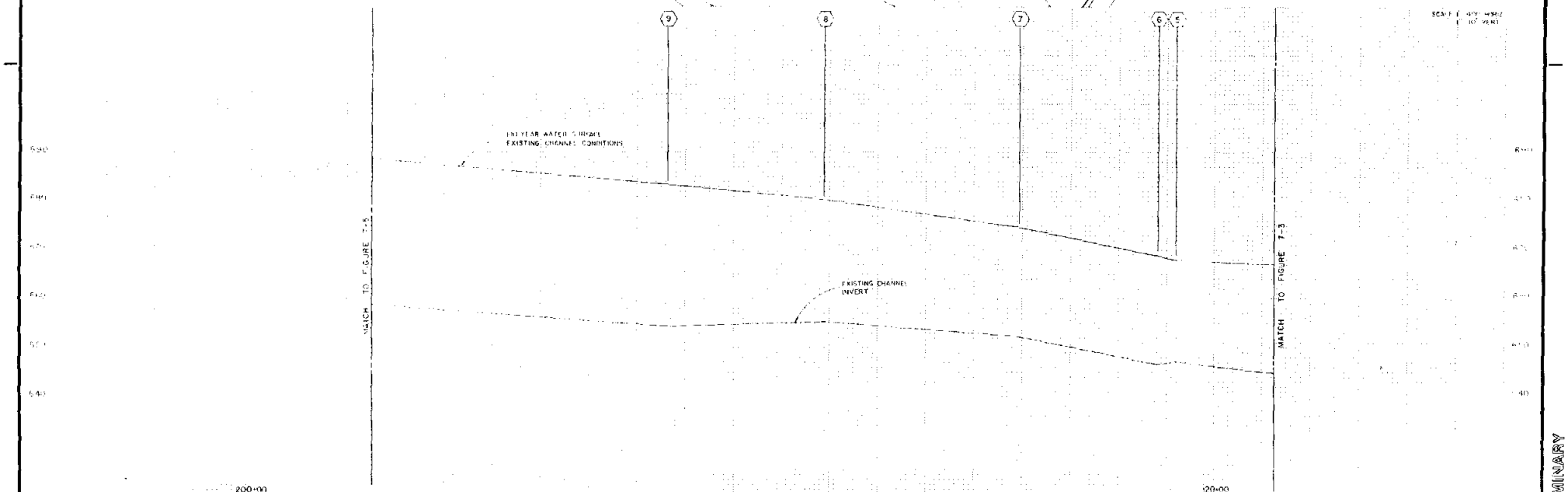
CIBOLO CREEK REACH 1
FIGURE 7-3
WATER SURFACE PLAN & PROFILE
SELECTED PLAN

SHEET

DATE MAY 1990

PROJ NO TEX 27068 A2





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FLOOD PROTECTION
PLAN

CIBOLO CREEK REACH 1
FIGURE 7-4
WATER SURFACE PLAN & PROFILE
SELECTED PLAN

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DATE MAY 1989
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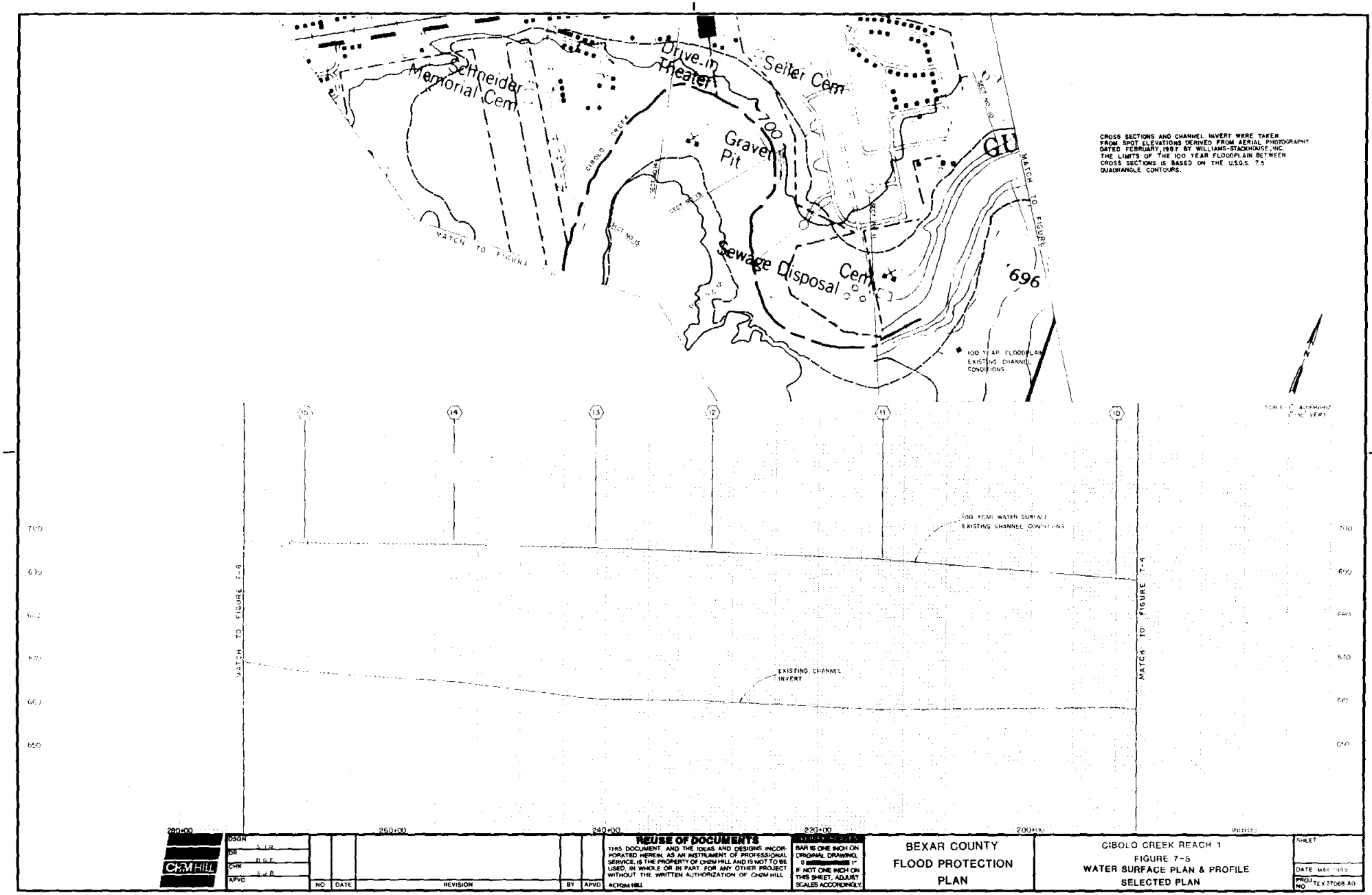
PRELIMINARY



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FLOOD PROTECTION
PLAN

CIBOLO CREEK REACH 1
FIGURE 7-5
WATER SURFACE PLAN & PROFILE
SELECTED PLAN

SHEET

DATE MAY 1989

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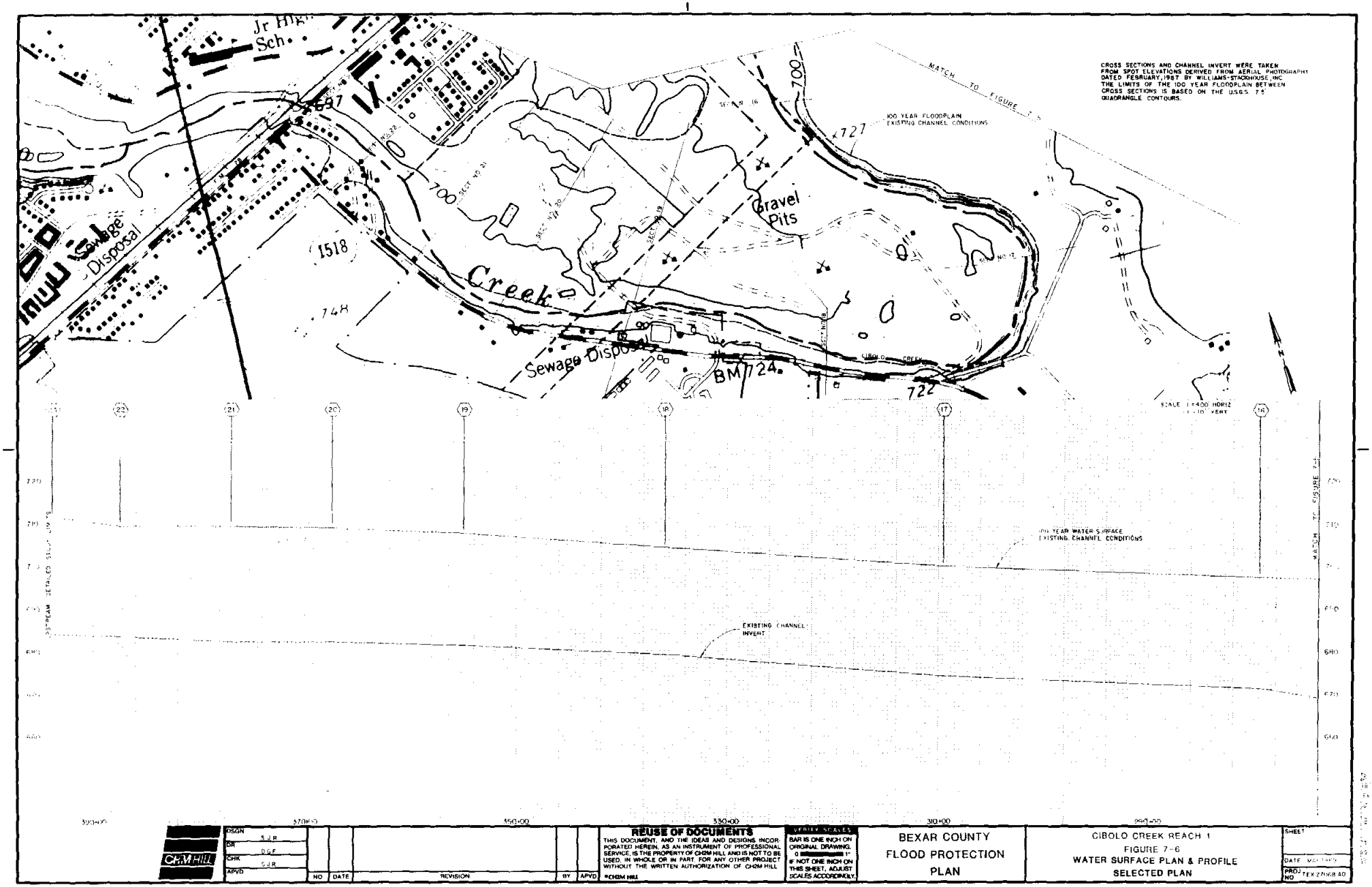

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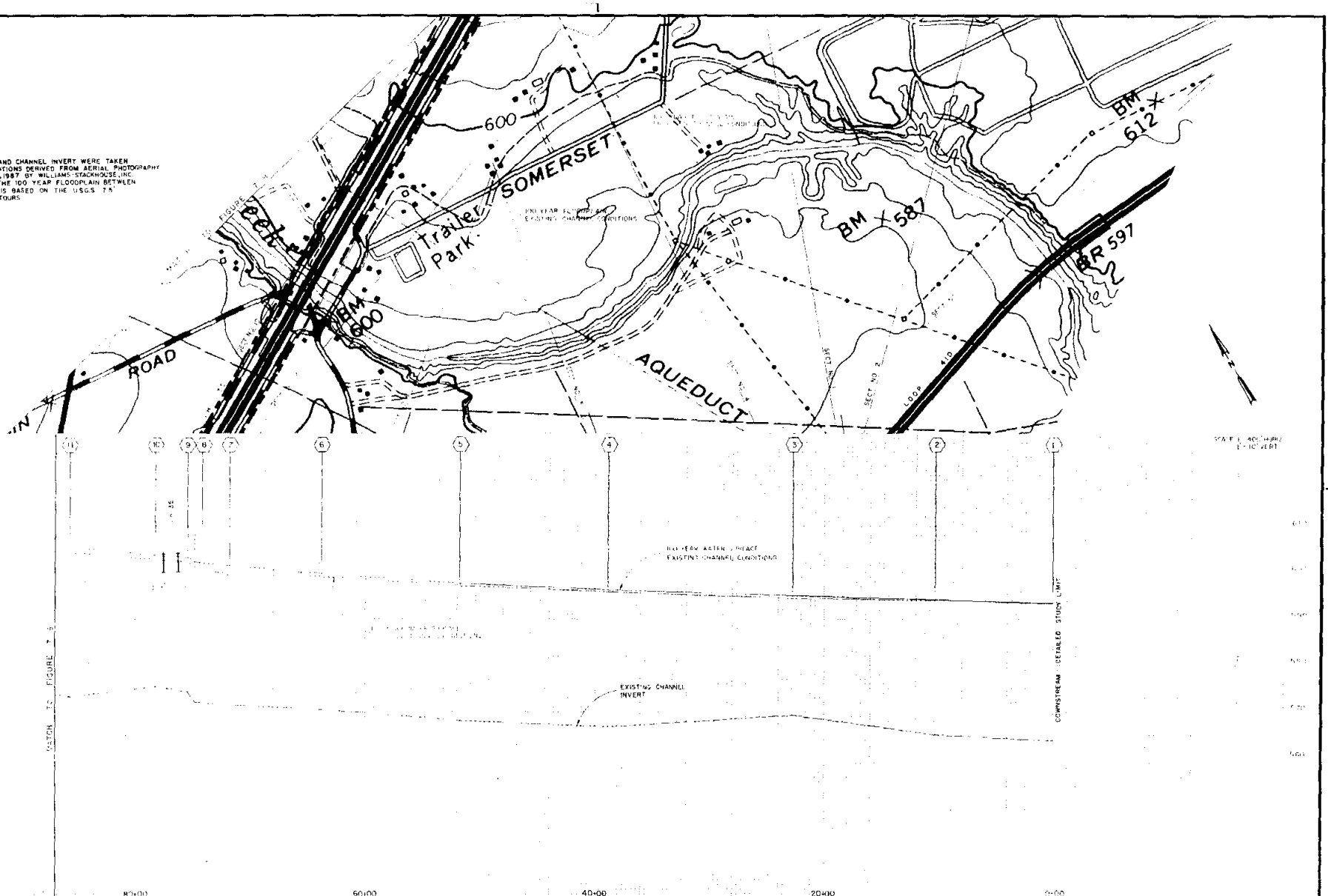

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	CHK								DATE MAY '88
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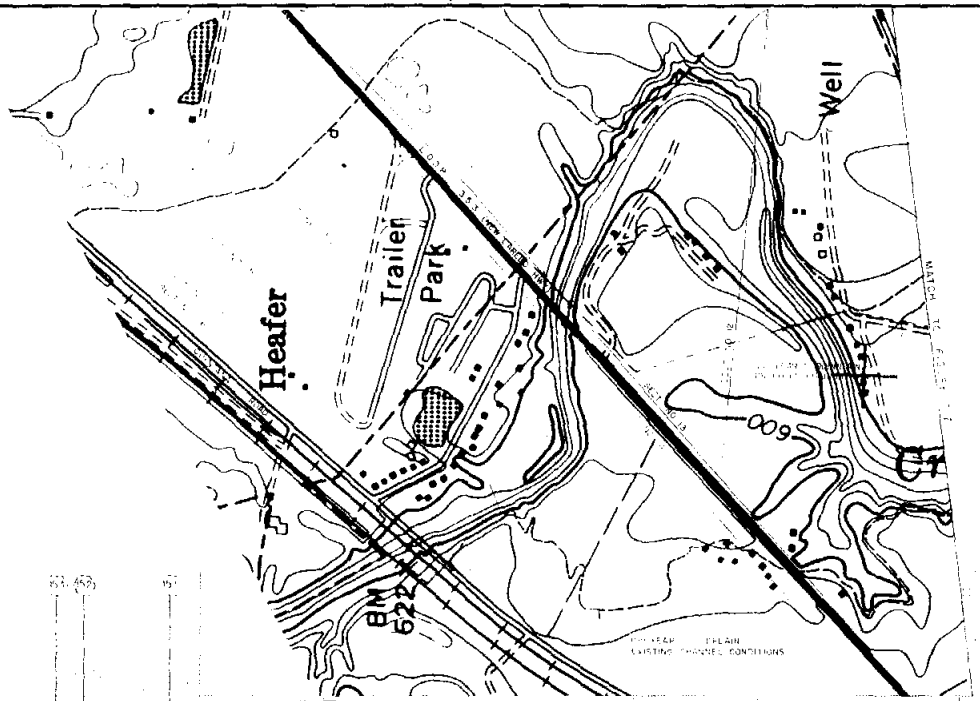

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FLOOD PROTECTION
PLAN

LEON CREEK REACH 1
FIGURE 7-8
WATER SURFACE PLAN & PROFILE
SELECTED PLAN

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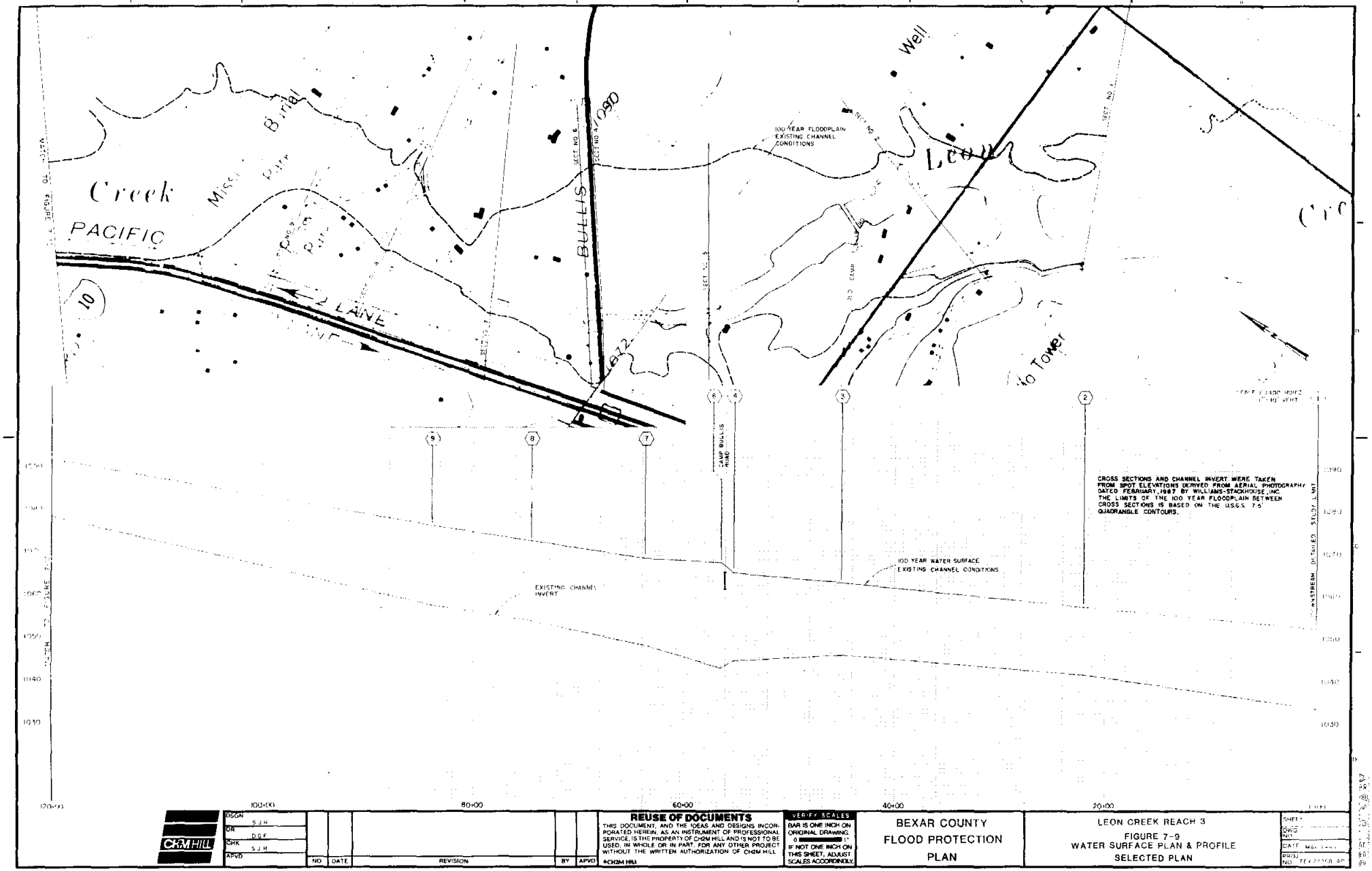

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BEXAR COUNTY
FLOOD PROTECTION
PLAN

LEON CREEK REACH 3
FIGURE 7-9
WATER SURFACE PLAN & PROFILE
SELECTED PLAN

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DATE	
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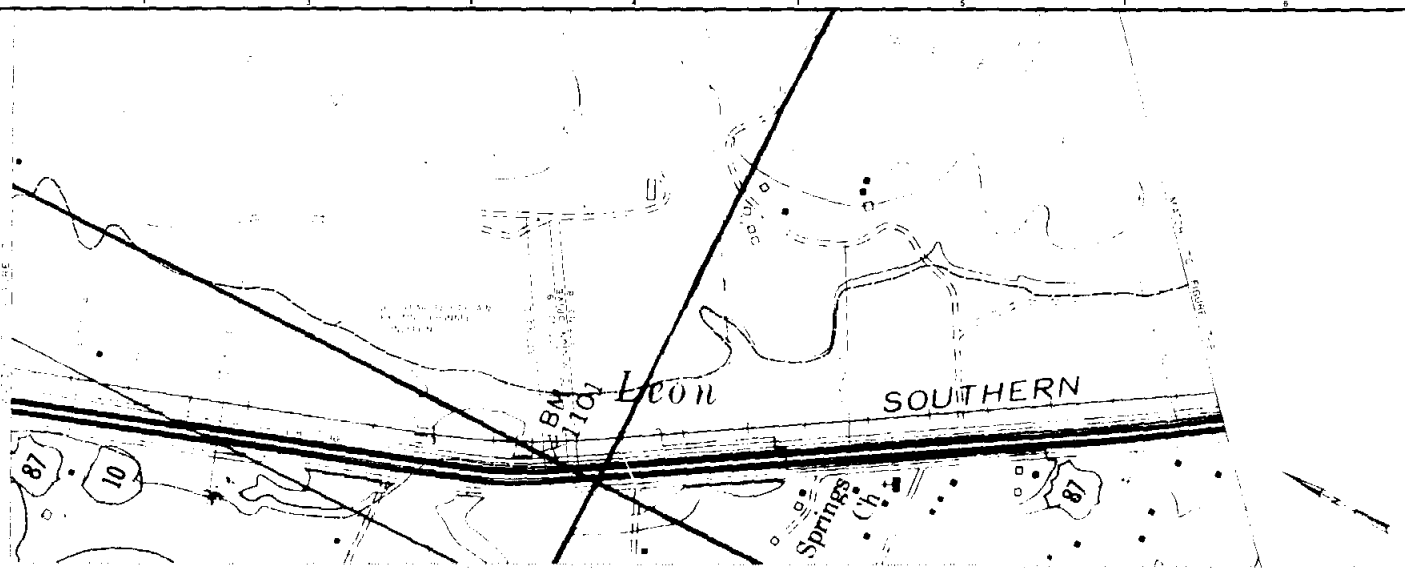

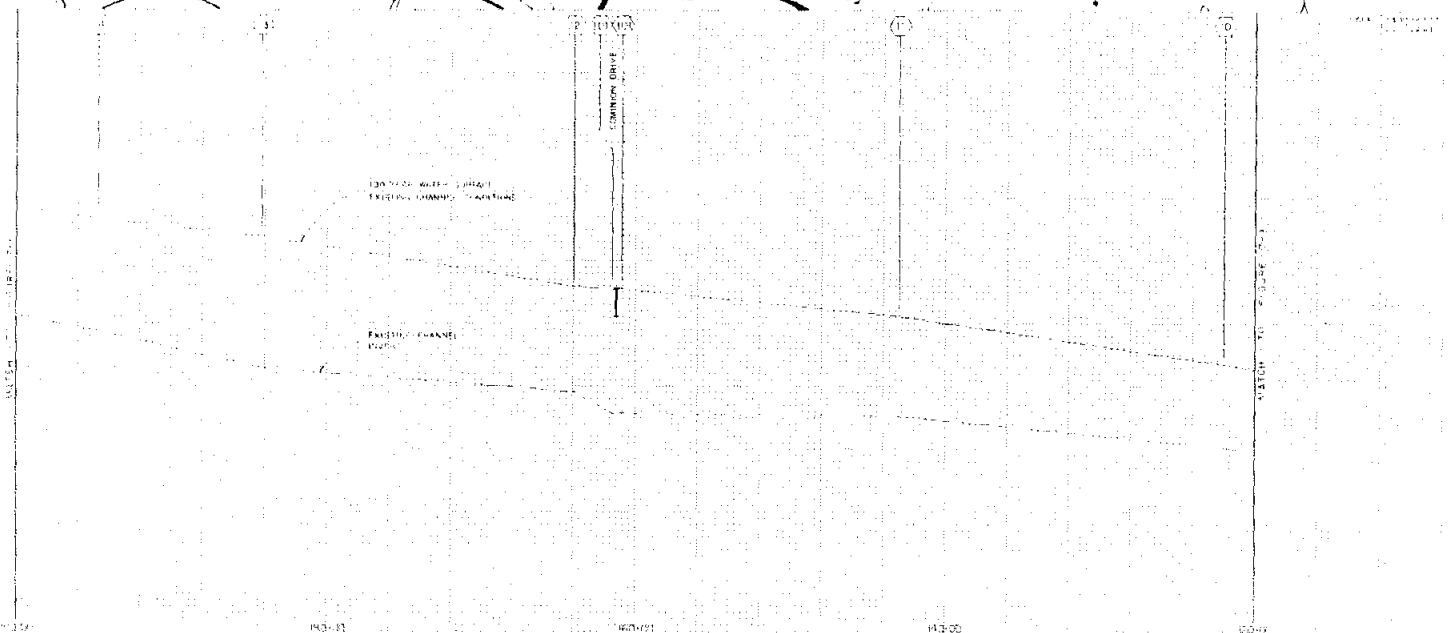

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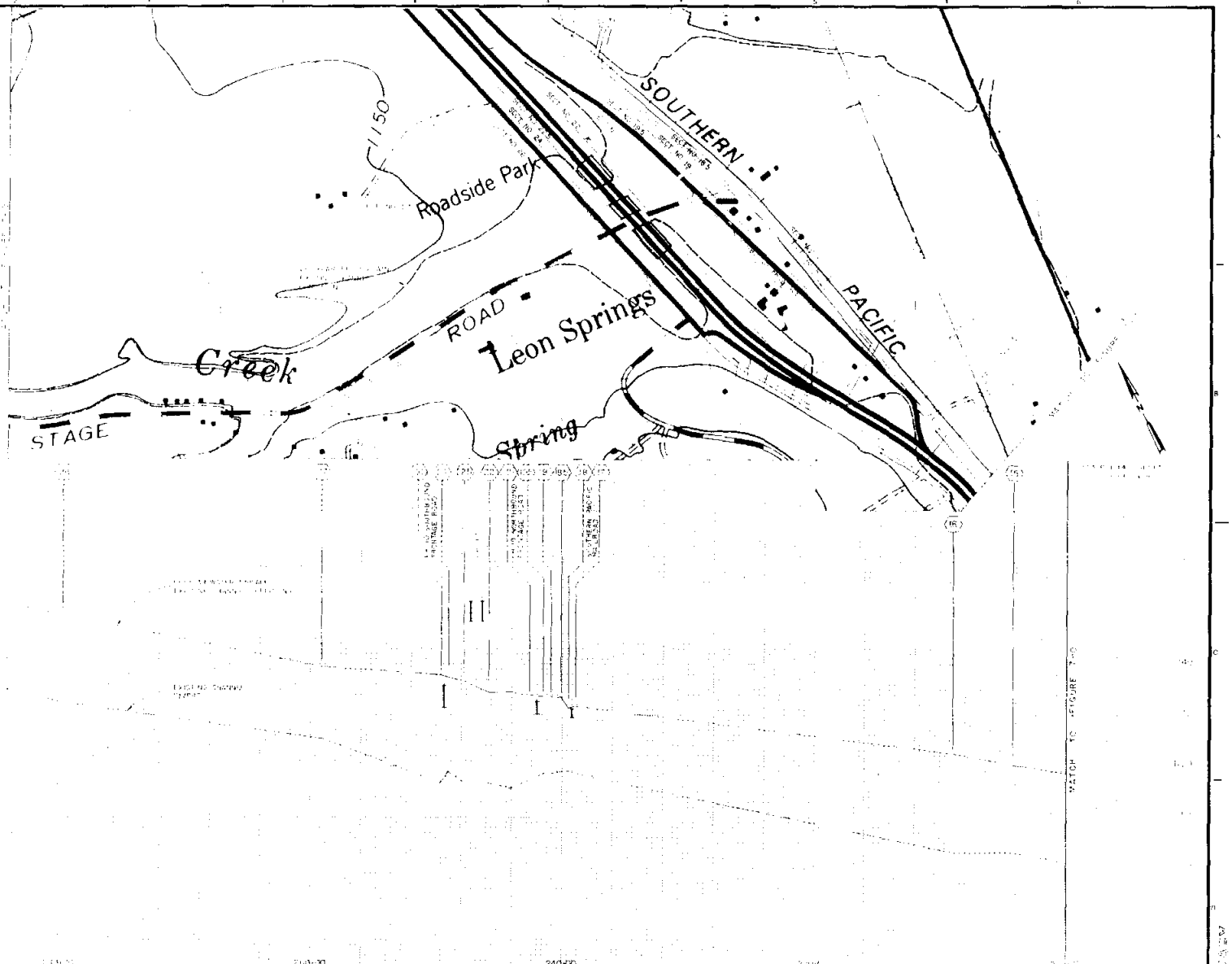
LEON CREEK REACH 3
FIGURE 7-10
WATER SURFACE PLAN & PROFILE
SELECTED PLAN

SHEET NO
DWG NO
DATE
PROJ NO



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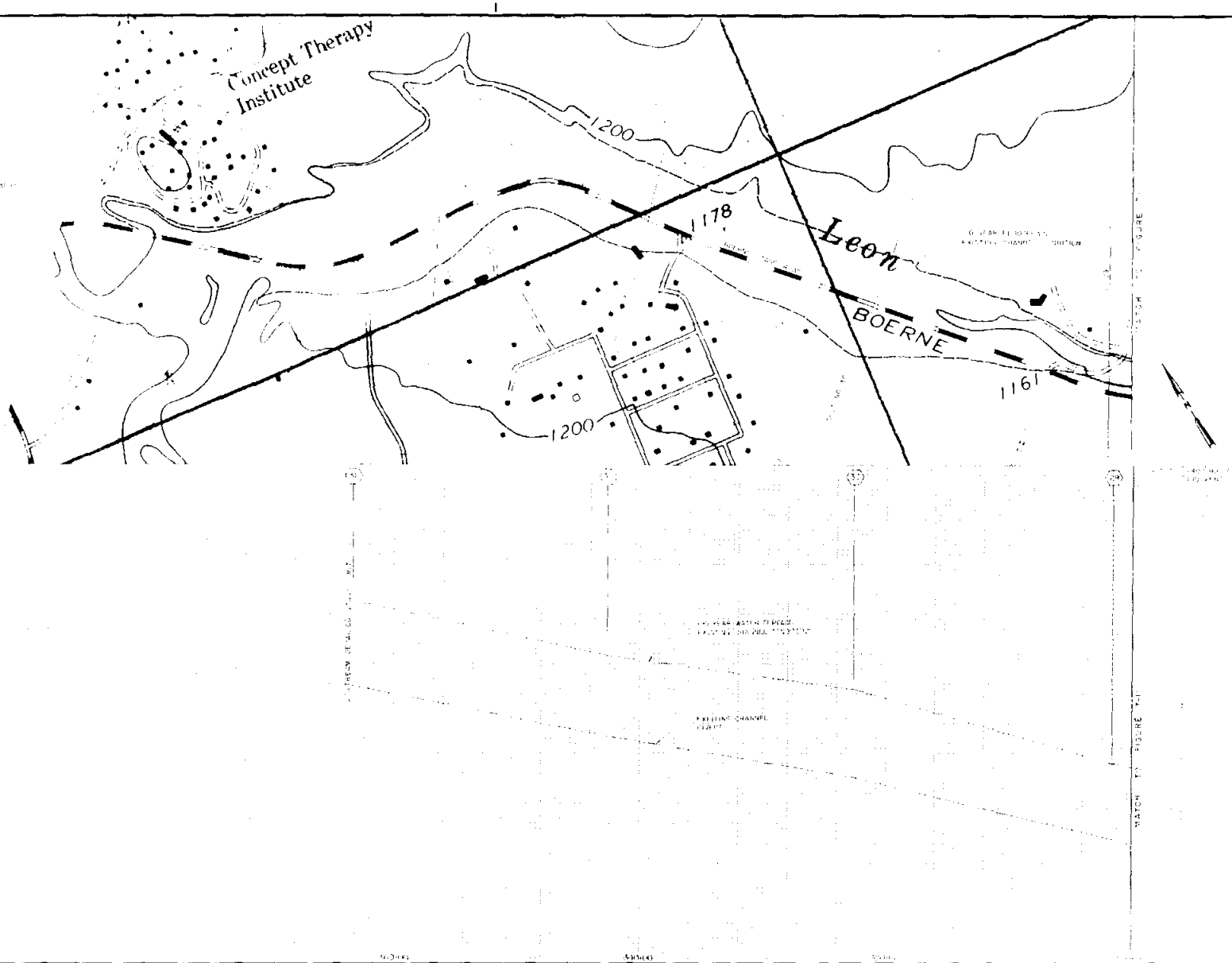

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Section 8

Funding Alternatives

Section 8
FUNDING ALTERNATIVES

INTRODUCTION

Several sources of funds were investigated and considered for funding the Selected Plan outlined in Section 7. The funding sources were grouped into internal and external funding categories. Internal funding sources were considered to be County generated funds with no funds from other agencies or governmental entities. External funding sources included grants or loans from state and federal agencies. The internal funding sources would still be needed to generate any matching funds required by the external funding programs.

INTERNAL FUNDING

GENERAL OBLIGATION BONDS

The County could include the Selected Plan as designated projects to be funded through general obligation bonds to be voted on in a bond election. The bonds would be repaid by an increase in the ad valorum tax rate.

BEXAR COUNTY FLOOD CONTROL TAX

Bexar County residents approved a 30¢ ad valorum tax, 15¢ for flood control and 15¢ for road improvements in 1951. The proceeds from the flood control tax have been used to fund the non-federal cost of flood control work in Bexar County. The San Antonio Channel Improvement Project (SACIP) has been the principal recipient of these funds. The County and the San Antonio River Authority (SARA) entered into a contract in 1955 for SARA to administer these funds for specific projects authorized in the contract. The contract has been amended several times since 1955.

SARA has indicated in several discussions with CH2M HILL that it would be willing to discuss including the Selected Plan in the next contract amendment so the Selected Plan could be funded and implemented. SARA has also indicated it would be willing to discuss a maintenance arrangement regarding any proposed improvements in the Selected Plan. There do not appear to be any restrictions on the type of flood control projects that could be funded so both the structural and nonstructural components of the Selected Plan could be included.

Presently, the County is only levying 1.055¢ of the authorized 15¢ flood control tax so there is the opportunity to use this funding source if the benefits outweigh the unpopularity of raising taxes.

EXTERNAL FUNDING

CORPS OF ENGINEERS

There are two programs administered by the Corps of Engineers that could provide partial funding of the Selected Plan. They are Section 205, 1948 Flood Control Act and Section 208, 1954 Flood Control Act.

Section 205 is known as the Small Projects Program. Federal participation in a project cannot exceed $5 million. The non-federal partner in the project would be responsible for all lands, easements and rights-of-way; relocation of utilities and bridges; operation and maintenance and any cost in excess of the federal limitation. The non-federal contribution can be in-kind services that will include a minimum 5 percent cash contribution. The non-federal share has to be at least 25 percent of the total project cost and no more than 50 percent of the total cost on structural improvements. Nonstructural improvements are funded 25 percent non-federal and 75 percent federal.

Projects are eligible for funding under Section 205 provided they have a "Federal Interest." Two criteria used to deter-

mine a "Federal Interest" are economic feasibility and environmental soundness. To apply for the program the County would need to contact the Fort Worth District of the Corps of Engineers and request a meeting.

Section 208 is designated for clearing and snagging to improve the flow characteristics of a channel. Salado Creek Reach 1--Upper Segment and Leon Creek Reach 1--Lower Segment could be considered for funding under Section 208. The federal share of costs under Section 208 cannot exceed $500,000 per project. Section 208 has not been utilized extensively because the Corps of Engineers has found if a project could benefit from clearing and snagging it probably would qualify for more extensive structural improvements or the environmental concerns about clearing vegetation have outweighed the benefits.

Any segments of the selected plan to be considered for funding under Section 205 or Section 208 would be studied further by the Corps of Engineers. The first step the Corps of Engineers would take would be to do a reconnaissance level study to determine if the proposed projects have a "Federal Interest." Once a "Federal Interest" has been determined the Corps of Engineers would perform a feasibility study to develop more detailed hydrology and hydraulics for the proposed project. If the project is still feasible, a detailed design memorandum will be prepared. The next step would be preparation of construction plans and specifications and then construction of the project. Generally, by the time a project has made it through all of the aforementioned steps, the Corps of Engineers has had enough time to plan and schedule funds in the federal budget to fund the project.

TEXAS WATER DEVELOPMENT BOARD

The grants program which this study was partially funded is only for reconnaissance studies. Any projects that are implemented from the Selected Plan would not be eligible for any funds from the grants program.

The Water Development Fund administered by the Texas Water Development Board (TWDB) is a low interest loan program that sells Texas Water Development Bonds at the State's bond rate and purchases the bonds of local political subdivisions enabling the local political subdivision to take advantage of the State's bond rating. This program is attractive only if the bond rating of the local political subdivision is not as good as the State of Texas. Presently the State's bond rating is AA. The program will fund both structural and non-structural alternatives.

The County would need to prepare a detailed engineering report, project costs, and an environmental assessment for each specific segment of the Selected Plan that the County wished to fund through this program. The engineering report, projects costs and environmental assessment would need to be prepared prior to applying for the loan and they must accompany the loan application to the Texas Water Development Board.

FEDERAL EMERGENCY MANAGEMENT AGENCY

The Federal Emergency Management Agency (FEMA) has a program under Section 1362 of Public Law 95-128 called the Flooded Property Purchase Program. The program has a list of conditions and criteria that must be met in order for purchase of real property to qualify for consideration as a viable project. They are:

- The property must be located in a flood risk area as determined by the Federal Insurance Administrator of FEMA;
- The property must have been covered by a flood insurance policy under the National Flood Insurance Program (NFIP) at the time damage took place;
- The building, while covered by flood insurance under the NFIP, must have been:

- damaged substantially beyond repair; or

- damaged not less than three previous times during the preceding five-year period, each time the cost of repair equalling 25 percent or more the structure's value; or

- damaged from a single casualty of any nature so that a statute, ordinance or regulation precludes its repair or restoration or permits repair or restoration only at significantly increased cost;

o A state or local community must enter into an agreement authorized by ordinance or legally binding resolution to take title to and manage the property in a manner consistent with sound land management use as determined by the Federal Insurance Administrator; and

o The community must agree to remove without cost to FEMA, by demolition, relocation, donation or sale, any damaged structures to which the community accepts title from FEMA, provided the Federal Insurance Administrator may, when it is in the public interest to do so, agree to assume a part or all of the cost of such removal.

The requirements of this program are fairly strict and generally prevent widespread use throughout a flood hazard area. However, it could be used on a case-by-case basis to assist funding for the nonstructural component of the Selected Plan.

SOIL CONSERVATION SERVICE

The Soil Conservation Service (SCS) has funded several projects in Bexar County under Public Law 566. These projects include the flood control dams on Salado, Martinez and Cibolo Creeks. These projects were developed and justified some years ago. The SCS has an agency policy that

prohibits participation in projects that have over 40 percent urban benefit. Bexar County has developed significantly since the above projects were authorized and it was the opinion of the Assistant State Conservationist for Water Resources that the projects developed from this study would not qualify. PL 566 has also had its funding cut for several years and the likelihood of receiving funds is not good.

Section 9

Implementation Plan

Section 9
IMPLEMENTATION PLAN

IMPLEMENTATION PRIORITIES

This subsection summarizes implementation priorities for the Selected Plan. The priorities are needed to establish the precedence of improvements as funding becomes available. The recommended sequencing of drainage improvements depends on several factors. For purposes of this plan, the following criteria were used to decide on priorities:

- Life-safety hazard to vehicles and occupants of structures was considered to be the highest priority.
- High flood damage areas were considered to be the next highest priorities.
- The construction sequencing of adjacent improvements was considered. For example, an upstream channel improvement with a lowered channel bed elevation would depend on a downstream channel improvement to be compatible.
- The effects of drainage improvements on downstream capacities were considered.

Other issues could affect the ultimate sequencing of the priorities. The County should consider the following issues while administering the plan:

- Certain improvements may depend on coordination between different jurisdictions; this coordination may change the priority of improvements.
- Drainage improvements near roadways may be solved simultaneously with street improvements even though they are lower priorities.

Table 9-1 shows a summary of improvements by implementation priority.

Table 9-1
SELECTED PLAN SUMMARY OF IMPROVEMENTS
BY IMPLEMENTATION PRIORITY

Priority	Study Reach	Improvement
1	All Study Reaches	Replace low water crossings, add warning signs, install railroad type gates, develop a barricade plan and detour plan
2	All Study Reaches	Plan 2--nonstructural plan
3	Leon Creek Reach 3--Lower Segment	Construct drainage chan nels to carry off-site runoff through or around Mobile City Estates mobile home park between Camp Bullis Road and Raymond Russell Park
4	Leon Creek Reach 1--Lower Segment	LC1-L1--creek shaping
5	Salado Creek Reach 1--Lower Segment	SC1-L1--replace Southern Pacific Railroad bridge
6	Salado Creek Reach 1--Upper Segment	SC1-U1--creek shaping

IMPLEMENTATION CONSIDERATIONS

UTILITIES

The selected plan will require surveys of existing utilities to resolve utility conflicts as drainage facilities are

designed. Utilities will need to be avoided or relocated when constructing improvements.

TRAFFIC

An additional County concern addressed by this plan is the potential for traffic hazards during the 100-year flood. This potential is high since 26 of 33 existing roadway crossings along the study reaches were overtopped.

RECOMMENDATIONS

This subsection gives some specific recommendations that could be pursued in order to implement the Selected Plan. They are as follows:

- Request a Community Assessment Visit from the Flood Management Unit of the Texas Water Commission (TWC). They will evaluate the administration of the flood damage prevention court order and make suggestions on ways to improve its administration. They can also talk to the Commissioners Court and District Attorney and give a presentation on the importance of enforcement of the court order and prosecution of violators.

- The Flood Management Unit of the TWC also has copies of several FEMA publications on flood plain management and floodproofing which they will provide to the County if requested.

- Meet with representatives of the Corps of Engineers to evaluate the possibility of qualifying parts or all of the Selected Plan for funding under the Section 205 and Section 208 programs.

- Contact FEMA to determine the extent to which Section 1362 could be utilized to fund the

relocation portion of the nonstructural part of the Selected Plan.

- Contact Southern Pacific Railroad about the possibility of cost sharing the replacement of the bridges at Southton Road and Leon Springs.

- Contact the Texas Department of Highways and Public Transportation about the possibility of cost sharing the replacement of the IH 10 frontage road bridges at Leon Springs and the New Laredo Highway bridge. If significant cost sharing is negotiated, the benefit-cost ratios for LC1-U1 and LC3-M1 would increase and they could be viable projects.

- Contact the San Antonio River Authority (SARA) about including the Selected Plan in the next amendment to the Bexar County Flood Control Tax contract. Also discuss entering into a maintenance agreement with SARA to maintain the portions of the Selected Plan implemented with funds from the Bexar County Flood Control Tax.

- Any of the structural portions of the Selected Plan that are implemented should have a detailed feasibility analysis conducted. This analysis should include detailed hydrologic analysis, more detailed benefit-cost analysis, an environmental assessment, a detailed determination of required utility relocations and a design memorandum. This would be followed by preparation of plans and specifications once funding has been secured.

- Conduct a more detailed study of the nonstructural portions of the Selected Plan to develop a specific program to address flood plain management, floodproofing, relocation/acquisition, flood warning and emergency access for each specific creek reach.

- Include construction of drainage channels to prevent flooding from off-site drainage of the Mobile City Estates mobile home park in the capital improvements program since the flooding is not considered to be from the 100-year flood in Leon Creek.

- Negotiate with Guadalupe County to replace low water crossings, develop a barricade plan and develop a flood warning system on Cibolo Creek.

- Re-evaluate the Selected Plan for Cibolo Creek when the re-study of Cibolo Creek is completed by FEMA and the Corps of Engineers.

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Appendix A

Appendix A
METHODOLOGY FOR ESTIMATION OF MONETARY DAMAGES

Flood damages were assessed to establish a baseline cost for comparing the effects of alternative improvement plans. Flood damages have been categorized as one of five types addressed in the article "State of the Art of Estimating Flood Damages in Urban Areas" (Grigg, 1975). Definitions of the five types follow.

DIRECT DAMAGES

These damages occur to structures, contents within structures, roads, utilities, and associated facilities. Direct damages are the major category of flood damages that were considered in this study.

INDIRECT DAMAGES

These damages include lost revenues and services of business, the cost of alleviating hardship, rerouting traffic, and emergency care. Indirect damages are usually calculated as a percentage of direct damages.

SECONDARY DAMAGES

These damages affect those whose property is not directly damaged from flooding. An example is adverse effects to people who depend on a product or service disrupted due to flooding. Secondary damages are not included in damage estimates.

INTANGIBLE DAMAGES

These types of damages were formulated by a 1969 Water Resources Council (WRC) task force, which recommended that benefits and costs should be summarized in four accounts. These accounts were published in the "Principals and Standards for Planning Water and Realty Land Resources" and consisted of environmental quality, regional development,

social well-being, and national economic development. National economic development is an increase in value of goods and services and an improvement in economic efficiency. Flood damages for natural economic development are generally tangible, although the other three types of damages proposed by WRC are intangible. Sufficient research has not been accomplished to estimate monetary value of the intangible WRC damages; therefore, these damages were not considered in this study.

UNCERTAINTY DAMAGES

These damages occur because of the uncertain nature of flooding. An example of an uncertainty damage is the excess amount people are willing to pay to avoid losses greater than the expected value of flood damage losses. These damages are difficult to determine without a local study of practices in buying insurance and therefore, were not considered in this study.

LAND USE TYPES

Land use has been divided into three flood hazard classifications for the calculation of damages. The following classifications were used:

A. Residential

B. Mobile Home Units

C. Commercial

DAMAGE CATEGORIES

Specific categories of flood damages were identified as contributing to the overall extent of damages in the study area. Several types of damages, however, were eliminated from consideration due to the unlikeliness of their occurrence or to the insignificance of the loss. The

categories of damages that were analyzed are shown in Table A-1.

Table A-1
DAMAGE CATEGORIES BY LAND USE

Land Use	Damage Categories	
	Direct	Indirect
All residential (including mobile homes)	Structural Contents Roadways Vehicles Utilities	Debris Removal Loss of Salaries Emergency Services
Commercial	Structural Inventory Equipment Roadways Vehicles Utilities	Debris Removal Loss of Business Income Loss of Sales Tax Emergency Services

GENERAL PROCEDURE FOR ESTIMATING DAMAGES

DIRECT DAMAGES

The procedure used to determine direct damages to residential and commercial property within the 100-year flood plain was to establish specific flood damage reaches, determine the first floor elevation of structures in the 100-year flood plain and 100-year water surface elevation at the structures, enter the FEMA or COE tables to get a damage factor for the structure and contents, multiply the damage factors times the respective values of the structure and contents to get the total structure and content damage for each individual structure. The total flood damage along

each reach was then computed by totaling the damage for each individual structure in the reach. This procedure was used to estimate damages for the 100-year flood events based on existing development hydrology. The damages were determined according to existing development within these flood plains.

Residential flood damages were based on the FEMA curves. Residential structure values were obtained from Bexar Appraisal District records. Residential contents were assumed to be 50 percent of the structure value as is widely accepted in benefit-cost analysis within the insurance industry (IDFCD, 1977). Commercial flood damages were based on the COE curves. Inventory and equipment values were assigned a percentage of structural value for each type of commercial or industrial property. The percentages were estimated from data collected by the Tulsa and Galveston District COE office.

The methods for quantifying direct damages in addition to structure and contents are provided in Table A-2.

Table A-2
METHODS FOR QUANTIFYING DIRECT DAMAGES IN ADDITION TO STRUCTURE AND CONTENTS

Damage Type	Source	Value of Damage
Utilities	Tulsa COE	$77/structure
Vehicles	Tulsa COE	$870/structure
Roads	Tulsa COE/ FEMA	$600/acre

INDIRECT DAMAGES

A cost estimate for providing emergency care provided by the Tulsa District COE is $600 per residential structure in the

flood damage area. Other indirect costs were applied as a percentage of direct costs in Table A-3.

Table A-3
INDIRECT COSTS AS A PERCENTAGE OF DIRECT COSTS

Land Use	Percentage of Direct Damages
Residential	15
Commercial	35
Utilities	10
Highways (Roads)	25

AVERAGE ANNUAL DAMAGES

Average annual damages for each study reach were calculated by plotting the 100-year total damages for each reach along with zero damages for the recurrence interval at which there were not any damages. The area under each curve is equal to the average annual flood damage.

Table 3-1 is a summary of property damage for all study reaches. An 8 percent discount rate was used to calculate the present worth of average annual damage over 50 years. The discount rate was provided by the County's financial advisor.

Appendix B

Appendix B

Table 1-B
OPINION OF COSTS
STRUCTURAL ALTERNATIVES--100-YEAR DESIGN FLOOD

Component/Location	Cost
REACH: Salado Creek 1--Lower Segment (SC1-L1)	
1. Replace existing South Pacific Railroad (280' x 12")	$ 336,000
2. Excavation to Accommodate Bridge	10,560
3. Contingency	69,312
4. Mobilization, Bonds, Insurance	17,328
5. Engineering, Inspection, Legal, Administration	86,640
6. Maintenance	50,867
7. Right-of-Way	0
SC1-L1 TOTAL	$ 570,716
REACH: Salado Creek 1--Upper Segment (SC1-U1)	
1. Clear, Shape, and Vegetate Channel (15,400' x 300')	$ 82,680
2. Contingency	16,536
3. Mobilization, Bonds, Insurance	4,134
4. Engineering, Inspection, Legal, Administration	20,670
5. Maintenance (106 acres)	64,837
6. Right-of-Way (106 acres)	715,500
SC1-U1 TOTAL	$ 904,357
REACH: Cibolo Creek 1--Lower Segment (CC1-L1a)	
1. Trapezoidal Channel (250' Bottom, 4:1 Side Slopes)	$2,635,544
2. Levee (10' Top, 3:1 Side Slopes)	6,885

Table 1-B
(Continued)

Component/Location	Cost
REACH: Cibolo Creek 1--Lower Segment (CC1-L1a) (Continued)	
3. Contingency	528,485
4. Mobilization, Bonds, Insurance	132,121
5. Engineering, Inspection, Legal, Administration	660,607
6. Maintenance (140 acres)	85,634
7. Right-of-Way (140 acres)	945,000
CC1-L1a TOTAL	$4,994,276
REACH: Cibolo Creek 1--Lower Segment (CC1-L1b)	
1. Trapezoidal Channel (250' Bottom, 4:1 Side Slopes)	$4,504,253
2. Contingency	750,708
3. Mobilization, Bonds, Insurance	187,677
4. Engineering, Inspection, Legal, Administration	938,386
5. Maintenance (170 acres)	103,985
6. Right-of-Way (170 acres)	1,147,500
CC1-L1b TOTAL	$6,881,800
REACH: Leon Creek 1--Lower Segment (LC1-L1)	
1. Clear, Shape, and Revegetate from IH 410 to New Laredo Highway (190 acres)	$ 178,000
2. Contingency	29,640
3. Mobilization, Bonds, Insurance	7,410
4. Engineering, Inspection, Legal, Administration	37,050
5. Maintenance (190 acres)	116,218
6. Right-of-Way (190 acres)	1,282,500
LC1-L1 TOTAL	$1,621,018

Table 1-B
(Continued)

Component/Location	Cost
REACH: Leon Creek 1--Upper Segment (LC1-U1a)	
1. Remove Fill From New Laredo Highway to Quintana Road	$ 438,851
2. Contingency	87,770
3. Mobilization, Bonds, Insurance	21,943
4. Engineering, Inspection, Legal, Administration	109,713
5. Maintenance (21 acres)	12,845
6. Right of Way (21 acres)	141,750
LC1-U1a TOTAL	$ 818,871
REACH: Leon Creek 1--Upper Segment (LC1-U1b)	
1. Remove Fill From New Laredo Highway to Quintana Road	$ 438,851
2. Replace Leon Creek Relief Bridge	1,100,000
3. Trapezoidal Channel (285' Bottom, 3:1 Side Slopes)	677,648
4. Contingency	532,000
5. Mobilization, Bonds, Insurance	133,000
6. Engineering, Inspection, Legal, Administration	665,000
7. Maintenance (36 acres)	22,020
8. Right-of-Way (36 acres)	243,000
LC1-U1b TOTAL	$4,255,020
REACH: Leon Creek 3--Middle (LC3-M1)	
1. Replace South Pacific Railroad Bridge (325' x 12')	$ 390,000
2. Replace IH 10 Northbound Frontage Road Bridge (210' x 31')	325,500

Table 1-B
(Continued)

Component/Location	Cost
REACH: Leon Creek 3--Middle (LC3-M1) (Continued)	
3. Channel Improvements From Railroad Bridge to IH 10 Southbound Frontage Road Bridge	81,300
4. Contingency	159,360
5. Mobilization, Bonds, Insurance 39,8406.	
Engineering, Inspection, Legal, Administration	199,200
7. Maintenance	0
8. Right-of-Way	0
LC3-M1 TOTAL	$1,195,200
REACH: Leon Creek 3--Upper and Middle (LC3-UM1)	
1. Replace South Pacific Railroad Bridge (325' x 12')	$ 390,000
2. Replace IH 10 Northbound and Southbound Frontage Road Bridges 2 (210' x 31')	651,000
3. Channel Improvements From Railroad Bridge to IH 10 Southbound Frontage Road Bridge	177,300
4. Replace Abutment Walls on IH 10 Mainlanes	186,666
5. Levee (10' top, 3:1 Side Slopes)	5,600
6. Channel Improvements--Near Concept Therapy Institution	1,166,000
7. Contingency	515,313
8. Mobilization, Bonds, Insurance	137,828
9. Engineering, Inspection, Legal, Administration	644,141
10. Maintenance	0
11. Right of Way	0
LC3-UM1 TOTAL	$3,873,848

Table 2-B
OPINION OF COSTS
NONSTRUCTURAL ALTERNATIVES--100-YEAR DESIGN FLOOD

Component	Cost
REACH: Salado Creek 1--Lower Segment (SC1-L2)	
Relocate 1 Mobile Homes	$ 5,000
Floodproof 2 Structure	10,000
Relocate 10 Structures	600,000
SC1-L2 TOTAL	$ 615,000
REACH: Salado Creek 1--Upper Segment (SC1-U2)	
Relocate 2 Mobile Homes	$ 10,000
Relocate 4 Structures	240,000
Relocate 1 Commercial Structure	49,400
SC1-U2 TOTAL	$ 299,400
REACH: Cibolo Creek 1--Lower Segment (CC1-L2)	
Relocate 23 Mobile Homes	$ 115,000
Floodproof 3 Structures	15,000
Relocate 6 Structures	360,000
CC1-L2 TOTAL	$ 490,000
REACH: Cibolo Creek 1--Upper Segment (CC1-U1)	
Relocate 3 Mobile Homes	$ 15,000
Floodproof 2 Structures	10,000
Relocate 2 Structures	120,000
Relocate 1 Commercial Structure	65,250
CC1-U1 TOTAL	$ 210,250

Table 2-B
(Continued)

Component	Cost
REACH: Leon Creek 1--Lower Segment (LC1-L2)	
Relocate 61 Mobile Homes	$ 113,000
Floodproof 3 Structures	15,000
Relocate 8 Structures	480,000
Relocate 2 Commercial Structures	491,530
LC1-L2 TOTAL	$1,099,530
REACH: Leon Creek 1--Upper Segment (LC1-U2)	
Relocate 56 Mobile Homes	$ 92,000
Relocate 23 Structure	1,380,000
Relocate 3 Commercial Structures	364,400
LC1-U2 TOTAL	$1,836,400
REACH: Leon Creek 3--Lower Segment (LC3-L1)	
Relocate 1 Mobile Homes	$ 5,000
Floodproof 2 Commercial Structures	20,000
LC1-L1 TOTAL	$ 25,000
REACH: Leon Creek 3--Middle Segment (LC3-M2)	
Relocate 2 Structures	$ 120,000
Relocate 3 Commercial Structures	253,700
Floodproof 3 Commercial Structures	30,000
LC3-M2 TOTAL	$ 403,700

Table 2-B
(Continued)

Component	Cost
REACH: Leon Creek--Upper Segment (LC3-UM2)	
Floodproof 2 Structures	$ 10,000
Relocate 4 Structures	240,000
LC3-M2 Total	403,700
LC3-UM2 TOTAL	$ 653,700

Appendix C

Table 1-C
QUESTIONNAIRE RESULTS

Question/Information	Salado	Cibolo	Leon 1	Leon 3
Number of Questionnaires Distributed	51	258	126	183
Number of Respondents	7	28	14	20
Highest Flood Level Above Finished Floor (ft.)				
	June 1986	June 1985	June 1986	June 1986
>0 to 1.0	1		2	
>1.0 to 2.0				
>2.0 to 3.0			1	1
>3.0 to 4.0			1	
>4.0		1-6'	1	
	Sept. 1978	July 1973	June 1987	June 1987
>0 to 1.0			1	
>1.0 to 2.0		1		
>2.0 to 3.0			1	1
>3.0 to 4.0			1	
>4.0		1-6'	1	
	Other	Other	Other	Other
>0 to 1.0				1-1965, 1-1976
>1.0 to 2.0			1-1973, 1-1988	
>2.0 to 3.0		1-1972		
>3.0 to 4.0				
>4.0				
Damages (All Storms)				
Creek Bank Erosion	5	18	6	10
Landscaping and/or Fences	6	18	6	16
Vehicle	1	2	4	2
Crawl Space or Basement			1	3
House Contents	1	1	6	5
Structure	2	2	6	
Problems Off Property (All Storms)				
Hazard to Vehicles	5	18	9	20
Hazard to Pedestrians	4	18	6	16
Blocked Bridges or Culverts	6	18	12	16
Ponding Water	5	15	7	12

Table 1-C
(Continued)

Question/Information	Salado	Cibolo	Leon 1	Leon 3
Question 1 Responses				
Attractive Open Channels				
High	3	17	6	11
Medium	1	2	2	4
Low		3	1	1
Not Sure	1	1		
Storm Sewers				
High	1	2	3	5
Medium		3	2	2
Low	1	9	2	6
Not Sure	1		1	2
Attractive Detention Ponds				
High		9	3	5
Medium	2	5	1	4
Low		4	3	5
Not Sure	1		1	2
Floodproofing Houses				
High	1	3	7	1
Medium		4		1
Low	1	10	3	9
Not Sure	1		1	3
Pump Station to Relieve Ponding				
High		4	1	2
Medium	1	1	3	1
Low		9	2	7
Not Sure	2	2	1	2
Question 2 Responses*				
Question 3 Responses				
Yes		7	1	6
No	7	17	12	14

*Descriptive responses were not included in this summary

Table 1-C
(Continued)

Question/Information	Salado	Cibolo	Leon 1	Leon 3
Question 4 Responses				
Yes			1	2
No		7	1	5
Question 5 Responses				
0		1	1	1
1	1	2	2	5
2	1	8	1	3
3	2	8	3	3
4	1	4		2
5		2	1	
>5			90	50, 6, 12
Question 6 Responses				
No Change				
High		3	4	4
Medium		1		1
Low	1	7	3	8
Not Sure	3	4	2	2
Remove Debris & Thin Trees				
High	4	18	6	15
Medium	1	1	2	4
Low		3	2	
Not Sure	2			
Repair Channel to Original				
High	1	8	6	9
Medium	1	2		2
Low		4	2	2
Not Sure	3	3		2
New Concrete Channel				
High	2	3	2	2
Medium		2	1	2
Low	1	8	3	10
Not Sure	2	3	1	1

Table 1-C
(Continued)

Question/Information	Salado	Cibolo	Leon 1	Leon 3
New Grass Channel				
High	4	7	5	4
Medium		6		4
Low		4	2	5
Not Sure	2	2	1	3
Other Channel*				
Question 7 Responses				
Yes	2	14	8	8
No	4	7	4	8
Question 8 Responses				
Yes	2	9	6	5
No	4	13	5	11
Question 9 Responses				
Yes	2	8	7	11
No	4	14	4	5

*Descriptive responses were not included in this summary

FLOOD CONTROL IMPROVEMENT QUESTIONNAIRE

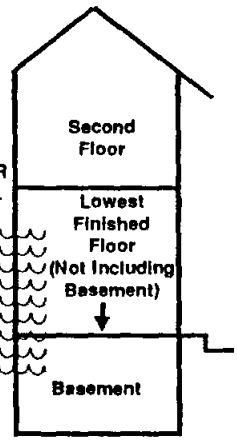
BEXAR COUNTY
PUBLIC WORKS DEPARTMENT NEEDS YOUR HELP

Bexar County's engineering consultant, CH2M HILL, needs information about damages and problems that occurred to your property or the area surrounding your property during past floods. Please fill out this questionnaire as completely as possible to help us develop solutions to flooding problems in your area. Please fold and mail within 5 days in this pre-stamped mailer.

For each flood listed in the columns on the right please circle the HIGHEST LEVEL of flood water measured from your lowest finished floor in feet.

SALADO CREEK
DATE OF FLOOD

June 1985	Sept. 1978	Other 19__
HIGHER	HIGHER	HIGHER
6 FT.	6 FT.	6 FT.
5 FT.	5 FT.	5 FT.
4 FT.	4 FT.	4 FT.
3 FT.	3 FT.	3 FT.
2 FT.	2 FT.	2 FT.
1 FT.	1 FT.	1 FT.
0 FT.	0 FT.	0 FT.
-1 FT.	-1 FT.	-1 FT.
-2 FT.	-2 FT.	-2 FT.
LOWER	LOWER	LOWER



Please Check the kind of damages you had on your property:

	June 1985	Sept. 1978	Other 19__
Creek Bank Erosion	☐	☐	☐
Damaged Landscaping and/or Fences	☐	☐	☐
Damaged Vehicle	☐	☐	☐
Damage in Crawl Space or Basement	☐	☐	☐
Damage to House Contents	☐	☐	☐
Damage to Structure	☐	☐	☐

Please Check the Kind of Problems that Occurred off Your Property:

	June 1985	Sept. 1978	Other 19__
Hazards to Vehicles	☐	☐	☐
Hazards to Pedestrians	☐	☐	☐
Blocked Bridges or Culverts	☐	☐	☐
Ponding Water	☐	☐	☐

IMPORTANT
Please Return this Questionnaire within 5 Days

Additional Comments:

PLEASE PROVIDE YOUR RETURN ADDRESS IN THE SPACE BELOW

NAME _____

ADDRESS _____

_____

Bexar County
Public Works Department
Bexar County Courthouse
San Antonio, TX 78205

Attn: Ron Pena

FLOOD CONTROL IMPROVEMENT QUESTIONNAIRE

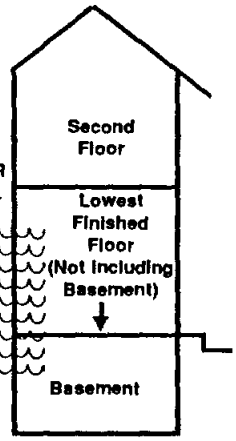
BEXAR COUNTY
PUBLIC WORKS DEPARTMENT NEEDS YOUR HELP

Bexar County's engineering consultant, CH2M HILL, needs information about damages and problems that occurred to your property or the area surrounding your property during past floods. Please fill out this questionnaire as completely as possible to help us develop solutions to flooding problems in your area. Please fold and mail within 5 days in this pre-stamped mailer.

For each flood listed in the columns on the right please circle the HIGHEST LEVEL of flood water measured from your lowest finished floor in feet.

CIBOLO CREEK
DATE OF FLOOD

	June 1985	July 1973	Other 19__
	HIGHER	HIGHER	HIGHER
	6 FT.	6 FT.	6 FT.
	5 FT.	5 FT.	5 FT.
	4 FT.	4 FT.	4 FT.
	3 FT.	3 FT.	3 FT.
	2 FT.	2 FT.	2 FT.
	1 FT.	1 FT.	1 FT.
	0 FT.	0 FT.	0 FT.
	- 1 FT.	- 1 FT.	- 1 FT.
	- 2 FT.	- 2 FT.	- 2 FT.
	LOWER	LOWER	LOWER



Please Check the kind of damages you had on your property:

	June 1985	July 1973	Other 19__
Creek Bank Erosion	☐	☐	☐
Damaged Landscaping and/or Fences	☐	☐	☐
Damaged Vehicle	☐	☐	☐
Damage in Crawl Space or Basement	☐	☐	☐
Damage to House Contents	☐	☐	☐
Damage to Structure	☐	☐	☐

Please Check the Kind of Problems that Occurred off Your Property:

Hazards to Vehicles	☐	☐	☐
Hazards to Pedestrians	☐	☐	☐
Blocked Bridges or Culverts	☐	☐	☐
Ponding Water	☐	☐	☐

IMPORTANT
Please Return this Questionnaire within 5 Days

Additional Comments:

PLEASE PROVIDE YOUR RETURN ADDRESS IN THE SPACE BELOW

NAME _____

ADDRESS _____

_____

Bexar County
Public Works Department
Bexar County Courthouse
San Antonio, TX 78205

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FLOOD CONTROL IMPROVEMENT QUESTIONNAIRE

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PUBLIC WORKS DEPARTMENT NEEDS YOUR HELP

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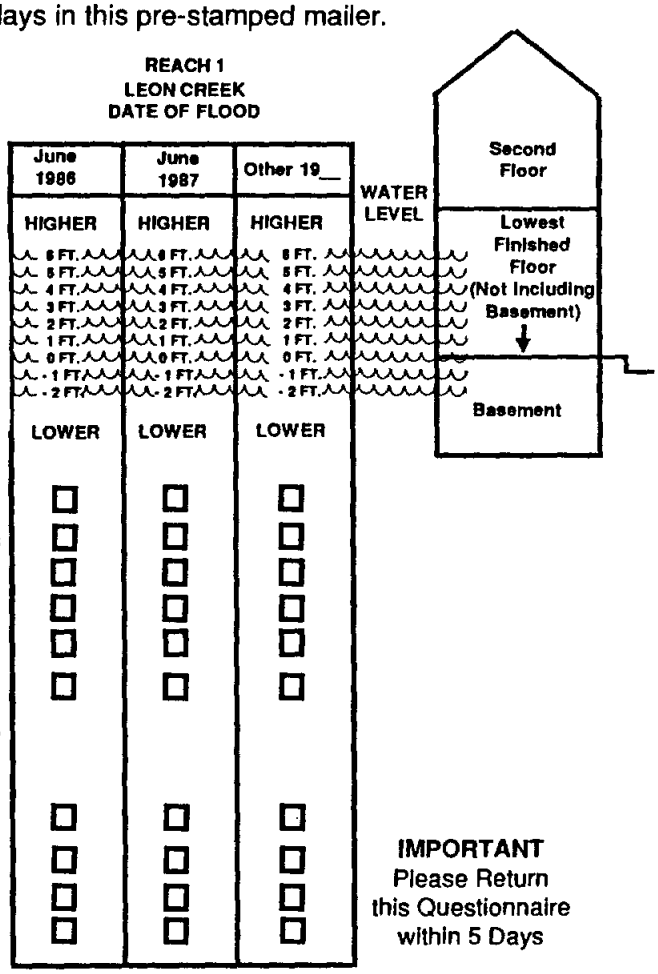
REACH 1
LEON CREEK
DATE OF FLOOD



Please Check the kind of damages you had on your property:

Creek Bank Erosion	☐	☐	☐
Damaged Landscaping and/or Fences	☐	☐	☐
Damaged Vehicle	☐	☐	☐
Damage in Crawl Space or Basement	☐	☐	☐
Damage to House Contents	☐	☐	☐
Damage to Structure	☐	☐	☐

Please Check the Kind of Problems that Occurred off Your Property:

Hazards to Vehicles	☐	☐	☐
Hazards to Pedestrians	☐	☐	☐
Blocked Bridges or Culverts	☐	☐	☐
Ponding Water	☐	☐	☐

IMPORTANT
Please Return this Questionnaire within 5 Days

Additional Comments:

PLEASE PROVIDE YOUR RETURN ADDRESS IN THE SPACE BELOW

NAME _____

ADDRESS _____

_____

Bexar County
Public Works Department
Bexar County Courthouse
San Antonio, TX 78205

Attn: Ron Pena

FLOOD CONTROL IMPROVEMENT QUESTIONNAIRE

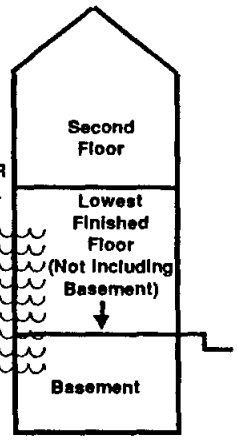
BEXAR COUNTY
PUBLIC WORKS DEPARTMENT NEEDS YOUR HELP

Bexar County's engineering consultant, CH2M HILL, needs information about damages and problems that occurred to your property or the area surrounding your property during past floods. Please fill out this questionnaire as completely as possible to help us develop solutions to flooding problems in your area. Please fold and mail within 5 days in this pre-stamped mailer.

For each flood listed in the columns on the right please circle the HIGHEST LEVEL of flood water measured from your lowest finished floor in feet.

REACH 3
LEON CREEK
DATE OF FLOOD

	June 1986	June 1987	Other 19__
	HIGHER	HIGHER	HIGHER
WATER LEVEL	6 FT. 5 FT. 4 FT. 3 FT. 2 FT. 1 FT. 0 FT. -1 FT. -2 FT.	6 FT. 5 FT. 4 FT. 3 FT. 2 FT. 1 FT. 0 FT. -1 FT. -2 FT.	6 FT. 5 FT. 4 FT. 3 FT. 2 FT. 1 FT. 0 FT. -1 FT. -2 FT.
	LOWER	LOWER	LOWER



Please Check the kind of damages you had on your property:

	June 1986	June 1987	Other 19__
Creek Bank Erosion	☐	☐	☐
Damaged Landscaping and/or Fences	☐	☐	☐
Damaged Vehicle	☐	☐	☐
Damage in Crawl Space or Basement	☐	☐	☐
Damage to House Contents	☐	☐	☐
Damage to Structure	☐	☐	☐

Please Check the Kind of Problems that Occurred off Your Property:

Hazards to Vehicles	☐	☐	☐
Hazards to Pedestrians	☐	☐	☐
Blocked Bridges or Culverts	☐	☐	☐
Ponding Water	☐	☐	☐

Additional Comments:

IMPORTANT
Please Return this Questionnaire within 5 Days

PLEASE PROVIDE YOUR RETURN ADDRESS IN THE SPACE BELOW

NAME _____

ADDRESS _____

_____

YOUR OPINION COUNTS

Bexar County is interested in knowing the type of flood control improvements that residents in flood-prone areas would prefer. Please respond to the following questions.

1. If the present storm drainage system proves to be inadequate, what would your choices be for an improved system? Circle the priority you would give each of the following alternatives:

ALTERNATIVE	PRIORITY			
Attractive Open Channels	High	Medium	Low	Not Sure
Storm Sewers	High	Medium	Low	Not Sure
Attractive Detention Ponds	High	Medium	Low	Not Sure
Floodproofing Houses.....	High	Medium	Low	Not Sure
Pump Station to Relieve Ponding	High	Medium	Low	Not Sure

Other-Please Specify _____

2. If a detention pond needs to be built in your community, where do you think it should be built?

_____

3. Do you presently carry flood insurance? Circle One: Yes No

4. If yes, Have you ever filed a claim? Circle One Yes No

5. How many people live or work in this building? _____

6. Please circle your priorities for an Open Channel:

ALTERNATIVE	PRIORITY			
No Change in Existing Channel	High	Medium	Low	Not Sure
Remove Debris & Thin Trees & Brush in Existing Channel	High	Medium	Low	Not Sure
Repair Existing Channel to Original Condition	High	Medium	Low	Not Sure
Construct an Attractive New Concrete Channel	High	Medium	Low	Not Sure
Construct an Attractive New Grass Channel	High	Medium	Low	Not Sure

Construct Other Type of Channel, such as:_____

7. Would you be willing to allow the County to build a wider channel if it affects your property? Circle One: Yes No

8. Would you be willing to donate right-of-way for the channel to the County? Circle One: Yes No

9. Would you be willing to donate right-of -way along the top of the channel to allow for access by County maintenance crews? Circle One: Yes No

COMMENTS:

Appendix D

Table 1-D

PROPERTY SUBJECT TO FLOODING
LEON CREEK REACH 3

UPPER REACH SEGMENT

PARCEL ADDRESS	PROPERTY CLASS	CB/NCB	PARCEL/LOT	BLOCK	FLOOD ELEVATION	1ST FLOOR ELEVATION
0 BOERNE STAGE	RS	4732	P-5		1152.00	1151.10
24183 BOERNE STAGE	RS	4732	P-7A		1152.30	1152.20
0	CM	4732	P-14A		1134.61	1137.57
	EX	4732	P-15		1134.61	1133.47

MIDDLE REACH SEGMENT

0 FREDSBG RD	CI	4732	P-18		1133.74	1132.00
24116 FREDSBG RD	CM	4732	P-18A		1133.74	1131.80
0 I.H. 10 W	CI	4732	P-18B		1133.74	1133.00
0 FREDSBG RD	CI	4732	P-18C		1133.74	1137.00
UNKNOWN	CM	4732	P-29, P-30, P-31		1138.50	1138.80
999 WEST COURT LN	VA	4752	P-1		1131.80	1130.60
23490 I.H. 10 W	RS	4752	P-7(2.20AC) CB 4754 P-6(5.10AC)		1118.50	1115.20

LOWER REACH SEGMENT

20345 CARRIE LOUISE	RS	4760	P-22 & P-23		1072.00	1073.00
19933 CARRIE LOUISE	RS	4760	P-24		1068.50	1064.40
0 SHADY LANE DR	CM	4760A	LOT N IRR 10.14 FT OF 1 & S 40 FT OF 2	BLK A	1068.50	1068.50
19825 SHADY LANE	RT	4760A	LOT 3	BLK A	1068.50	1070.20
0 SHADY LANE	CM	4760A	LOT N 95.91 FT OF 37	BLK A	1068.31	1068.50
0 SHADY LANE	CM	4760A	LOT S IRR 93.66 OF 37	BLK A	1068.31	1068.27
0 CAMP BULLIS	CM	4760A	LOT TR B & LOT 1	BLK B	1068.31	1068.61
19830 SHADY LANE	RT	4760A	LOT 3 & S 1/2 OF 4	BLK B	1068.50	1070.20
19850 SHADY LANE	RT	4760A	LOT N 1/2 OF 4 & S 1/2 OF 5	BLK B	1068.70	1069.00
20010 SHADY LANE	RT	4760A	LOT 12	BLK B & C	1069.20	1071 40
999 CAMP BULLIS RD	CI	5936	LOT SW PT OF 1	BLK D	1068.80	1068 20

Table 1-D

PROPERTY SUBJECT TO FLOODING
LEON CREEK REACH 1

LOWER REACH SEGMENT

PARCEL ADDRESS	PROPERTY CLASS	CB/NCB	PARCEL/LOT	BLOCK	FLOOD ELEVATION	1ST FLOOR ELEVATION
	RT	4295	P-6		602.00	598.75
	RT	4303	P-60		603.60	598.75
0 LOOP 410 NW	CM	4295	P-4		596.00	588.00
0 SOMERSET RD	RS	4295	P-4B		601.50	602.00
0 SOMERSET RD	RS	4295	P-6		602.00	598.75
9846 SOMERSET RD	RS	4295	P-6A		602.00	598.00
9486 SOMERSET RD	RT	4295	P-6B		601.50	599.00
8821 HWY 81 S	CM	4303	P-53(CB 4303) 12.74 AC, P-1(CB 5467) 1.833 AC		616.00	608.00
0 HWY 81 S	RS	4303	P-55		608.00	608.00
UNKNOWN	RS	4303	P-56 CB 5448 P-1		607.50	606.50
9375 PANAM EXPY S	RS	4303	P-60		603.60	598.75
9395 S PANAM EXPWY	RT	4303	P-61		604.20	603.70
UNKNOWN	RS	5447	CB 5447(P-2A) CB 5448(P-2A)		607.20	606.00
UNKNOWN	RS	5447	CB 5447(P-2B) CB 5448(P-2B) CB 4303(P-57)		607.20	606.00

UPPER REACH SEGMENT

0	CM	5466	P-3A(1.29AC), NCB 11300 P-107(.33AC)		619.00	612.00
0 PLUMNEAR RD	RT	5466A	LOT 7	BLK 1	616.30	611.00
0 PLUMNEAR RD	RT	5466A	LOT 8	BLK 1	616.30	611.00
0 PLUMNEAR RD	RS	5466A	LOT 9	BLK 1	616.30	608.50
0 PLUMNEAR RD	RT	5466A	LOT 10	BLK 1	616.50	610.50
0 PLUMNEAR RD	RS	5466A	LOT 17	BLK 1	619.40	613.00
0 PLUMNEAR RD	RS	5466A	LOT 18 & 19	BLK 1	618.70	610.00
0 PLUMNEAR RD	RT	5466A	LOT 20	BLK 1	618.00	611.50
0 PLUMNEAR RD	RS	5466A	LOT 21 & 22	BLK 1	618.00	610.50
0 PLUMNEAR RD	RS	5466A	LOT 1	BLK 2	616.00	608.75
0 PLUMNEAR RD	RS	5466A	LOT 2	BLK 2	616.00	609.00
0 PLUMNEAR RD	RS	5466A	LOT N 150 FT OF 5	BLK 2	616.30	609.50
0 PLUMNEAR RD	RT	5466A	LOT N 150' OF 6 & E IRR 300' OF TR-28A	BLK 2	616.30	609.50
0 PLUMNEAR RD	RS	5466A	LOT N 150 FT OF 7	BLK 2	616.30	610.00
0 PLUMNEAR RD	RS	5466A	LOT N 150' OF 9(.258 AC) & W IRR 520' OF TR-28(3.67 AC)	BLK 2	616.80	611.00
0 PLUMNEAR RD	RS	5466A	LOT N 150 FT OF 10	BLK 2	616.50	609.00
0 PLUMNEAR RD	RT	5466A	LOT N 150 FT OF 11	BLK 2	616.80	611.50
0 PLUMNEAR RD	RS	5466A	LOT N 150 FT OF 15	BLK 2	617.70	607.00
0 PLUMNEAR RD	RT	5466A	LOT 24	BLK 2	618.70	609.80
0 PLUMNEAR RD	RT	5466A	LOT 25	BLK 2	618.00	609.00
0 PLUMNEARRD	RS	5466A	LOT 26	BLK 2	618.00	607.75
154 PLUMNEAR RD	RS	5466A	LOT N 150 FT OF 14	BLK 2	617.40	607.50
103 PLUMNEAR RD	RT	11300	P-1(2.2AC), P-108(5.813AC)		616.30	610.00
8611 NEW LAREDO HWY	RT	11300	LOT 1 ARB P-106		616.30	613.25
UNKNOWN	CM	11300	LOT 4		618.04	615.30
8311 NEW LAREDO HWY	CM	11300	LOT 5		616.00	612.40
8418 QUINTANA RD	RS	11300	P-104		618.04	614.90
8418 QUINTANA RD	RT	11300	P-104A		618.04	615.90
8615 NEW LAREDO HWY	RS	11300	P-108A		616.00	610.60

Table 1-D

PROPERTY SUBJECT TO FLOODING
CIBOLO CREEK REACH 1

LOWER REACH SEGMENT

PARCEL ADDRESS	PROPERTY CLASS	CB/NCB	PARCEL/LOT	BLOCK	FLOOD ELEVATION	1ST FLOOR ELEVATION
0						
12529 OMAR DR	RT	5055B	LOT 17	BLK 8	680.50	680.50
12537 OMAR DR	RT	5055B	LOT 18	BLK 8	681.00	681.25
0 LOST MEADOWS	RS	5055C	LOT 3	BLK 3	676.27	675.00
124 LOST MEADOWS	RS	5055C	LOT 4	BLK 3	677.67	677.43
130 LOST MEADOWS	RS	5055C	LOT SE 520 FT OF 7	BLK 3	681.27	681.39
0 OMAR DR	RT	5472	P-2		683.00	683.76

UPPER REACH SEGMENT

1075 FM 78	RT	5054	P-19 & P-20 & P-20B		712.41	712.40
1075 FM 78	CM	5054	P-19 & P-20 & P-20B		712.41	706.30
0 SCHAEFER RD	RS	5054	P-41		686.40	684.50
0 SCHAEFER RD	RT	5055A	P-5		668.90	666.80
12086 AZTEC LANE	RS	5911	LOT 8		710.25	710.70
0 AZTEC LANE	RT	5911	LOT 9		710.20	709.97
12096 AZTEC LN	RS	5911	LOT 10		710.25	709.47
0 AZTEC LN	RS	5911	LOT 11		710.25	707.48
12115 AZTEC LN	RS	5911	LOT 13		710.50	712.42
12045 AZTEC LN	RS	5911	LOT 16 & 17		710.25	710.79
0 FM 1518	RS	5911	LOT 22		710.25	709.57
12048 FM 1518	CM	5911	LOT 24		710.50	711.00

Table 1-D

PROPERTY SUBJECT TO FLOODING
CIBOLO CREEK REACH 1

LOWER REACH SEGMENT

PARCEL ADDRESS	PROPERTY CLASS	CB/NCB	PARCEL/LOT	BLOCK	FLOOD ELEVATION	1ST FLOOR ELEVATION
0						
0 BLUEGILL DR	RS	5055B	LOT 4	BLK 5	673.80	674.23
12536 CRESCENT BEND	RT	5055B	LOT 24	BLK 5	676.20	678.80
12454 CRESCENT BEND	RS	5055B	LOT 27	BLK 5	676.00	678.30
12504 CRESCENT BEND	RS	5055B	LOT 28	BLK 5	676.00	678.20
12442 CRESCENT BEND	RT	5055B	LOT 29	BLK 5	676.00	676.50
12430 CRESCENT BEND	RT	5055B	LOT 30	BLK 5	676.00	677.00
0 CRESCENT BEND	RT	5055B	LOT 31	BLK 5	676.00	675.00
12418 CRESCENT BEND	RT	5055B	LOT 32	BLK 5	676.00	674.00
12410 CRESCENT BEND	RT	5055B	LOT 33	BLK 5	676.20	672.50
12402 OMAR DR	RT	5055B	LOT 34	BLK 5	676.00	671.50
12403 CRESCENT BEND	RT	5055B	LOT 1	BLK 6	676.20	674.00
12411 CRESCENT BEND	RT	5055B	LOT 2	BLK 6	676.00	673.50
12513 CRESCENT BEND	RT	5055B	LOT 8	BLK 6	676.20	678.30
12521 CRESCENT BEND	RT	5055B	LOT 9 & 10	BLK 6	676.20	678.50
0 CRESCENT BEND	RT	5055B	LOT 12	BLK 6	676.20	677.30
12625 CRESCENT BEND	RS	5055B	LOT 15 & 16	BLK 6	676.27	675.29
12530 SWEETWATER ST	RT	5055B	LOT 17	BLK 6	677.00	679.00
12530 SWEETWATER ST	RS	5055B	LOT 18	BLK 6	677.60	678.00
12522 SWEETWATER ST	RS	5055B	LOT 19	BLK 6	677.60	679.50
12514 SWEETWATER ST	RT	5055B	LOT 20	BLK 6	677.60	680.00
12506 SWEETWATER ST	RT	5055B	LOT 21	BLK 6	677.60	680.50
12500 SWEETWATER ST	RT	5055B	LOT 22 & 23	BLK 6	677.60	680.50
0 SWEETWATER ST	RT	5055B	LOT 24	BLK 6	677.60	680.58
0 SWEETWATER ST	RT	5055B	LOT 26	BLK 6	677.60	679.00
0 SWEETWATER ST	RT	5055B	LOT 27	BLK 6	677.60	678.00
12429 SWEETWATER ST	RT	5055B	LOT 4	BLK 7	679.00	678.00
0 SWEETWATER ST	RT	5055B	LOT 6	BLK 7	678.50	679.50
12451 SWEETWATER ST	RT	5055B	LOT 7	BLK 7	678.00	680.50
12459 SWEETWATER ST	RT	5055B	LOT 8	BLK 7	678.50	681.40
12501 SWEETWATER ST	RT	5055B	LOT 9	BLK 7	678.50	680.70
12515 SWEETWATER ST	RS	5055B	LOT NE 1/2 OF 11	BLK 7	678.00	679.74
12454 SWEETWATER ST	RT	5055B	LOT 16	BLK 7	680.00	682.80
12434 LAKEVIEW DR	RT	5055B	LOT 18	BLK 7	680.48	681.32
12424 LAKEVIEW DR	RS	5055B	LOT 19	BLK 7	680.48	682.35
12332 LAKEVIEW DR	RS	5055B	LOT 20	BLK 7	680.48	678.94
12324 SWEETWATER ST	RS	5055B	LOT 21	BLK 7	680.48	680.50
0 OMAR DR	RT	5055B	LOT 1, 2 & 3	BLK 8	672.00	674.79
11827 OMAR DR	RT	5055B	LOT 4	BLK 8	673.40	671.50
11907 OMAR DR	RT	5055B	LOT 5	BLK 8	674.10	673.04
0 OMAR DR	RT	5055B	LOT 7 & 8	BLK 8	674.87	671.58
12327 OMAR DR	RT	5055B	LOT 9 & 10	BLK 8	676.20	673.00
0 OMAR DR	RT	5055B	LOT 11	BLK 8	677.00	674.12
0 OMAR DR	RT	5055B	LOT 12	BLK 8	677.67	674.5[illegible]
12429 OMAR DR	RT	5055B	LOT 13	BLK 8	679.00	676.50
12507 OMAR DR	RT	5055B	LOT 14	BLK 8	679.00	677.40
12521 OMAR DR	RT	5055B	LOT 16	BLK 8	680.48	678.50

Table 1-D

PROPERTY SUBJECT TO FLOODING
CIBOLO CREEK REACH 1

LOWER REACH SEGMENT

PARCEL ADDRESS	PROPERTY CLASS	CB/NCB	PARCEL/LOT	BLOCK	FLOOD ELEVATION	1ST FLOOR ELEVATION
0 SCHAEFER RD	RT	5055A	P-6		668.00	667.50
0 SCHAEFER RD	RS	5055A	P-7		668.00	665.45
UNKNOWN	RS	5055	P-7A		667.80	665.00
0 SCHAEFER RD	RS	5055A	P-8		667.50	665.60
12677 SCHAEFER RD	RT	5055A	P-9		667.60	666.50
12103 OMAR DR	RT	5055B	LOT 12	BLK 1	670.40	671.50
12111 OMAR DR	RT	5055B	LOT 13	BLK 1	670.40	671.40
5048 LYNDON DR	RT	5055B	LOT 14	BLK 2	670.40	673.50
12159 CROOKED TREE	RT	5055B	LOT 15	BLK 2	670.40	671.50
12141 CROOKED TREE	RT	5055B	LOT 16	BLK 2	668.90	670.00
12109 CROOKED TREE	RT	5055B	LOT 18	BLK 2	668.00	668.90
12073 CROOKED TREE	RT	5055B	LOT 19	BLK 2	668.00	668.96
12028 CROOKED TREE	RT	5055B	LOT 29	BLK 2	667.50	668.90
12040 CROOKED TREE	RT	5055B	LOT 30	BLK 2	667.50	668.96
12060 CROOKED TREE	RT	5055B	LOT 31	BLK 2	668.00	669.50
12110 CROOKED TREE	RT	5055B	LOT 32 & 33	BLK 2	668.00	669.00
12142 CROOKED TREE	RT	5055B	LOT E 80 FT OF N 60 OF 34	BLK 2	668.92	670.00
12160 CROOKED TREE	RT	5055B	LOT 35 & W 20 FT OF 34	BLK 2	668.92	671.50
12172 CROOKED TREE	RT	5055B	LOT 37	BLK 2	670.40	672.50
12512 LYNDON DR	RT	5055B	LOT 1	BLK 3	670.40	672.50
0 LAKEVIEW DR	RS	5055B	LOT 33	BLK 3	677.60	677.00
12555 LAKEVIEW DR	RS	5055B	LOT 35	BLK 3	679.07	679.24
12535 LAKEVIEW DR	RS	5055B	LOT 36 & 37	BLK 3	679.07	679.24
0 LAKEVIEW DR	RT	5055B	LOT 38	BLK 3	679.07	681.00
12505 LAKEVIEW DR	RS	5055B	LOT 39	BLK 3	679.07	679.69
12475 LAKEVIEW DR	RT	5055B	LOT 42	BLK 3	680.48	682.00
12455 LAKE GROVE DR	CM	5055B	LOT 44	BLK 3	680.48	681.53
0 LAKEVIEW DR	RT	5055B	LOT 45	BLK 3	681.00	680.50
0 LAKEVIEW DR	RT	5055B	LOT 47, SW 50FT OF 46 & NE 50 FT OF 48	BLK 3	681.00	681.60
0 LAKEVIEW DR	RT	5055B	LOT SW 50 FT OF 48	BLK 3	681.20	682.16
12327 LAKE VIEW DR	RT	5055B	LOT 49	BLK 3	681.20	682.16
12319 LAKEVIEW DR	RS	5055B	LOT 50	BLK 3	681.20	680.16
0 LYNDON DR	RT	5055B	LOT 3	BLK 4	671.80	673.50
12509 LYNDON DR	RT	5055B	LOT 6	BLK 4	671.80	674.00
12157 LYNDON DR	RT	5055B	LOT 7	BLK 4	671.80	674.00
12525 LYNDON DR	RT	5055B	LOT 8	BLK 4	671.80	673.50
12538 BLUEGILL DR	RT	5055B	LOT 26	BLK 4	673.40	676.00
12526 BLUEGILL DR	RT	5055B	LOT 27	BLK 4	673.40	675.00
12518 BLUEGILL DR	RT	5055B	LOT 28	BLK 4	673.40	673.50
0 BLUEGILL DR	RT	5055B	LOT 29	BLK 4	673.40	674.00
12420 BLUEGILL DR	RT	5055B	LOT 31 & 32	BLK 4	673.00	674.00
0 BLUEGILL DR	RT	5055B	LOT 33	BLK 4	673.40	672.00
0 OMAR DR	RT	5055B	LOT 34	BLK 4	673.40	670.00
0 OMAR DR	RT	5055B	LOT 1	BLK 5	674.20	672.50
0 BLUEGILL DR	RT	5055B	LOT 2	BLK 5	674.20	672.75
0 BLUEGILL DR	RT	5055B	LOT 3	BLK 5	673.80	674.50

Table 1-D

PROPERTY SUBJECT TO FLOODING
SALADO CREEK REACH 1

UPPER REACH SEGMENT

PARCEL ADDRESS	PROPERTY CLASS	CB/NCB	PARCEL/LOT	BLOCK	FLOOD ELEVATION	1ST FLOOR ELEVATION
0 HWY 181 S	CI	18191	P-26A		533.17	533.65
9751 OLD C CHRISTI	RS	18191	P-22		533.17	531.11
9751 OLD C CHRISTI	RT	18191	P-22		533.17	531.11
9801 OLD C CHRISTI	CM	4007	P-315		533.17	528.50
9593 OLD C CHRISTI	RS	18191	P-24E		533.17	534.49
9677 OLD C CHRISTI	RT	18191	P-24 & P-24A		533.17	533.50
0	RS	10881	P-19		533.62	532.50
9496 OLD C CHRISTI	RT	10881	P-14		533.62	536.26
0	RT	10881	P-18		533.62	533.01
9692 OLD C CHRISTI	RS	10881	P-21		533.62	531.72
9670 OLD C CHRISTI	RT	10881	P-20		533.62	535.20
9790 OLD C CHRISTI	RS	4007	P-136		533.62	529.23

LOWER REACH SEGMENT

12240 WHITNEY AV	RS	4069	LOT 12 & E 25 FT OF 11	BLK 11	515.50	514.80
12203 BLUE WING RD S	RS	4069	LOT 1-6	BLK 7	515.50	514.60
12207 WHITNEY AVE	RS	4069	LOT 1 & 2	BLK 12	515.30	514.25
12214 WHITNEY AV	RS	4069	LOT 10 & W 25 FT OF 11	BLK 11	515.50	514.30
12190 WHITNEY AVE	RS	4069	LOT 9	BLK 11	515.30	514.00
12460 SOUTHTON RD	RS	4069	LOT 4, 5, 6, 10, 11, 12	BLK 6	515.30	513.80
11970 SOUTHTON RD	RS	5162	LOT 14	BLK 5	515.30	512.10
12280 SOUTHTON RD	RS	4069	LOT 6	BLK 12	515.30	512.00
12020 SOUTHTON RD	RS	5162	LOT 8-9 & 10	BLK 5	515.30	511.00
11978 SOUTHTON RD	RS	5162	LOT 15 & 16	BLK 5	515.50	510.50
12270 SOUTHTON RD	RS	4069	LOT 5	BLK 12	515.30	510.20
3870 CLEVELAND AVE	RS	4069	LOT 4	BLK 12	515.30	508.50
12030 SOUTHTON RD	RT	5162	LOT 7	BLK 5	515.30	513.50