SAN JACINTO

REGIONAL WATERSHED MASTER DRAINAGE PLAN

Prepared for:
Harris County Flood Control District
San Jacinto River Authority
Montgomery County
City of Houston

APPENDIX C
EXISTING FLOOD HAZARD ASSESSMENT

San Jacinto Regional Watershed
Master Drainage Plan

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Prepared for

Harris County Flood Control District
San Jacinto River Authority
Montgomery County
City of Houston

by

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1.0 Introduction

The existing conditions flood hazard assessment established the existing watershed conditions and analyzed the current flooding risks and vulnerabilities necessitating mitigation projects. The task consisted of determining the runoff risk, which includes developing discharges for the major streams, and flood hazard assessment which includes determining the resulting water surface elevations and floodplains for the study area. The results of the assessment were calibrated to historical storm events and are presented in **Appendix D** of the report. The watershed vicinity map is shown in **Exhibit C1**. The current FEMA floodplains extents are shown in **Exhibit C2**.

2.0 Runoff Risk

One of the primary tasks of the San Jacinto Regional Watershed Master Drainage Plan was to develop or update the existing conditions hydrologic analysis to provide an improved baseline conditions for the entire upper San Jacinto River watershed. Baseline conditions modeling is compared with proposed conditions modeling to understand the extent of impacts due to proposed improvements within the watershed. Comparisons with existing models are used to develop and support conclusions about expected impacts to flooding extents and frequency. Streams included in the existing flood hazard assessment and proposed floodplain mitigation alternatives analysis modeling are listed in **Table 1**.

Table 1. Modeled Streams with Associated Lengths

Stream Name	Stream Length (Miles)
West Fork San Jacinto River	50.6
East Fork San Jacinto River	86.9
San Jacinto River	24.2
Lake Creek	69.5
Cypress Creek	51.2
Little Cypress Creek	21.7
Spring Creek	69.1
Willow Creek	20.5
Caney Creek	57.9
Peach Creek	49.6
Luce Bayou	30.1
Tarkington Bayou	50.4
Jackson Bayou	10.2
TOTAL	**591.9**

The available FEMA effective models for the SJR and its tributaries obtained from responsible agencies were utilized as a starting point for the existing flood risk assessment effort. A description of the source of the baseline models used is provided below.

- Effective models for the SJR, Spring Creek, Willow Creek, Cypress Creek and Little Cypress Creek, Luce Bayou and Jackson Bayou were downloaded from the HCFCD Model and Map Management (M3) website.
- Models for the drainage area upstream of Lake Conroe, as well as a dam breach model of the West Fork San Jacinto River downstream of Lake Conroe, were provided by SJRA.
- Base Level Engineering (BLE) models were obtained for East Fork San Jacinto River, Peach Creek, and Caney Creek from FEMA.

2.1 Existing Runoff Model Conversion

Sub-watersheds that had available hydrologic models were updated to the latest model versions and included in the study. The existing FEMA effective HEC-HMS models for Spring Creek (J100-00-00), Willow Creek (M100-00-00), Jackson Bayou (R100-00-00) and Cypress Creek (K100-00-00), including Little Cypress Creek (L100-00-00), were obtained from Harris County Flood Control District using their M3 website. Spring Creek, Willow Creek, and Jackson Bayou models were developed in 2007 using HEC-HMS version 3.3. The Cypress Creek HMS model was developed in 2013 using HEC-HMS version 3.4.

These existing models used 1998 USGS rainfall data, which is specified in the *HCFCD Hydrology & Hydraulics Guidance Manual*[1]. The Atlas 14 rainfall data released by NOAA in 2018 showed significant increase in rainfall depths within Harris County, as shown in **Table 2**. Effective models were converted to HEC-HMS v. 4.3 and updated with the Atlas 14 rainfall. In general, the 1% ACE/24-hour rainfall increased between 3 and 5 inches.

Table 2. Precipitation Comparison for Converted Models

Watersheds	1998 USGS total rainfall depth, 1% ACE/24-Hour (inches)	Atlas 14 rainfall depth 1%ACE/24-Hour (inches)
Spring Creek (J100-00-00)	12.4	16.3
Cypress Creek (K10-00-00)	12.4	16.3
Jackson Bayou (R100-00-00)	13.5	18.0
Willow Creek (M100-00-00)	12.4	16.3

Watershed parameters including subbasin areas, channel slopes, watershed slopes, percent impervious, detention values, and Clark Unit hydrograph parameters were not changed from the effective models. Green & Ampt remained the selected loss method but the loss parameters were updated due to reclassification of soils in the northwestern portion of the Harris County as stated in the *HCFCD white*

[1] Hydrology & Hydraulics Guidance Manual, Harris County Flood Control District (2009)

paper[2]. The revised Green & Ampt parameters are shown in **Table 3**. Each subbasin was updated to reflect the Green & Ampt and Simple Canopy loss methodologies.

Table 3. Green and Ampt Parameters for Selected Watersheds

	Spring Creek	Cypress Creek, Little Cypress Creek, Willow Creek	Luce Bayou	Jackson Bayou
Initial Content	0.059	0.048	0.024	0.075
Saturated Content	0.46	0.46	0.46	0.46
Suction (inches)	2.286	4.33	3.50	12.45
Conductivity (in/hr)	0.181	0.079	0.024	0.024

The storage routing tables were extrapolated based on the existing information. **Figure 1** shows comparison of storage routing curve between Effective and Revised Effective at reach R1020300_0001R. The converted models were simulated based on Atlas 14 rainfall data for the 50%, 20%, 10%, 4%, 2%, 1%, and 0.2% ACE storm events.

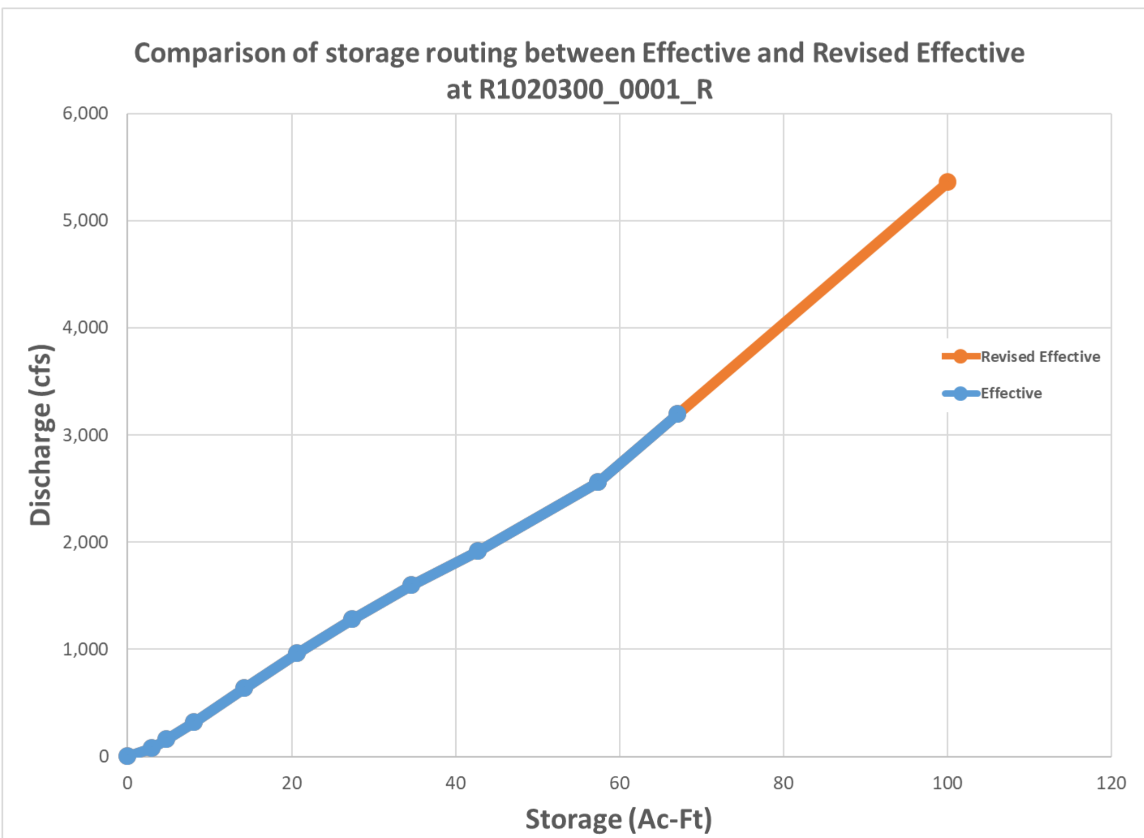


Figure 1: Storage Routing Curve Extrapolation

[2] HCFCD White Paper 03 "Replacing Green & Ampt Loss Function in HEC-HMS with Initial & Constant Loss Method, dated 07/20/2018"

2.2 New Runoff Model Development

New hydrologic models were required to be developed for previously unstudied watersheds to establish existing watershed conditions and analyze current flooding risks. While some watersheds did have previous studies, those studies are many decades old and included severely outdated data (topography, rainfall, landuse, modeling software, etc.) and were considered unreliable and unusable. New model development included watershed delineation, defining runoff losses, defining BDF values, and developing hydrologic models.

2.2.1 Watershed and Subbasin Delineation

Watershed and subbasin boundaries for the unstudied streams were initially delineated using GIS tool HEC-GeoHMS. Delineated boundaries were then manually revised using high-resolution Near Map aerial imagery, 2018 HGAC LiDAR, FEMA BLE, and field reconnaissance data. A summary of the total contributing drainage area for these unstudied watersheds is presented in **Table 4.**

Table 4. Unstudied Watersheds and Associated Area

Watershed Name	Total Contributing Drainage Area (sq.miles)
West Fork San Jacinto River downstream of Lake Conroe	299.0
Lake Creek	330.9
Peach Creek	158.6
Caney Creek	217.9
East Fork San Jacinto River	413.1
Luce Bayou	213.8

The drainage areas were further subdivided to develop discharge rates throughout the studied stream. Stream confluences and gage locations as well as major existing drainage features such as bridges, culverts, detention basins, and major outfalls were used as guides in the drainage area delineation process. Future potential gage locations were also considered as drainage area divides. The target size for the subbasins ranged from approximately 10 to 15 square miles, which resulted in over 400 drainage basins for the entire watershed. **Exhibit C3** shows the subbasin delineation for each watershed.

Subbasin naming convention was developed to be consistent with the *Harris County H&H Guidance Manual*[3]. Watersheds within Harris County will follow the existing HCFCD naming convention while watersheds outside of Harris County were assigned a four-character main stem identifier followed by three-digit number of the subbasin beginning on the downstream end of the main river. The naming convention for each watershed is included in **Table 5.**

[3] Hydrology & Hydraulics Guidance Manual, Harris County Flood Control District (2009)

Table 5. Subbasin Naming Convention

Watershed	Naming Convention
Caney Creek	GCC_###X
Cypress Creek	K100_###X
East Fork SJR	GEF_###X
Jackson Bayou	R100_###X
Lake Creek	GLC_###X
Luce Bayou	S100_###X
Peach Creek	GPC_###X
San Jacinto River	G103_###X
Spring Creek	J100_###X
West Fork SJR	GWF_###X
Willow Creek	M100_###X

2.2.2 Initial and Constant Losses

The initial and constant loss method was used to calculate the rainfall infiltration, interception, and depression storage for each watershed. The initial and constant lost method was chosen because the method is conducive to quick and accurate calibration due to it having only two parameters, initial loss and constant loss rate, and due to runoff rates reacting directly to changes made to these parameters.

The initial loss, or abstraction as it is called in other loss methods, is the amount of precipitation that is immediately infiltrated into the soil and vegetation during the beginning of the rain event. The pre-calibrated initial loss for all basins was assumed to be 1-inch and was later adjusted during the historical storm calibration.

The constant loss rate represents the ultimate infiltration capacity of the soils. The constant loss rate was based on an area's hydrologic soil group (HSG) which is a measure of the potential of a soil to produce runoff. The SSURGO soils database downloaded from NRCS was used to determine the soil groups in each subbasin. The HSG soil classifications of A, B, C, D, A/D, B/D, and C/D for the study area are shown in **Exhibit C4**.

The constant loss rate was assigned to each hydrologic soil group for the drained or undrained condition based on the rates recommended by the HEC-HMS technical reference manual. The recommended loss rates for HSG A, B, C and D were the average of the minimum and maximum range of constant loss, and the loss rates for the dual hydrologic soil groups (A/D, B/D, and C/D) were the averages of the individual HSG rates. The loss rates used for different HSGs are shown in **Table 6**. Composite constant loss rates were computed using a weighted loss method based on the soil type. The composite rates were later calibrated as part of the historical storm calibration.

Table 6. SCS Soil Groups and Infiltration (Loss) Rates

Soil Group	Description	Min. Constant Loss Rate (in/hr)	Max. Constant Loss Rate (in/hr)	Average Recommended Loss Rates (in/hr)
A	Deep Sand, deep loess, aggregated silts	0.30	0.45	0.38
B	Shallow loess, sandy loam	0.15	0.30	0.23
C	Clay loams, shallow sandy loam, soils low in organic content, and soils usually high in clay	0.05	0.15	0.1
D	Soils that swell significantly when wet, heavy plastic clays, and certain saline soils	0.00	0.05	0.03
A/D	Type A soil for drained conditions and Type D soil for undrained.			0.21
B/D	Type B soil for drained conditions and Type D soil for undrained.			0.13
C/D	Type B soil for drained conditions and Type D soil for undrained.			0.02

2.2.3 Basin Development Factors

The basin development factor (BDF) is one of the parameters used in developing the Time of Concentration (Tc) and Storage Coefficient (R) parameters required in the Clark Unit hydrograph transform method (Section 2.2.4). This method for calculating TC and R values was originally developed by the USGS. HCFCD has recently adopted this method and replaced its standard method because it is straightforward, easy to use, produces more consistent results than other standard methods, is effective in rural areas, and has been shown to produce results consistent with existing methodology and historic storm events. The BDF for a watershed is essentially a measure of the amount of development, and in turn, the level of efficiency of the drainage system in the watershed. BDF values range from 0 (representing areas with no drainage infrastructure) to 12 (representing areas with fully effective drainage systems). The type and level of efficiency of the drainage system within each subbasin was estimated using NearMap aerial imagery, 2018 HGAC Lidar data, and street view from Google Earth. BDF values were determined based on the step-wise method recommended in *HCFCD White Paper*[4]. The BDF value is determined by dividing the drainage area into thirds and assigning a value of 0, 0.5, or 1 to each third based on four different categories: channel improvements, channel linings, storm sewers, and curb-and-gutter streets. The individual values are then summed to determine the overall basin BDF value.

- **Channel Improvements (CI)** - If the channel was straightened, enlarged, deepened or cleaned, a value of 1 was assigned, and if the channel remained natural with no visible alterations, a code of 0 was assigned. Arterial storm sewers or roadside ditch systems are considered when small

[4] HCFCD White Paper 06 "Tc and R Methodology in Harris County, Revised 03/06/2019"

subbasins are not served by a drainage channel. A code of 0.5 was assigned if drainage network appeared to be roadside ditches. For example, the area GWF_020_upper is assigned a value of 1, as the WFSJR in this section looks straightened and cleaned as can be seen in **Figure 2**.

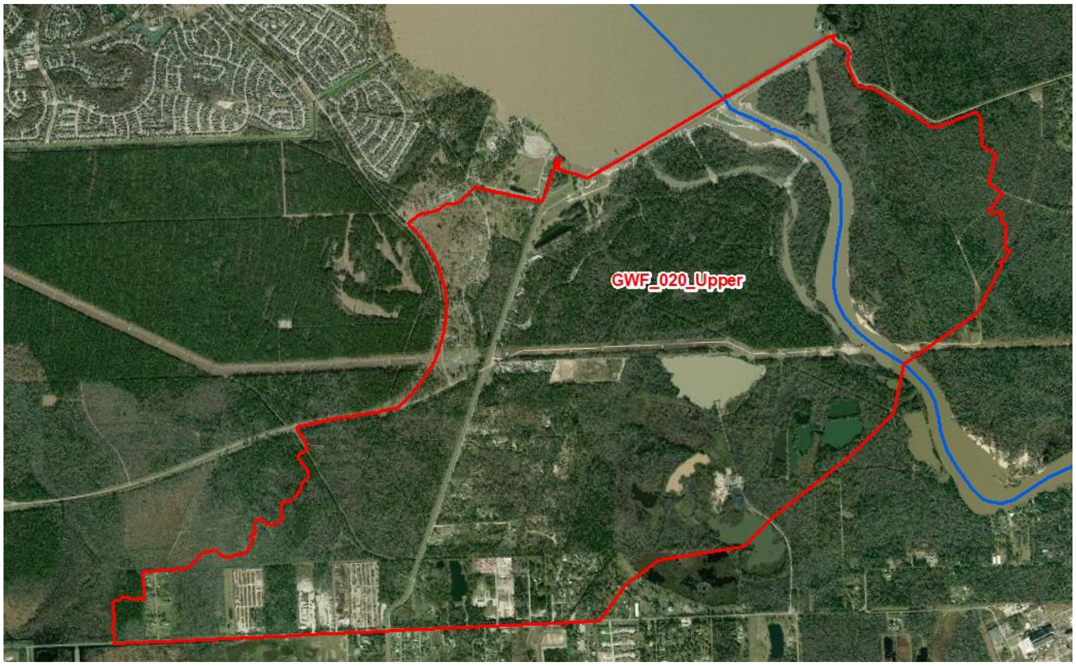


Figure 2: Aerial View of GWF_020_Upper

- **Channel Linings (CL)** - If more than 50 percent of the length of the main drainage channel and principal tributaries were lined with an impervious material, a code of 1 was assigned, and if the channel was not lined, a value of 0 was assigned. Arterial storm sewers or roadside ditch systems are considered when small subbasins are not served by a drainage channel. A code of 0.5 was assigned that satisfied the roadside ditch drainage condition. Most of the channels within SJR are not lined with an impervious material. General example of an impervious channel is shown in **Figure 3**.

Figure 3: BDF Channel Linings Example

- **Storm Sewers (SS)** - If more than 50 percent of the length of the main drainage channel and secondary tributaries were enclosed as a storm sewer, a value of 1 was assigned to the sub basin third, and a value of 0 was assigned if less than 50 percent of the storm sewers were enclosed. If the storm sewer system was designed using criteria and methods developed prior to 1984, or if a high tailwater condition was known to affect the normal operation of the sewer system, a value of 0.5 was assigned to the subbasin third. For example, the area GWF_040_Lower is assigned a value of 1, as this area is drained by storm sewer system as can be seen in **Figure 4**.

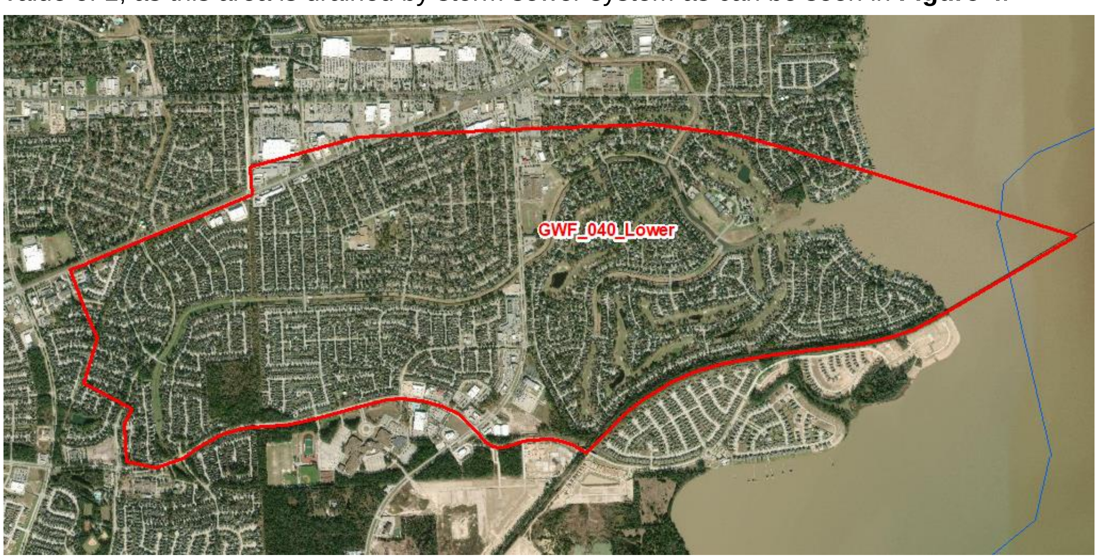


Figure 4. Aerial View of GWF_040_Lower

- **Curb-and-Gutter Streets** - A value of 1 was assigned to curb-and-gutter streets if more than 50 percent of the third is urbanized and the streets and roads were constructed with curb and gutters as shown in Figure 20. A value of 0 was assigned if there was less than 50 percent urbanization and curb and gutters on the streets. If the street system was designed without specific provisions or overland sheet flow, a 0.5 value was assigned to the respective sub basin third. **Figure 5** is an example of curb and gutter streets.

Figure 5: Curb and Gutter Streets

The overall BDF in the sub basin is the sum of all the four indices. BDF does not directly account for impervious cover but changes in BDF reflect improvements in drainage systems that accompany urbanization. BDF values for the watersheds are shown in **Exhibit C5** and detailed BDF calculations are provided in **Appendix D**.

2.2.4 Clark Transform

The Clark transform method in HEC-HMS simulates the process of converting precipitation into a runoff hydrograph. As discussed previously, time of concentration (Tc) and storage coefficient (R) are the two required parameters for this method and are calculated using a combination of the computed BDF and watershed parameters. Watershed parameters include subbasin drainage area, BDF value, length of longest watercourse (miles), channel slope (feet/mile), watershed slope (feet/mile), percent impervious (%), detention volume (ac-ft), and percent ponding (%). A mathematical relationship from the "Tc & R Methodology" and "Hydrologic Methodology" HCFCD white paper[5] was utilized to calculate the base Tc and R values is shown in **Figure 6**.

[5] HCFCD White Paper 06 “Tc and R Methodology in Harris County, Revised 03/06/2019”

$$Tr = 10^{[(-0.05228 \times BDF) + 0.4028 \log_{10}(A) + 0.3926]}$$

$$Tc = (-0.144 \ln(S \times S_o) + 1.4693) [Tr + (A^{0.5})/2]$$

$$R = (-0.179 \ln(S \times S_o) + 1.5772) [8.271 e^{-0.1167*BDF} (A^{0.3856})]$$

BDF = basin development factor (range from 0 to 12)
A = drainage area to point of interest (square miles)
S = channel slope (feet per mile)
S_o = overland slope (feet per mile)
$S \times S_o$ = 26 or greater; if less than 26, slope is not a significant factor and 26 should be used
Tr = lag time (hours)
Tc = time of concentration (hours)
R = Clark storage coefficient or residence time (hours)

Figure 6: Tc and R Equations

The base values were then adjusted for slope and detention. Channel slope and overland slope were calculated according to Section II.3 of *HCFCD Hydrology and Hydraulics Manual*. The parameters for the slope correction factor and detention correction factor were calculated per the Harris County Standard Method. The watershed slopes for each basin are shown in **Exhibit C6**.

Watershed detention volume was calculated using GIS and includes volume from ponds located outside of the effective 1% ACE floodplain as identified based on a review of aerial imagery. The volume was used to calculate the detention rate (DR) for each sub basin. Percent ponding (DPP) for each subbasin was calculated according to Section II.3 of *HCFCD Hydrology and Hydraulics Manual*. Detailed calculations relating to the Clark Transform parameters is provided in **Appendix D**.

2.2.5 Impervious Percentage

Land cover data was acquired from the Houston-Galveston Area Council (HGAC). The land use classifications were verified by using GIS and NearMap aerial imagery. Impervious percentages were assigned to each land use based on recommendations by the HCFCD. The HCFCD categories of land cover consisted of water, high density, light industrial/commercial, residential/urban average, developed green areas, undeveloped, residential/rural lots, high density and isolated transportation. Each HGAC category was assigned a corresponding HCFCD category and impervious percentage values based on the recommendations provided in the HCFCD white paper[6], as shown in **Table 7**. The HGAC land cover data did not have a separate classification for transportation, so major highways and thoroughfare corridors were incorporated into the existing land use shapefile. **Exhibit C7** shows the existing conditions impervious percentages and **Appendix D** includes the calculation tables for the sub basin impervious percentage.

[6] HCFCD White Paper 02 "Impervious Cover Updates in Harris County, Updated 07/18/2018"

Table 7. Percent Impervious Relationship Between HGAC and HCFCD

HGAC		HCFCD	
Description	**Grid Code**	**Description**	**Impervious Percent**
Open Water	1	Water	100
Developed High Intensity	2	High Density	85
Developed Medium Intensity	3	Light Industrial/Commercial	65
Developed Low Intensity	4	Residential – Urban Average	33
Developed Open Space	5	Developed Green Areas	15
Barren Lands	6	Undeveloped	0
Forest/Shrubs	7	Undeveloped	0
Pasture/Grasslands	8	Undeveloped	0
Cultivated Crops	9	Residential – Rural Lots	5
Wetlands	10	Undeveloped	0
Building	11	High Density	85
**Transportation*	-	Isolated Transportation	80

2.2.6 Muskingum-Cunge Routing

Stream routing was used to route flows through major tributaries that were not included in the hydraulic modeling effort. The tributary routing was used to determine the hydrograph attenuation due to storage in the subbasins in which tributaries did not contribute directly to the studied stream. For this study, Muskingum-Cunge routing methodology was selected. The parameters determined for this method included:

- Length - length of the routing reach measured along the channels
- Slope – average slope of the tributary based on the length and invert elevations obtained from the terrain.
- Manning's average n-value - weighted n-value of the floodplain along the stream determined from aerial imagery
- Index flow - determines the celerity of the routed flows. The HEC-HMS technical reference manual suggests using an index flow of approximately half the peak discharge.
- 8-point cross section - Eight station/elevation points representing the general cross section for the tributary

2.2.7 Rainfall

The Atlas 14, Volume 11 rainfall data, released by NOAA in 2018, represents the best available design rainfall data for Texas. It shows significant increase in rainfall depths across the Texas region compared with previous precipitation data.

To best represent NOAA Atlas 14 rainfall, the average rainfall depth was calculated across each basin based on the NOAA Atlas 14 partial-duration precipitation frequency rasters. **Table 8** and **Figure 7** show the resulting recommended 1%-ACE, 24-hour rainfall depths for each basin. Existing conditions models included rainfall data for a range of storms 50%, 20%, 10%, 4%, 2%, 1% and 0.2% ACE events. The storm duration, intensity duration and intensity position were set to 1 day, 5 minutes and 67 percent, respectively based on HCFCD criteria. The Atlas 14 rainfall utilized was based on the respective watershed and not the entire SJR basin. Specific information relating to the rainfall depths per basin is provided in **Appendix D**.

Table 8. Specific Atlas 14 Rainfall Depths by Watershed

Watershed	**NOAA Atlas 14 24 Hour Depth (in)**						
	50% ACE	20% ACE	10% ACE	4% ACE	2% ACE	1% ACE	0.2% ACE
San Jacinto River – Entire Basin	4.77	6.41	8.05	10.60	12.90	15.56	23.06
West Fork San Jacinto River-Conroe Lake	4.59	6.12	7.65	10.02	12.14	13.98	21.56
Caney Creek-Lake Creek	4.55	6.06	7.59	9.98	12.14	4.66	21.75
Crystal Creek-West Fork San Jacinto River	4.91	6.65	8.39	11.12	13.59	16.46	24.39
Frontal Lake Houston	5.20	7.06	8.91	11.79	14.36	17.37	25.98
Little Cypress Creek-Cypress Creek	4.83	6.50	8.21	10.89	13.33	16.18	24.00
Walnut Creek-Spring Creek	4.76	6.39	8.08	10.73	13.18	16.04	23.99
Peach Creek-Caney Creek	4.91	6.64	8.35	11.02	13.40	16.17	23.91
Tarkington Bayou-Luce Bayou	5.06	6.88	8.69	11.51	14.03	16.97	25.56
Winters Bayou-East Fork San Jacinto River	4.69	6.27	7.80	10.14	12.20	14.56	21.28
East Fork San Jacinto River – Frontal Lake	5.06	6.88	8.70	11.53	14.07	17.03	25.50

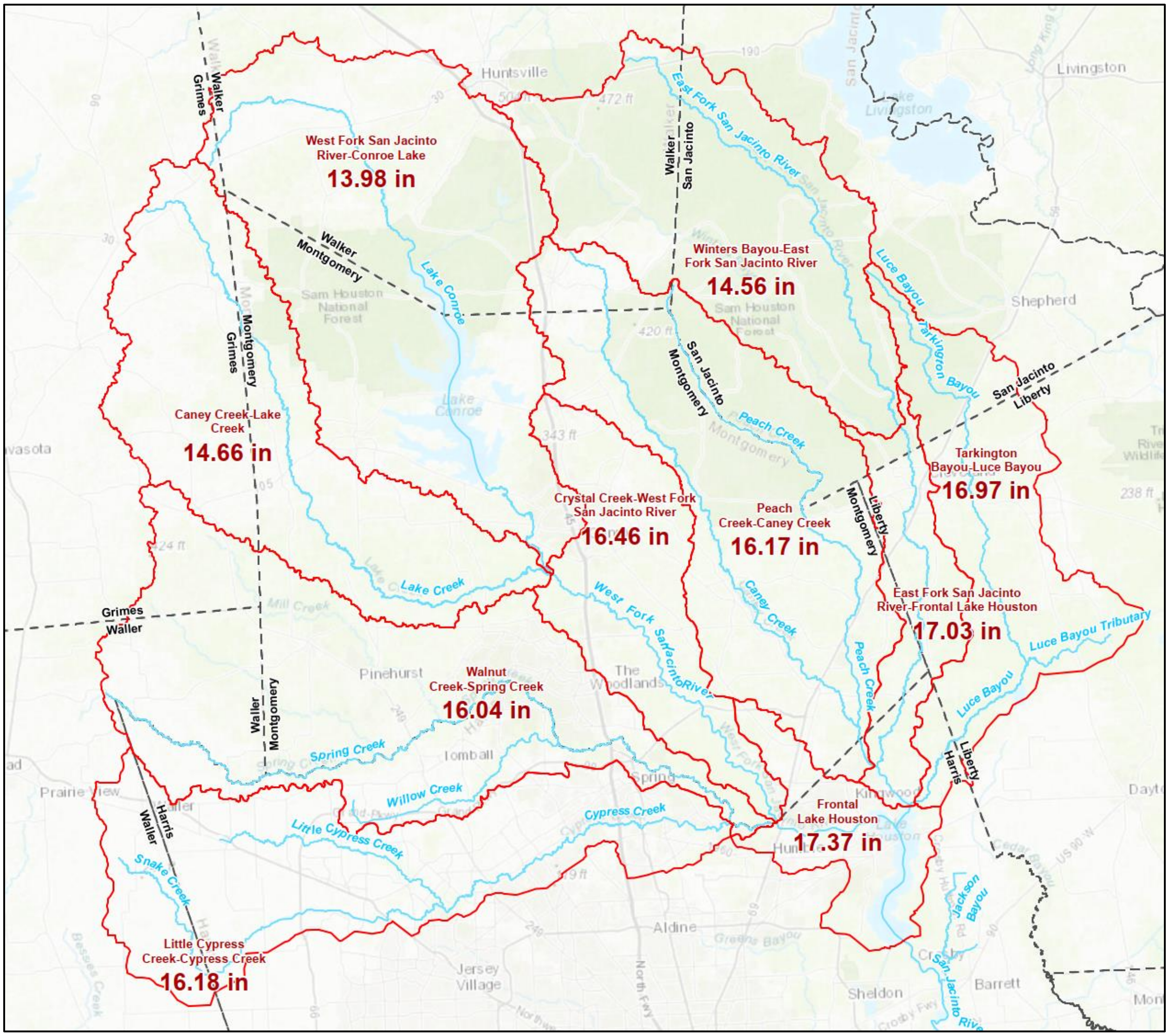


Figure 7. Atlas 14 Rainfall Depths by Watershed

2.2.8 HEC-HMS Model Development

A new hydrologic model was developed for Caney Creek, Peach Creek, Lake Creek, Luce Bayou, EFSJR and WFSJR in HEC-HMS v4.3 to simulate runoff for existing conditions. Computational methods used in the HEC-HMS model were selected based on HCFCD H&H Guidance Manual. The subbasins used the Initial and Constant loss method and the Clark Unit Hydrograph transform method. Routing reaches between subbasins used the Muskingum-Cunge method. Input parameters for each subbasin required for the Clark Unit Hydrograph are the time of concentration Tc, and storage coefficient R. Each model run combines a basin model, meteorological model, and control specifications.

3.0 Flood Hazard Assessment

The flood hazard assessment includes estimating the extent and frequency of flooding for each of the major streams. Hydraulic models were updated or developed to assess the existing flood hazard for each stream. The models provided information to identify flood risks along the studied streams and to develop inundation data sufficient for local communities to utilize when updating their Hazard Mitigation Plans. All hydraulic models were created or updated to HEC-RAS version 5.0.7, the latest version released by the USACE. Current FEMA effective models for the streams located in Harris County were converted from a steady flow analysis to an unsteady flow analysis. The conversion for these models involved incorporating updated topography, new cross section alignments, and additional bridge and culvert crossings. New models were created for the remaining streams which involved development of new stream centerlines, cross sections, Manning's roughness values, and boundary conditions. These new models were also analyzed under unsteady conditions. The new, developed cross sections and the utilized Manning's roughness parameters are show in **Exhibit C8** and **Exhibit C9**, respectively.

3.1 Flood Hazard Model Conversion

The HCFCD maintains the FEMA effective models for Spring Creek, Willow Creek, Little Cypress Creek, Cypress Creek, and Jackson Bayou. Each of these models is maintained in HEC-RAS v. 3.0.1. The effective models were updated to HEC-RAS v 5.0.7 and converted to an unsteady flow analysis for each storm event. In general, the unsteady conversion consisted of applying flow boundary conditions at the respective cross sections, assigning HTab parameters, adding pilot channels as necessary for stability, updating the bridge modeling methods, and changing the ineffective area assignments.

Bridge modeling methods were adjusted to achieve model stability and model the headloss through bridge structures. For unstable bridges, only the energy method was selected for low flows while for high flows energy or pressure/weir methods were chosen if the bridge was overtopped. Ineffective areas were also adjusted in cross sections bounding structures to provide stability to the model which consisted of "stepping" the ineffective areas to gradually increase the conveyance at the structure. Ineffective areas were also removed in areas that were deemed unnecessary based on the terrain. Interpolated cross sections were added to better capture the water surface elevations occurring at structures and to reduce instabilities in the model. The sections below describe the specific model changes for each of the converted watersheds.

3.1.1 Spring Creek (J100-00-00)

Flow boundary conditions were assigned based on the basin delineations within Spring Creek and the tributaries outfalling into Spring Creek. Drainage basins within Spring Creek were assigned a uniform lateral inflow while tributary flows were assigned as lateral inflows. A baseflow of 30 cfs was added to the upstream flow boundary for each storm event. HTab parameters were assigned to each structure for the headwater elevation, tailwater elevation and maximum discharge. HTab parameters for the cross sections were set to minimum elevations at increments of 0.1 – 0.15 and a number of points ranging from 450 – 500. Pilot channels were added in several areas of Spring Creek to improve stability in the model and consisted of 1-foot channels sloped from the U/S to the D/S channel invert with a roughness value assigned based on the respective channel N value.

3.1.2 Willow Creek (M100-00-00)

Flow boundary conditions were assigned based on the basin delineations within Willow Creek and the tributaries outfalling into Willow Creek. Drainage basins within Willow Creek were assigned a uniform lateral inflow while tributary flows were assigned as lateral inflows. A baseflow of 100 cfs was added to the upstream flow boundary for each storm event. HTab parameters were assigned to each structure for the headwater elevation, tailwater elevation and maximum discharge. HTab parameters for the cross sections were set to minimum elevations at increments of 0.1 and a number of points ranging from 100 – 300. Pilot channels were added in several areas of Willow Creek to improve stability in the model and consisted of 1-foot channels sloped from the U/S to the D/S channel invert with a roughness value assigned based on the respective channel N value.

3.1.3 Cypress Creek (K100-00-00)

An existing HEC-RAS version 4.1 steady-state hydraulic model was utilized as the base model for Cypress Creek. The hydraulic model was based on the original steady-state model geometry data, with only minor changes made to the geometry in order to allow the unsteady model to run. Lateral structures were added to represent the Cypress Creek overflow which allow flow to leave the system at the southern boundary.

3.1.4 Little Cypress Creek (L100-00-00)

An existing HEC-RAS version 5.0 unsteady hydraulic model developed by HCFCD for the Little Cypress Frontier Program was utilized as the base model for Little Cypress Creek. The model was converted to a version 5.0.7. Ineffective flow areas were adjusted throughout the model for stability issues with the newer version of HEC-RAS.

3.1.5 Jackson Bayou (R100-00-00) and Gum Gully (R102-00-00)

Flow boundaries were assigned based on the basin delineations within Jackson Bayou and Gum Gully and their receiving tributaries. Drainage basins within each stream were assigned a uniform lateral inflow while tributary flows were assigned as lateral inflows. A baseflow of 15 cfs was added to the upstream flow boundary for both Jackson Bayou and Gum Gully for each storm event.

HTab parameters were assigned to each structure for the headwater elevation, tailwater elevation and maximum discharge. HTab parameters for the cross sections were set to minimum elevations at increments of 0.1 and a number of points ranging from 100 – 300. Pilot channels were added in several areas of Willow Creek to improve stability in the model and consisted of 1-foot channels sloped from the U/S to the D/S channel invert with a roughness value assigned based on the respective channel N value.

3.2 New Flood Hazard Model Development

New hydraulic models were developed for Lake Creek, West Fork San Jacinto River, Caney Creek, Peach Creek, East Fork San Jacinto River, and Luce Bayou/Tarkington Bayou. Hydraulic model components were developed using ArcGIS software, specifically the HEC-GeoRAS toolset. HEC-GeoRAS is a tool in ArcMap where hydraulic features can be created in GIS and imported directly into HEC-RAS. GeoRAS was used to create stream centerlines, cross sections, flow paths, bank stations and roughness values.

3.2.1 Stream Centerlines

Stream centerlines represent the approximate alignment of the channel along the channel invert and are used to assign stationing for cross sections. Stream centerlines were drawn in ArcGIS along the thalweg for each stream. The HGAC 2018 LiDAR was utilized to determine placement of the centerline which was drawn from upstream to downstream. The extents of the stream centerlines were from the lower limits of the upstream drainage basin to the confluence with another stream or at the downstream end of the San Jacinto River. Once stream centerlines were drawn, river and reach names were assigned to each feature and the GeoRAS tools were used to determine the topology and length/stationing.

3.2.2 Cross Sections

Cross sections consist of station-elevation data extracted from the terrain along a line drawn across the channel and extending into the overbanks. Cross sections provide the model with information about the shape and dimensions of the channel and adjacent overbank areas which are used by HEC-RAS for hydraulic calculations. Cross sections were drawn in ArcGIS perpendicular to the respective stream centerline and topography to correctly model the available cross-sectional area for flow conveyance within the river.

Placement of cross sections followed HCFCD guidelines[7] of approximately 1,000 feet of spacing to provide sufficient detail in the model. Bends in the cross sections were minimized to two or less, except in special areas where tributary confluences and structures were located. Cross sections were placed close to one another at structures to accurately model the contraction and expansion losses. GeoRAS tools were used to assign a river reach, stationing, bank stations, reach lengths and to extract station elevation data from the provided terrain.

3.2.3 Flow Path Centerlines

Flow path centerlines determine the reach lengths between cross sections for both the channel and left and right overbanks. Flow paths were drawn along the stream centerline parallel to the direction of flow for both the channel and overbanks. The flow path centerlines followed HCFCD guidelines[7] in that flow paths were drawn along the centroid of each flow regime. Flow paths for the channel were drawn along the stream centerline and about one-third of the distance between the stream centerline and floodplain fringe for the overbank flow paths. After the flow path centerlines were created for the particular stream, each centerline was assigned either left overbank, right overbank, or channel depending on placement and was used to determine the reach lengths for cross sections using the GeoRAS toolset.

3.2.4 Bank Stations

Bank stations are used to classify the channel and overbanks in a given cross section and to assign changes in Manning's n values. A two-step process was performed to assign bank stations for each cross section. First, bank lines were drawn in GIS to follow along the terrain break between the channel and overbank and were assigned to each cross section using the GeoRAS toolset. Second, cross sections with the bank points from the first step were then imported into HEC-RAS and were adjusted manually for each

[7] HCFCD Unsteady Modeling Guidelines – Draft (2018)

cross section using the graphical cross section editor. The second step was done to ensure the banks were placed appropriately within the cross sections as to accurately capture the channel of the stream.

3.2.5 Manning's N Values

Manning's n values were assigned to each cross section based off the land use from the aerial imagery and documentation of Manning's n values for each land use. A shapefile of land use was derived from the 2018 HGAC Land Cover Dataset and was used to assign Manning's n values. Since the shapefile consisted of detailed data covering a large geographic area, focus was given to simplifying the number of Manning's n value categories. Then the Manning's n values were spatially extracted into each cross section. Channel Manning's n values were assigned in HEC-RAS between bank stations with a uniform value of 0.04 for each stream with the exception of 0.02 for areas with backwater such as Lake Houston and the Galveston Bay. A table of Manning's N values used in the hydraulic models is shown below in **Table 9**. These values were further adjusted in the calibration process as discussed in **Appendix D**.

Table 9: Manning's N Values

Land Classification	Manning's N Value
Open Water	0.02
Channel	0.04
Pasture/Grasslands	0.05
Forest	0.10
Low/Medium Intensity Development	0.12
High Intensity Development	0.15

3.2.6 HTab Parameters

Hydraulic table (HTab) parameters are used in HEC-RAS to establish a table of elevations versus hydraulic properties of cross sections and structures. The properties include flow areas, conveyance, and storage and computed by the geometry pre-processor. During an unsteady analysis, the model determines water surface elevations based off curves relating these hydraulic properties and discharges. For cross sections, three variables can be adjusted for the HTab parameters and include:

- Starting Elevation is the first elevation in the HTab table and was set to the invert of the channel.
- Increments determine the spacing of each point in the Htab curve and can be used to provide greater detail for the hydraulic properties. For this study, increments of 0.1 feet and 0.15 feet were used to capture sufficient detail from the cross sections.
- The number of points should be set to encompass the maximum water surface elevation to not allow the model to extrapolate above the parameter curves set. Points were established to be set just above the maximum 0.2% ACE water surface elevation to avoid extrapolation.

For structures, HTab parameters are similar with the exception of the introduction of free flow and submerged curves and the ability to establish maximum headwaters, tailwaters, and discharges.

- The free flow curve assumes no influence from tailwater while the submerged curves utilize multiple tailwaters to determine headwaters.
- The number of points on the free flow curve and submerged curves can be adjusted to a maximum of 100 and 50 respectively while the number of submerged curves can be adjusted to a maximum of 60. For this study, the number of points and submerged curves were adjusted accordingly where needed.
- The maximum headwaters, tailwaters, and discharges refines the curves by setting limits allowing for greater detail at the structure. The maximums were adjusted accordingly for each structure in the study to capture sufficient detail in the HTab curves.

3.2.7 Obstructions

Obstructions are utilized in HEC-RAS to block flow passing through a specific area within a cross section. As a result, the area blocked is not included in the conveyance calculations. Obstructions were used to block out areas such as ponds and parallel tributaries as to not overcount storage and conveyance capacity within the model. Aerial imagery and the terrain dataset were used to determine where to place obstructions. Obstructions were applied in HEC-RAS by assigning stations and elevations within each cross section.

3.2.8 Ineffective Areas

Ineffective areas are used in HEC-RAS to either temporary or permanently block conveyance in specified portions of cross sections. Ineffective areas were used to model the bridge contractions and expansions as well as sand pits located along the banks of several streams within the study area. The ineffective areas for bridges followed HCFCD guidance[8] and were placed at a 1:1 and 2:1 (distance: width) ratio on both sides of the bridge or culvert opening for the contraction and expansion, respectively.

Permanent ineffective areas were used to model the sand pits and were placed at the top elevation and the width of the sand pits. The assumption was that water fills into the sand pits but that area of the cross section cannot convey flow since the pit is not connected back into the stream.

3.2.9 Boundary Conditions

Boundary conditions were set up in the model to simulate runoff from the drainage basins and to establish a downstream condition for flow to leave the model. For the first cross section, a flow boundary was applied to represent the runoff from the most upstream drainage basin. Uniform lateral inflow hydrographs were used to introduce subbasin flows within the reach where the terrain indicated a need to distribute the flow across a range of cross sections. Tributary flows were modeled using a lateral inflow hydrograph, which applies flow at a single cross section acting as a point discharge rather than uniformly distributing flow along the reach.

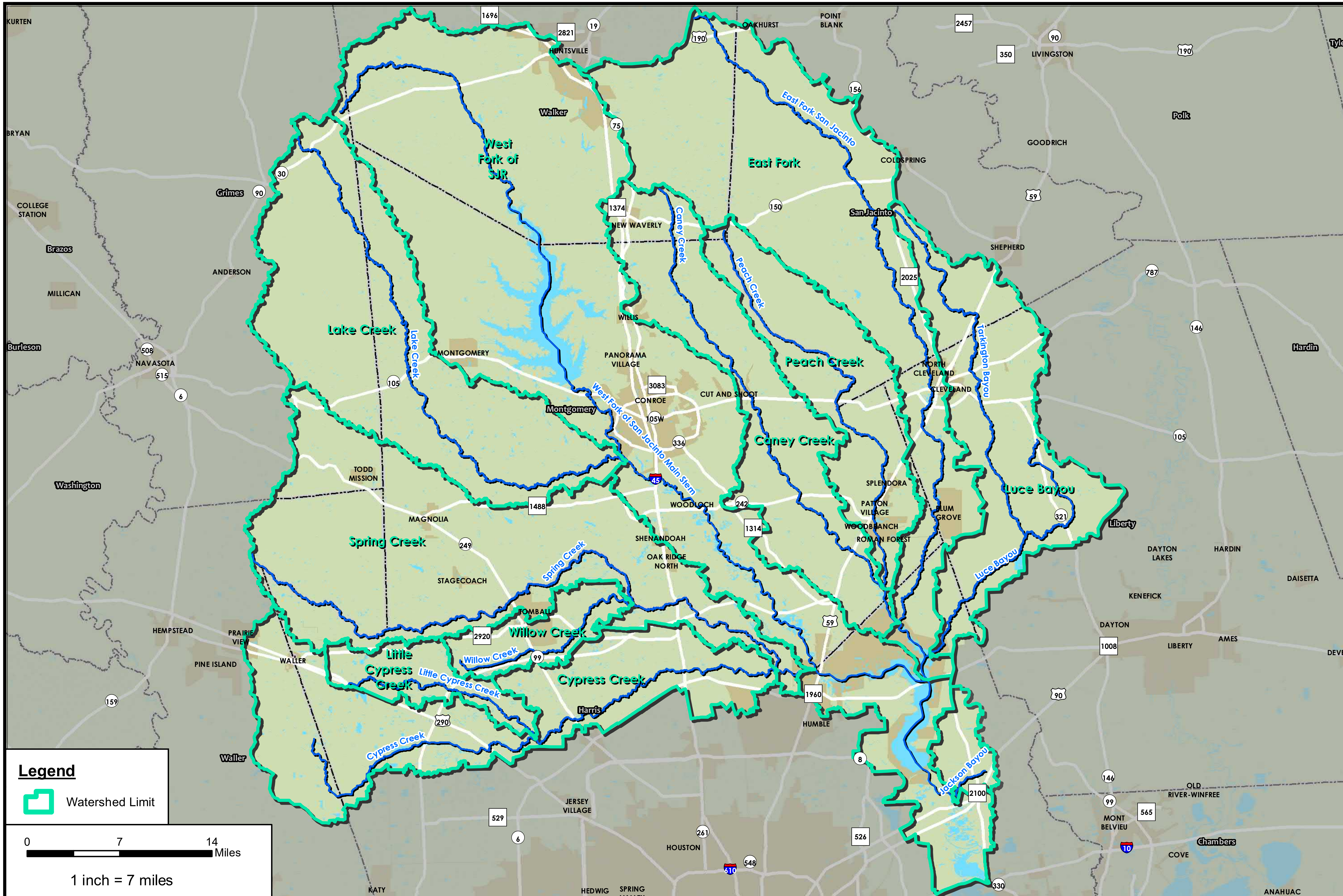
[8] HCFCD Unsteady Modeling Guidelines – Draft (2018)

3.2.10 HEC-RAS Model Development

A new project was established for each reach in HEC-RAS v. 5.0.7 to model the unsteady flow conditions for each storm event. After the model components were developed in HEC-GeoRAS, the data was imported in the geometry editor within HEC-RAS.

For an unsteady flow analysis, models are built piecewise starting with only the cross sections first then adding structures from downstream to upstream along with additional model components such as ineffective areas and obstructions. The process singles out areas of instability if they arise and makes it easier to address these issues within the model. After the river reach with only cross sections is stabilized, the first downstream structure can be added. Once the first structure is stabilized, each subsequent structure is added starting from downstream to upstream until the entire model with structures is stabilized. After the model completely runs with structures, other components can be added such as ineffective areas and blocked obstructions in a similar manner.

Once the models were developed, they were combined into one comprehensive model for the entire watershed and calibrated to historical storm events. The calibration and resultant existing conditions discharges and elevations are discussed in **Appendix D.**



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FtUS

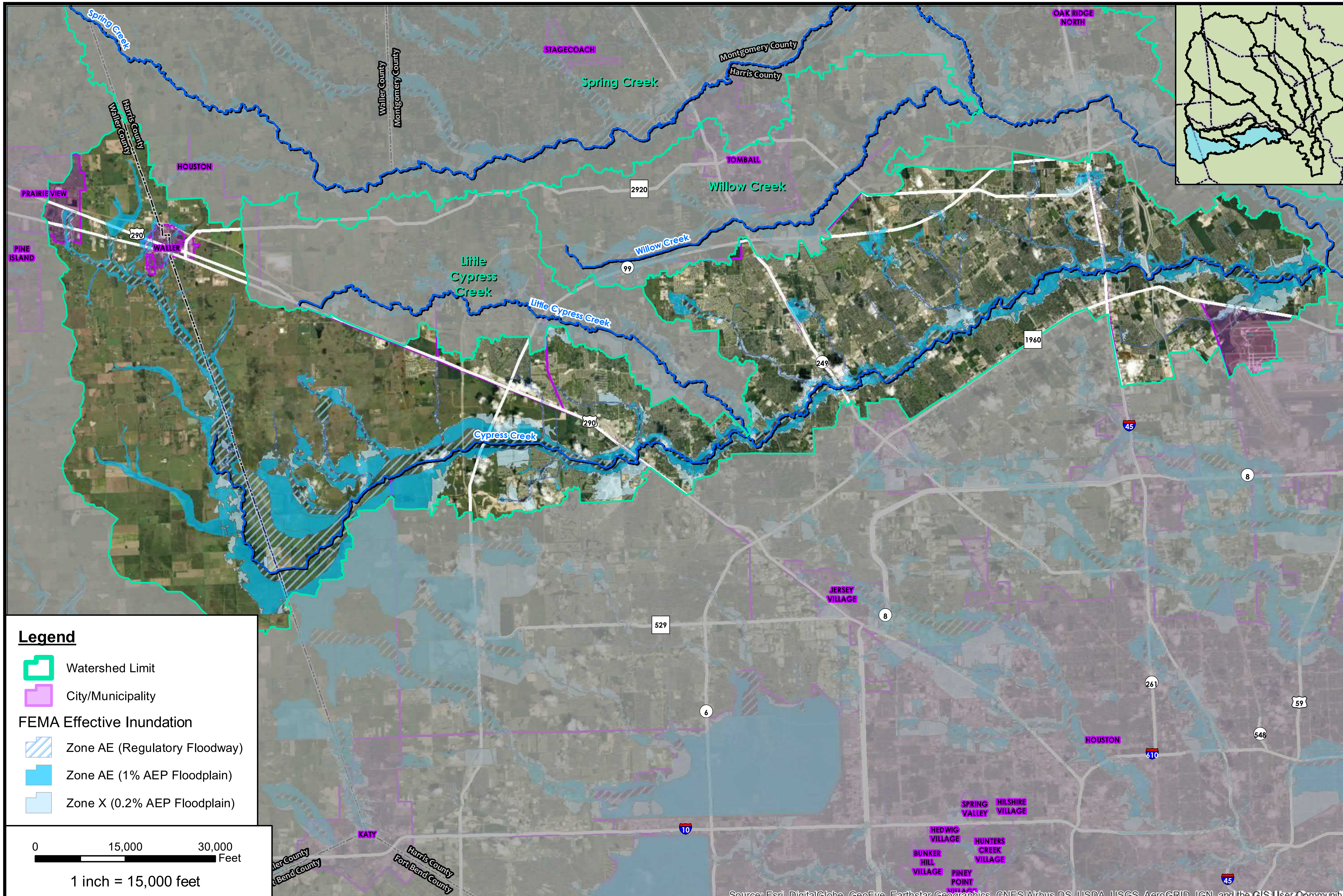
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

VICINITY MAP

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C1



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DATUM & COORDINATE SYSTEM

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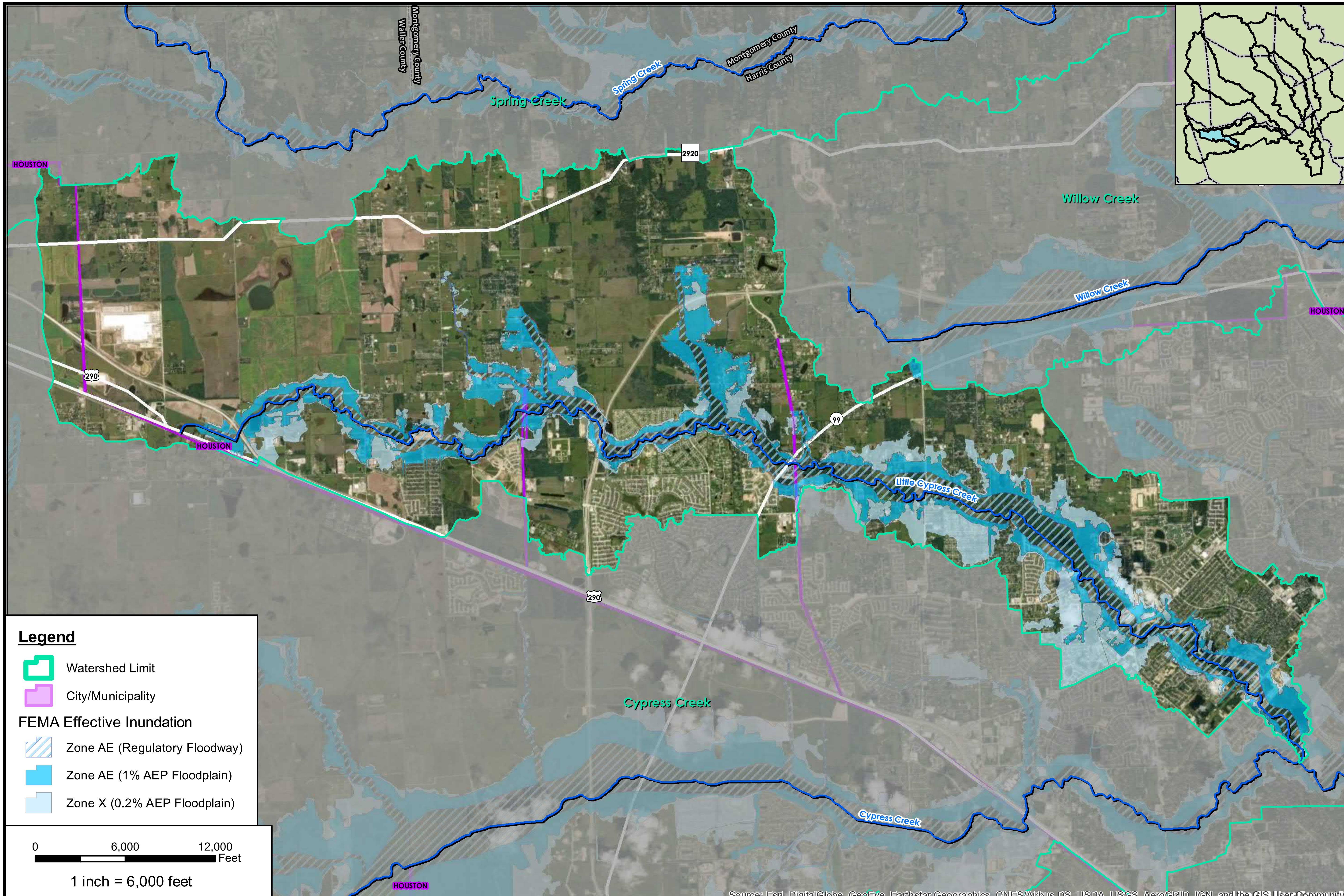
HARRIS COUNTY FLOOD CONTROL DISTRICT

Upper San Jacinto Regional Watershed Master Drainage Plan

FEMA Effective FIRM | CYPRESS CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C2-A



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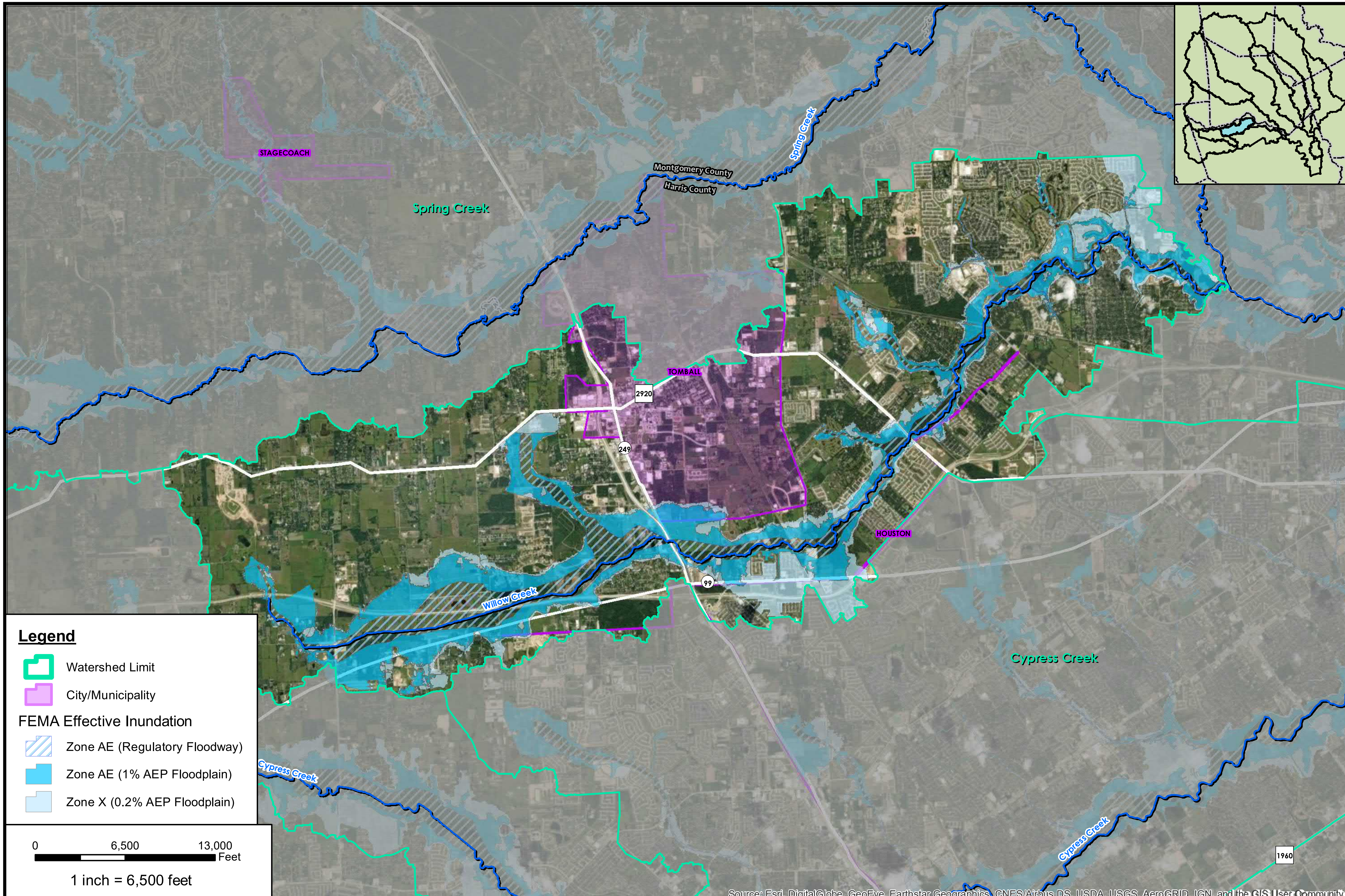
HARRIS COUNTY FLOOD CONTROL DISTRICT
Upper San Jacinto Regional Watershed Master Drainage Plan

FEMA Effective FIRM | LITTLE CYPRESS CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C2-B



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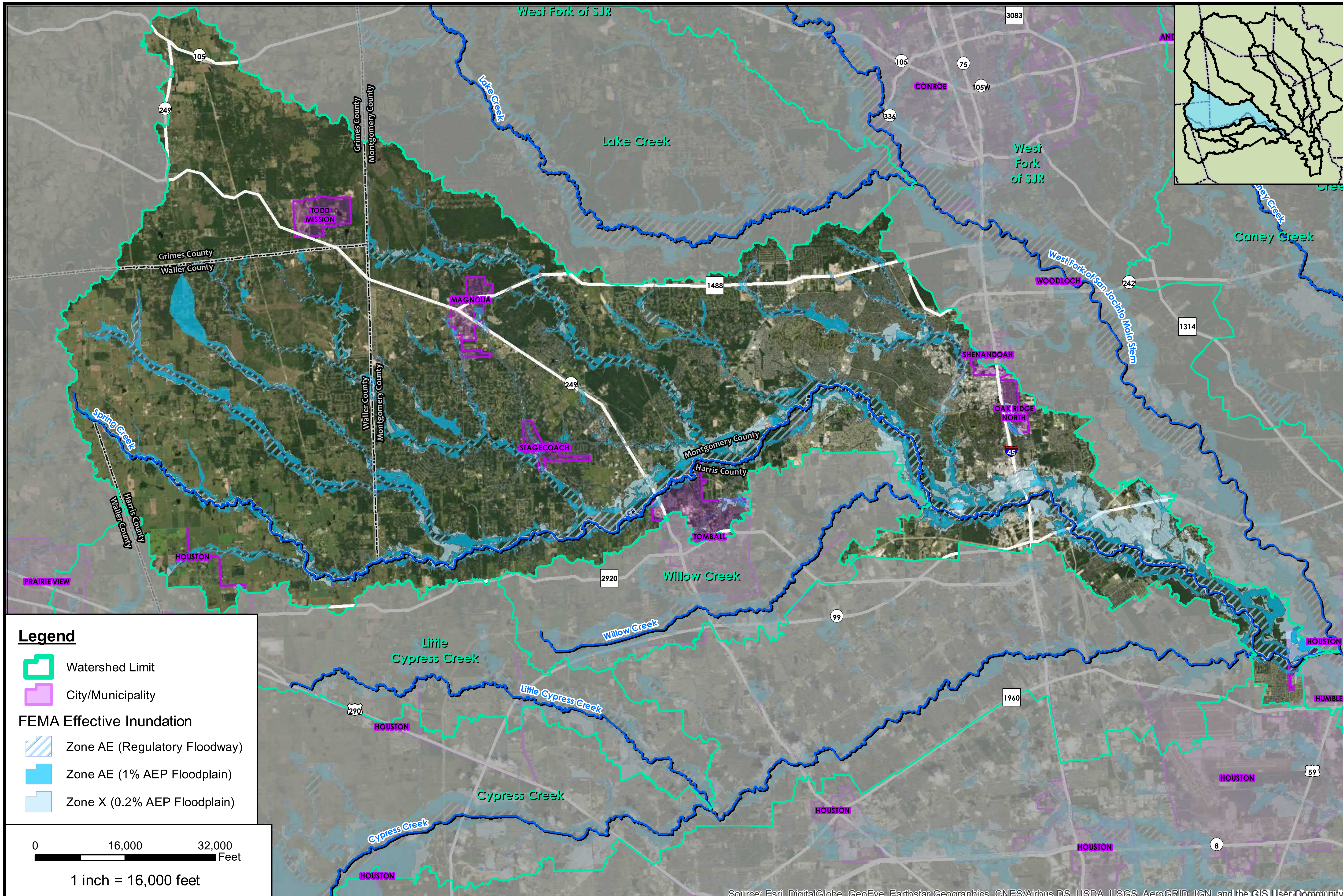
HARRIS COUNTY FLOOD CONTROL DISTRICT
Upper San Jacinto Regional Watershed Master Drainage Plan

FEMA Effective FIRM | WILLOW CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C2-C



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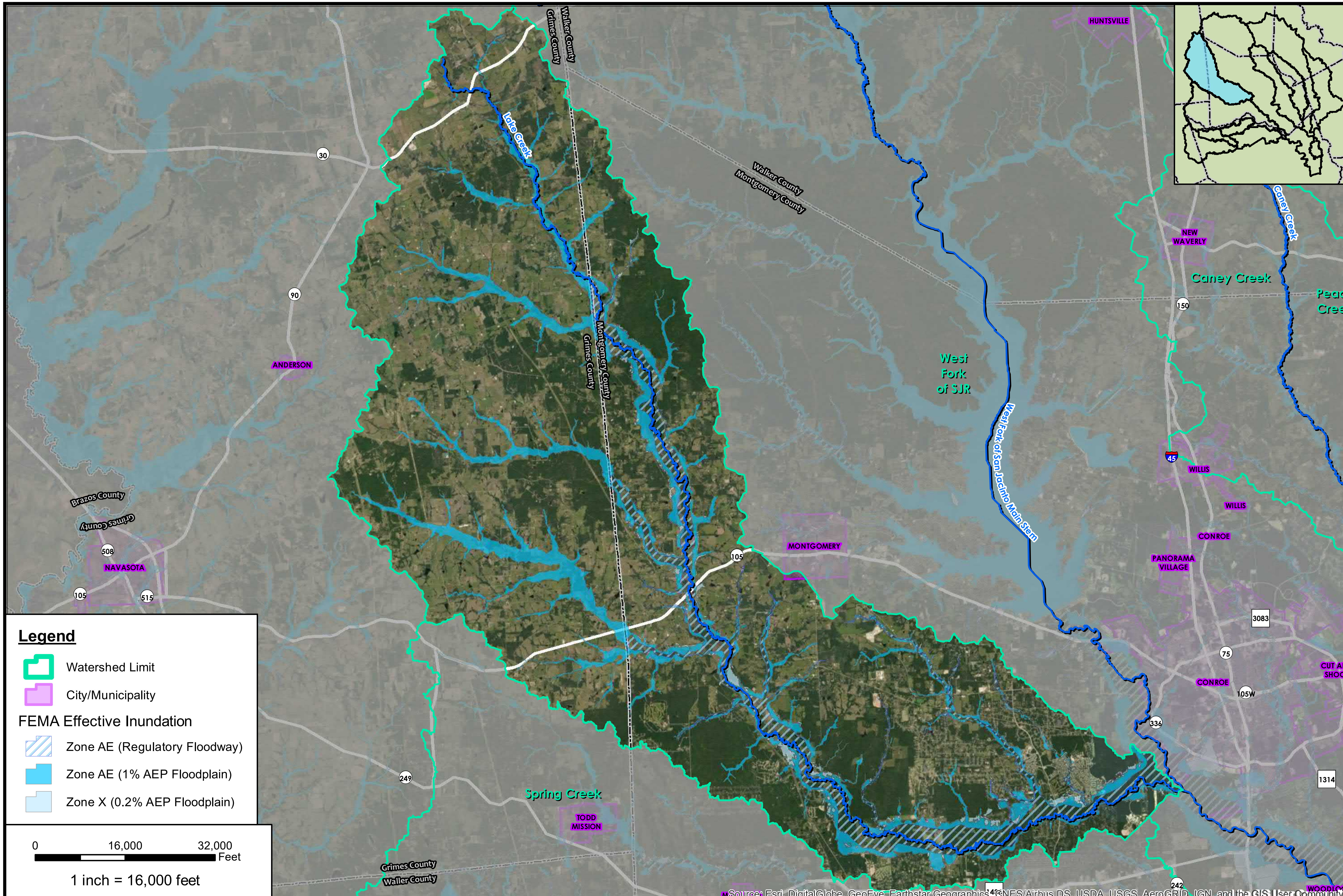
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

FEMA Effective FIRM | SPRING CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C2-D



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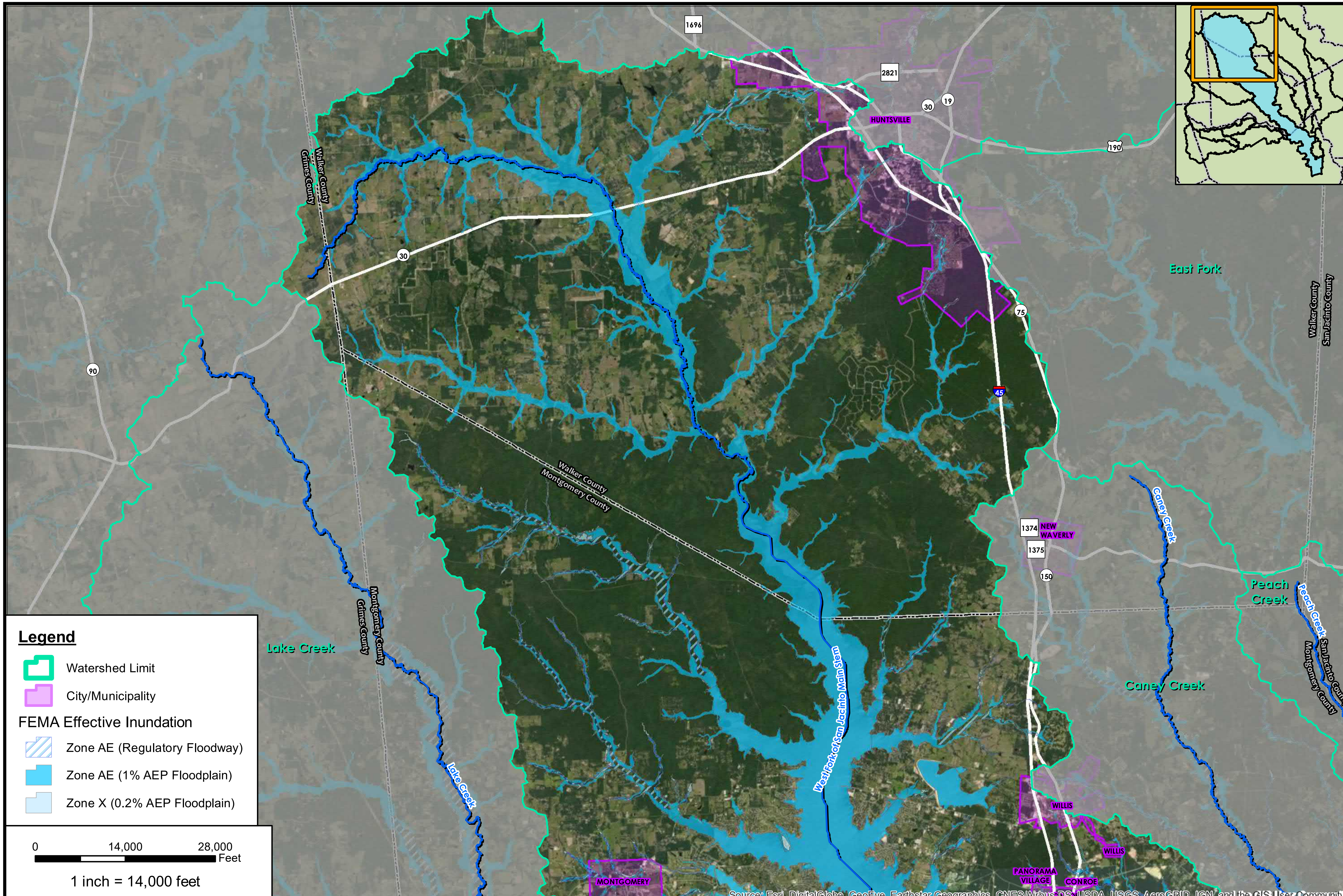
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

FEMA Effective FIRM | LAKE CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C2-E



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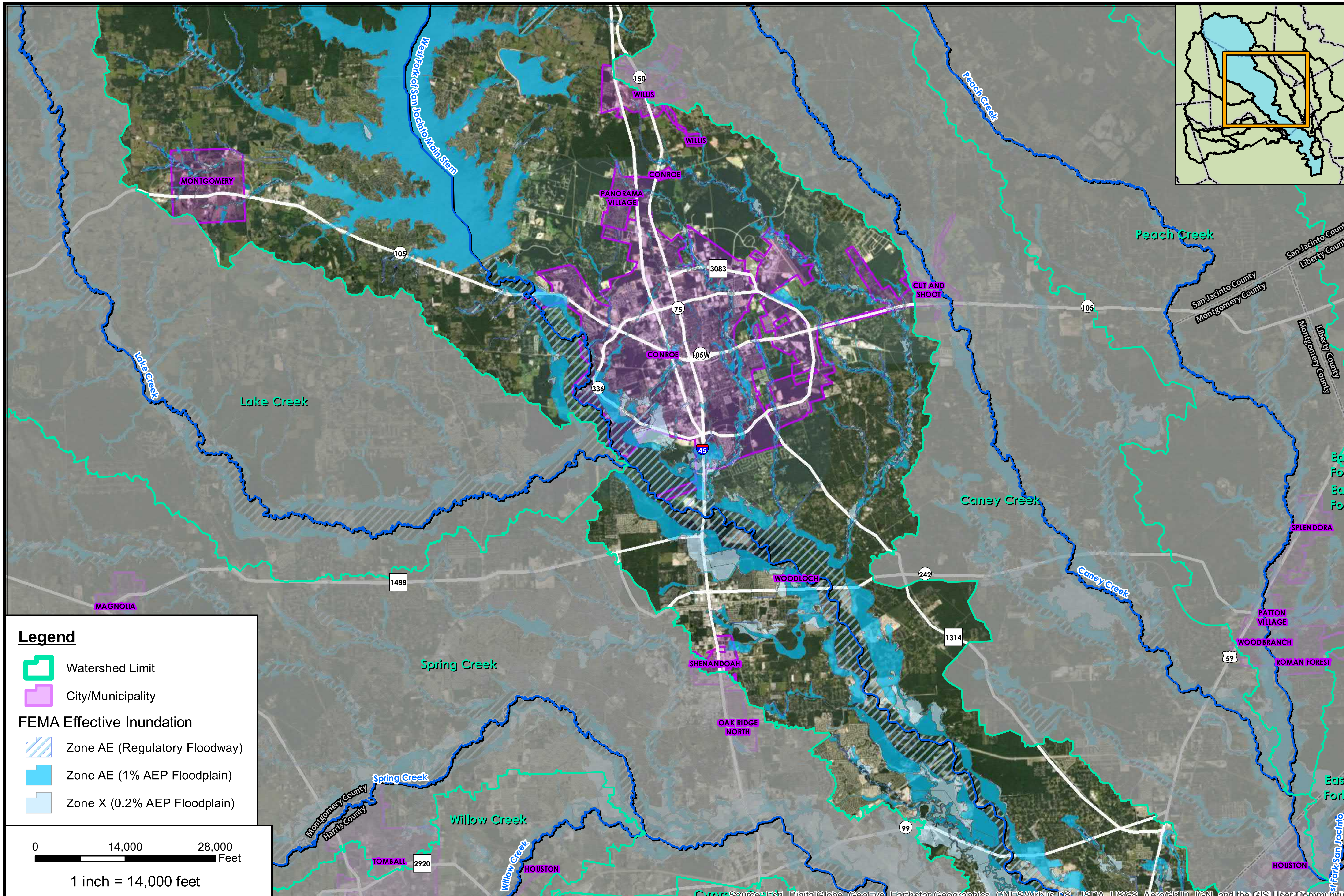
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

FEMA Effective FIRM | WEST FORK SAN JACINTO (UPSTREAM PORTION)

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C2-F



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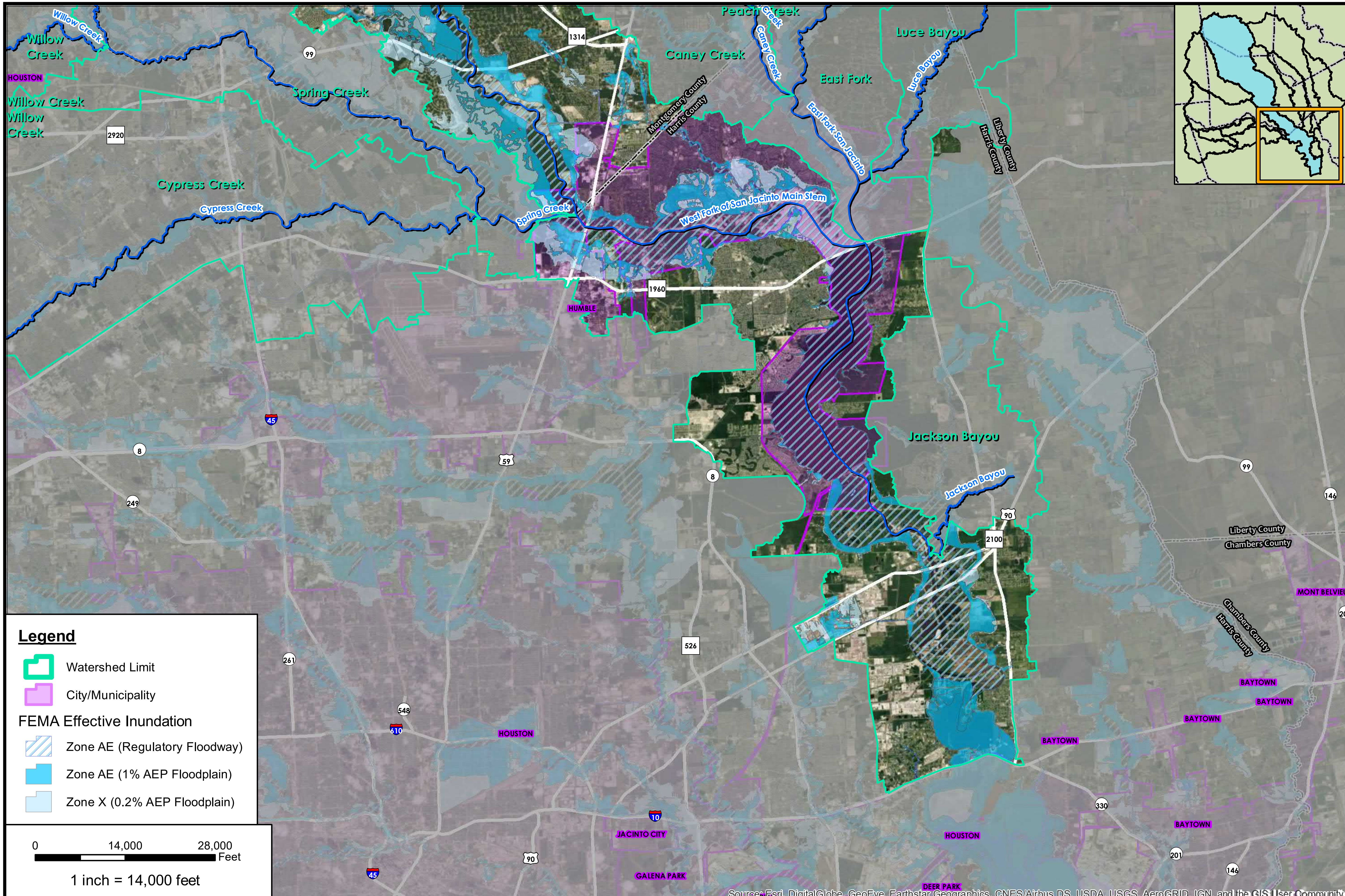
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

FEMA Effective FIRM | WEST FORK SAN JACINTO (CONROE PORTION)

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C2-G



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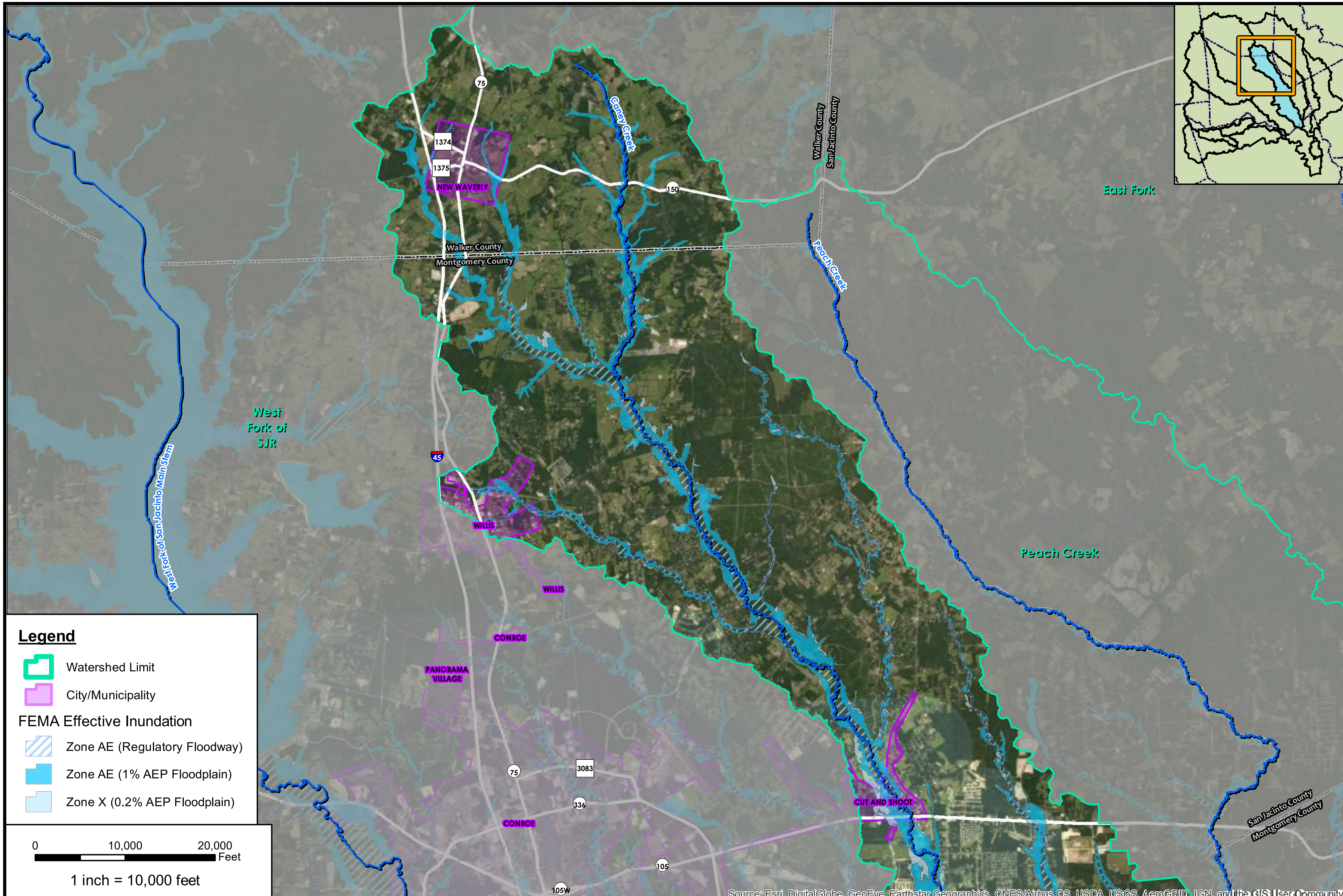
HARRIS COUNTY FLOOD CONTROL DISTRICT
San Jacinto Regional Watershed Master Drainage Plan

FEMA Effective FIRM | WEST FORK SAN JACINTO (DOWNSTREAM PORTION)

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C2-H



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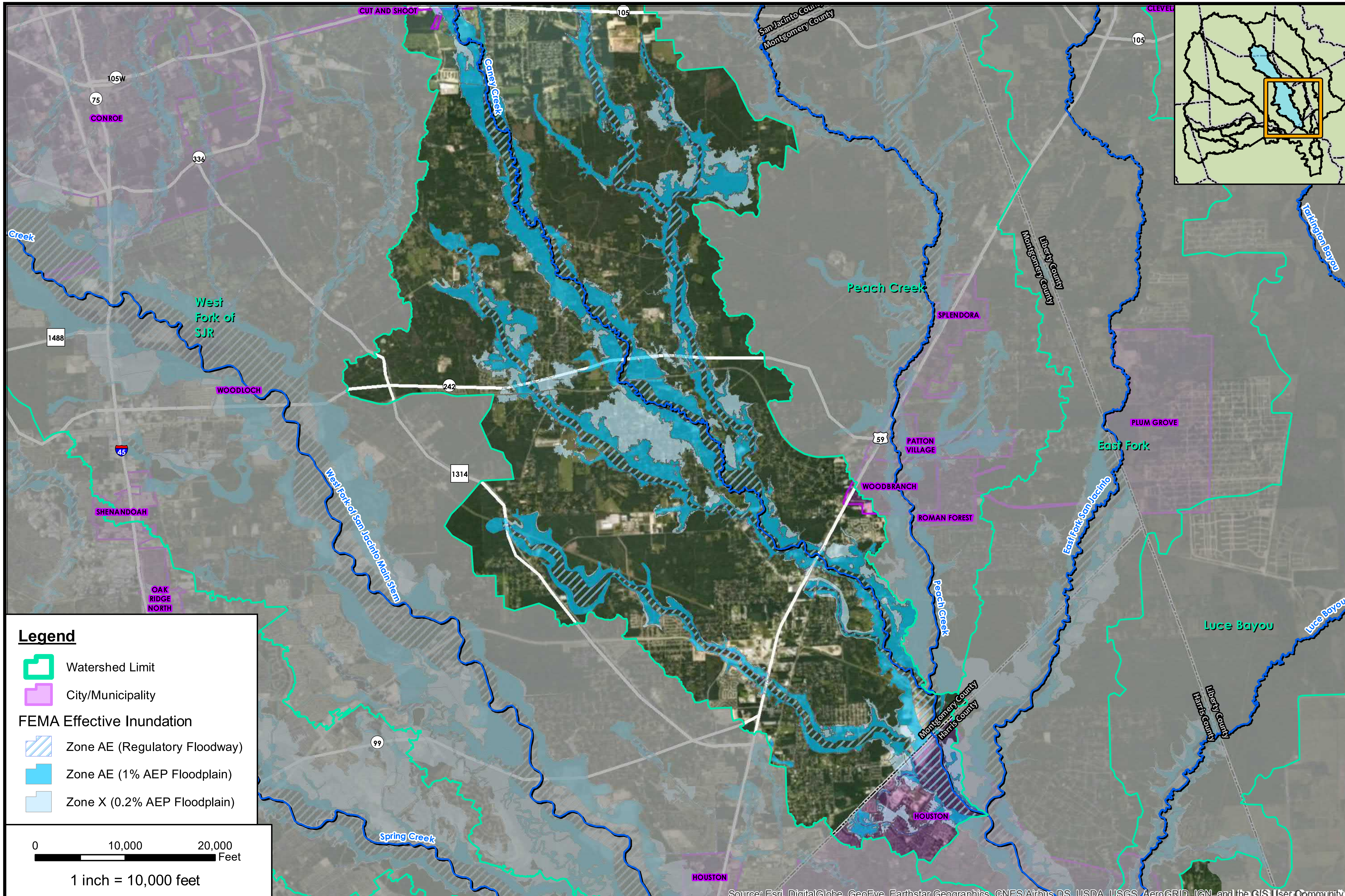
HARRIS COUNTY FLOOD CONTROL DISTRICT
San Jacinto Regional Watershed Master Drainage Plan

FEMA Effective FIRM |
CANEY CREEK (UPSTREAM PORTION)

Exhibit C2-I



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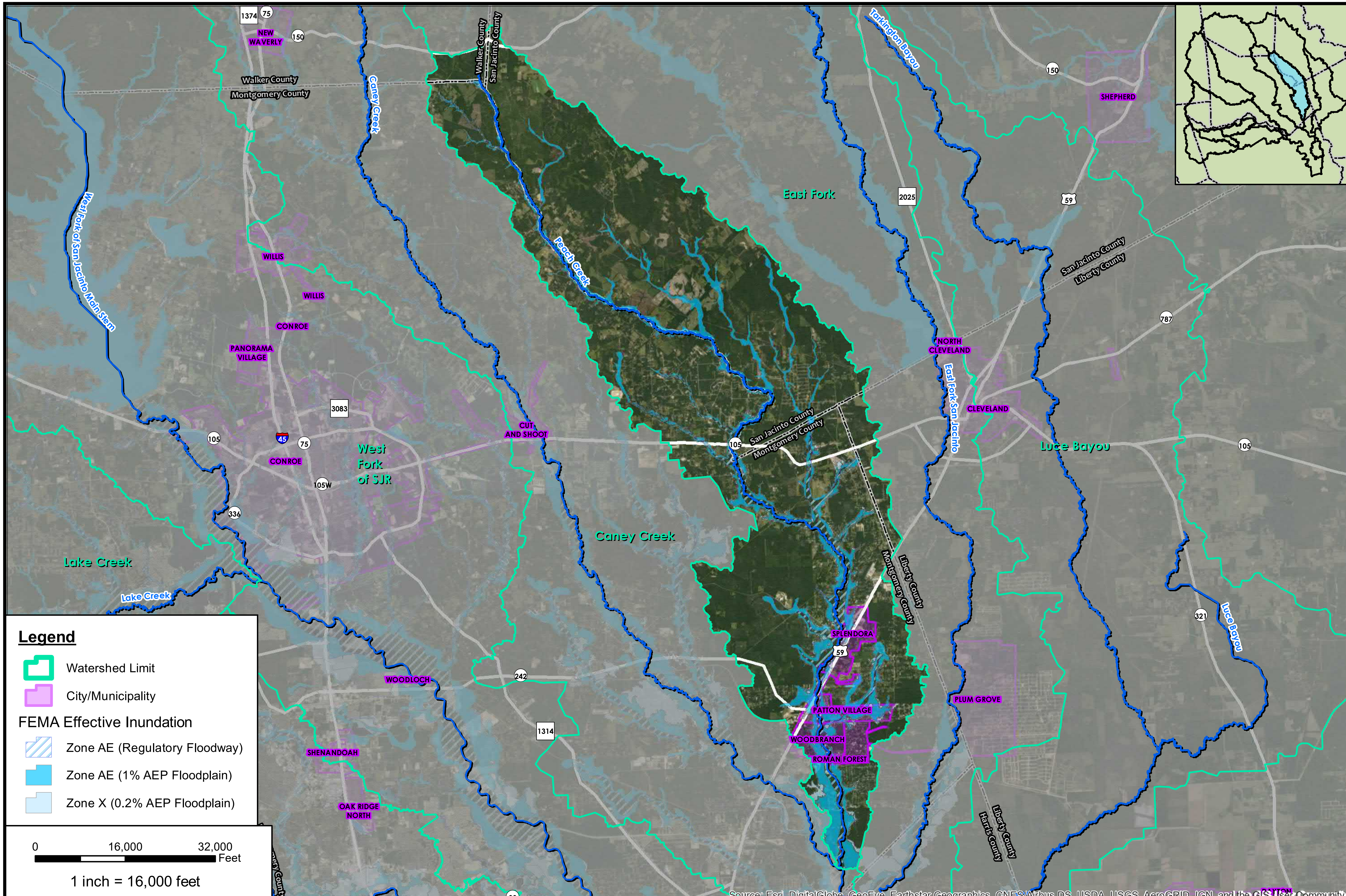
FEMA Effective FIRM | CANEY CREEK (DOWNSTREAM PORTION)

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C2-J



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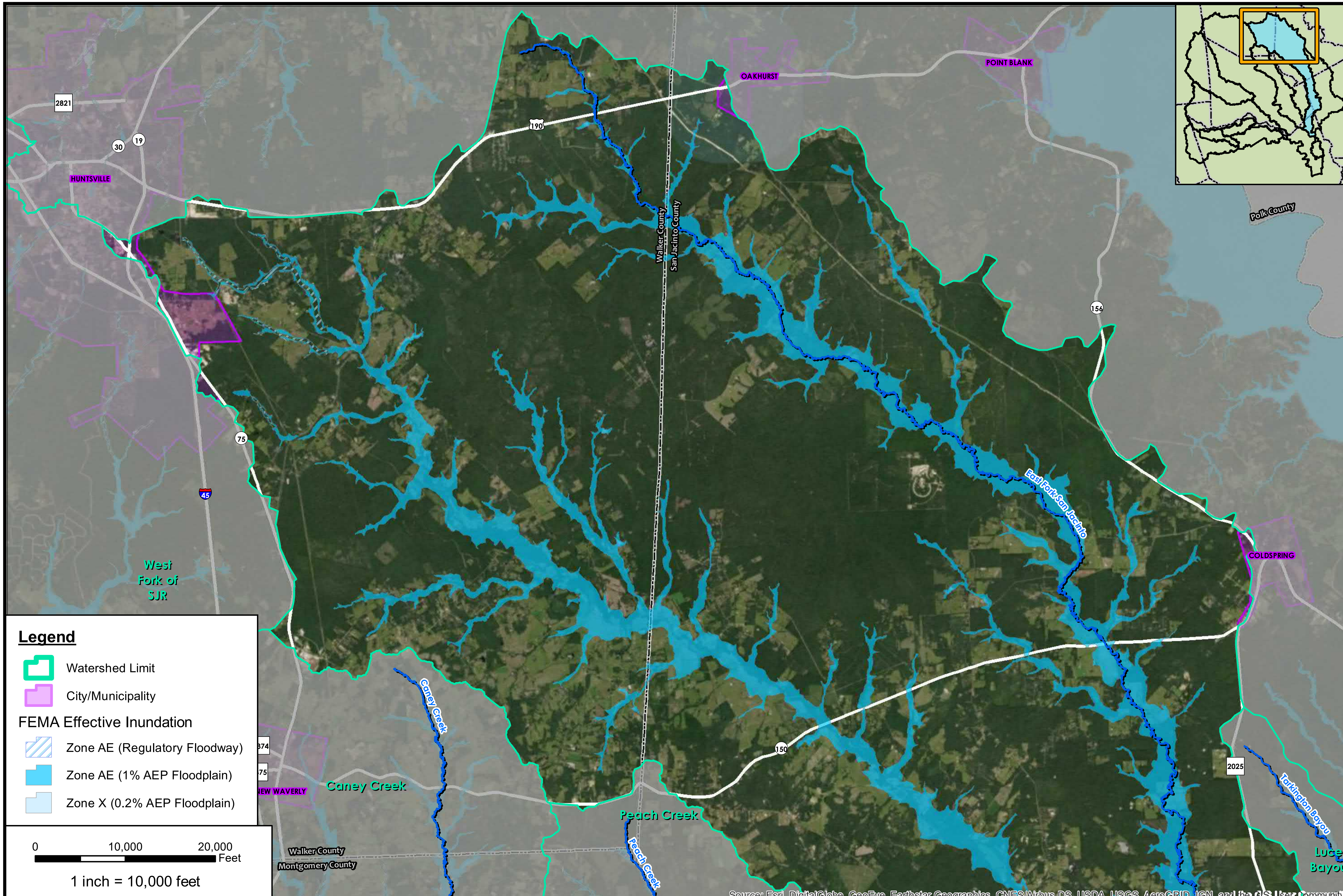
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

FEMA Effective FIRM | PEACH CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C2-K



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HARRIS COUNTY FLOOD CONTROL DISTRICT

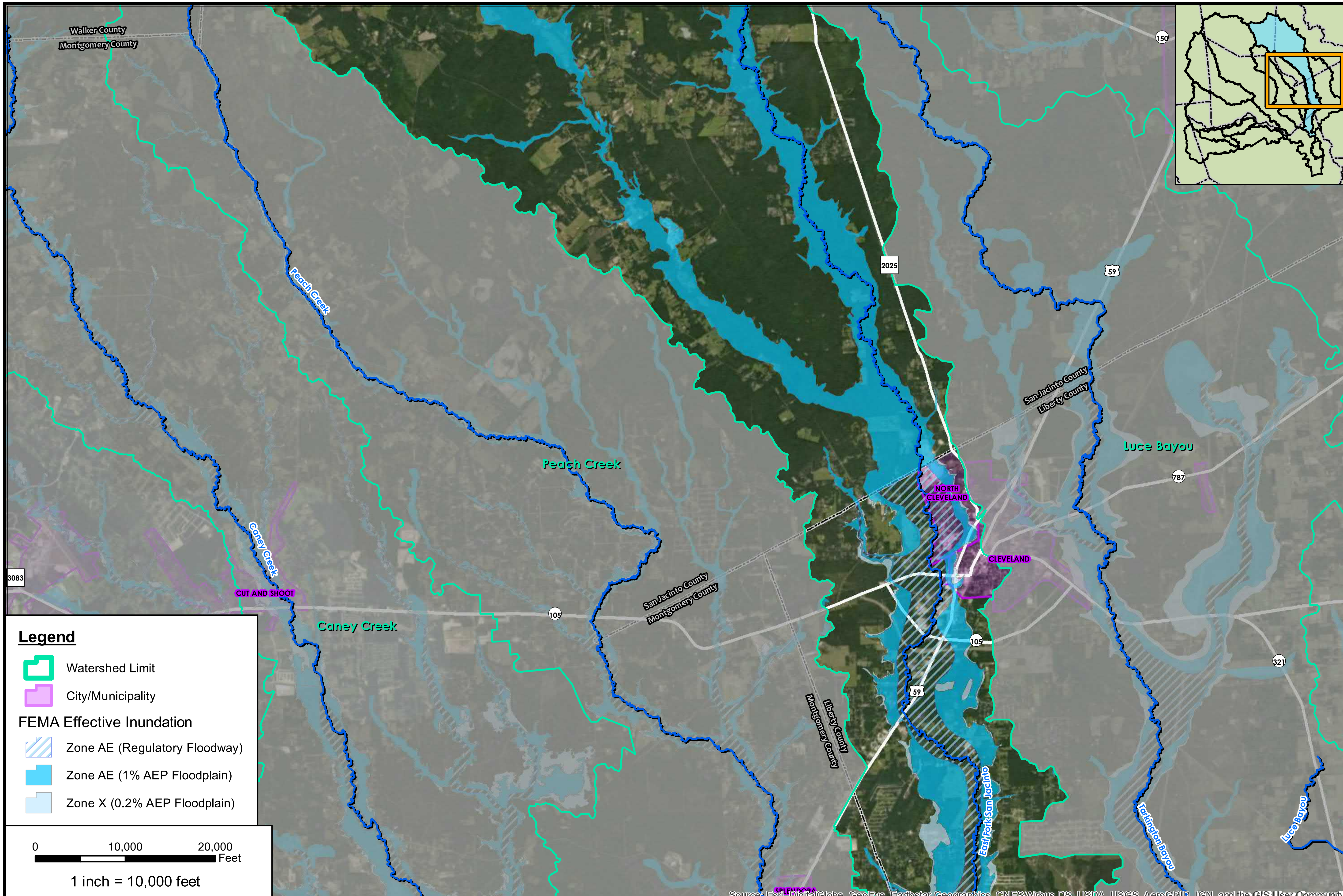
San Jacinto Regional Watershed Master Drainage Plan

FEMA Effective FIRM |

EAST FORK SAN JACINTO (UPSTREAM PORTION)

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C2-L



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HARRIS COUNTY FLOOD CONTROL DISTRICT

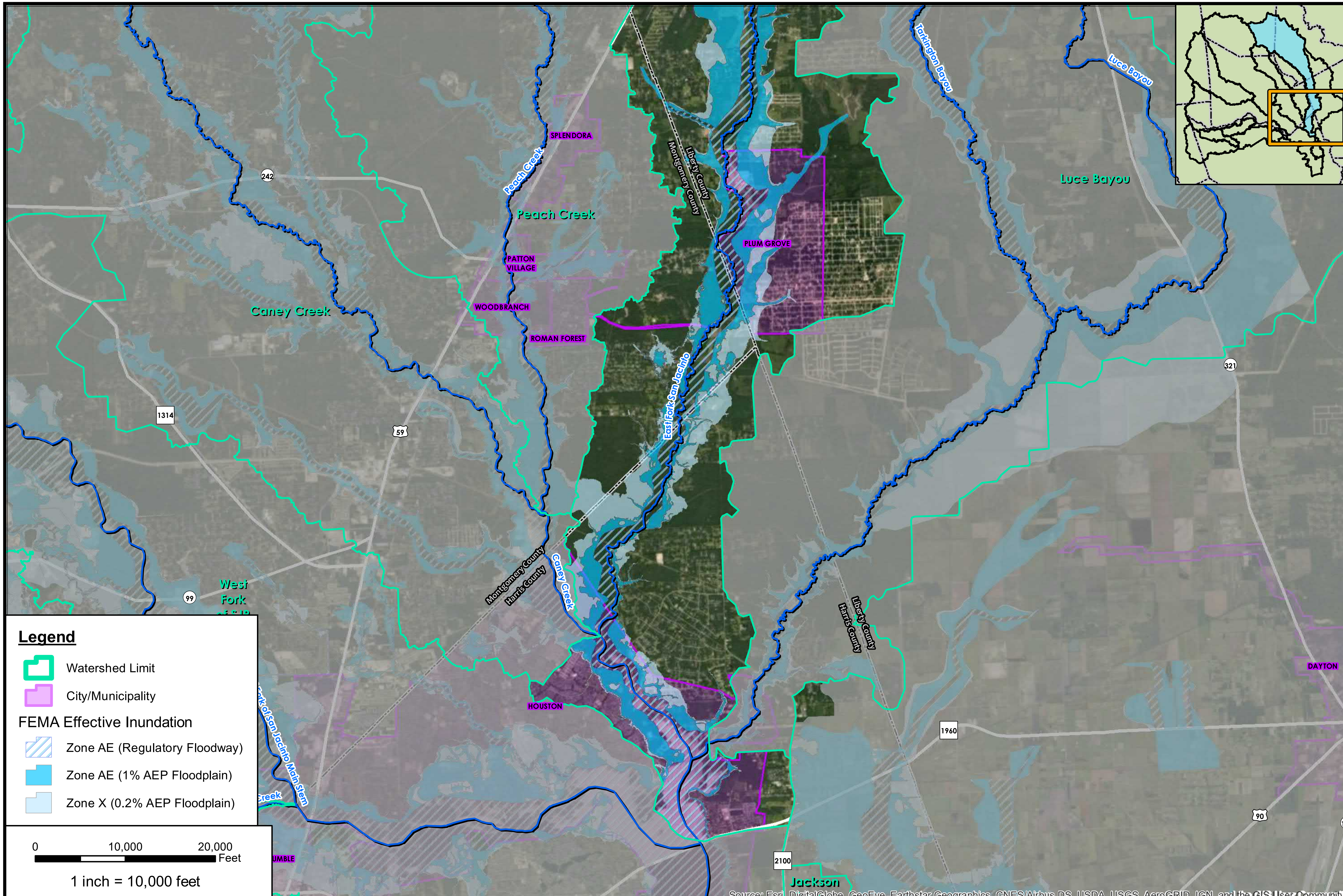
San Jacinto Regional Watershed Master Drainage Plan

FEMA Effective FIRM |

EAST FORK SAN JACINTO (CLEVELAND PORTION)

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C2-M



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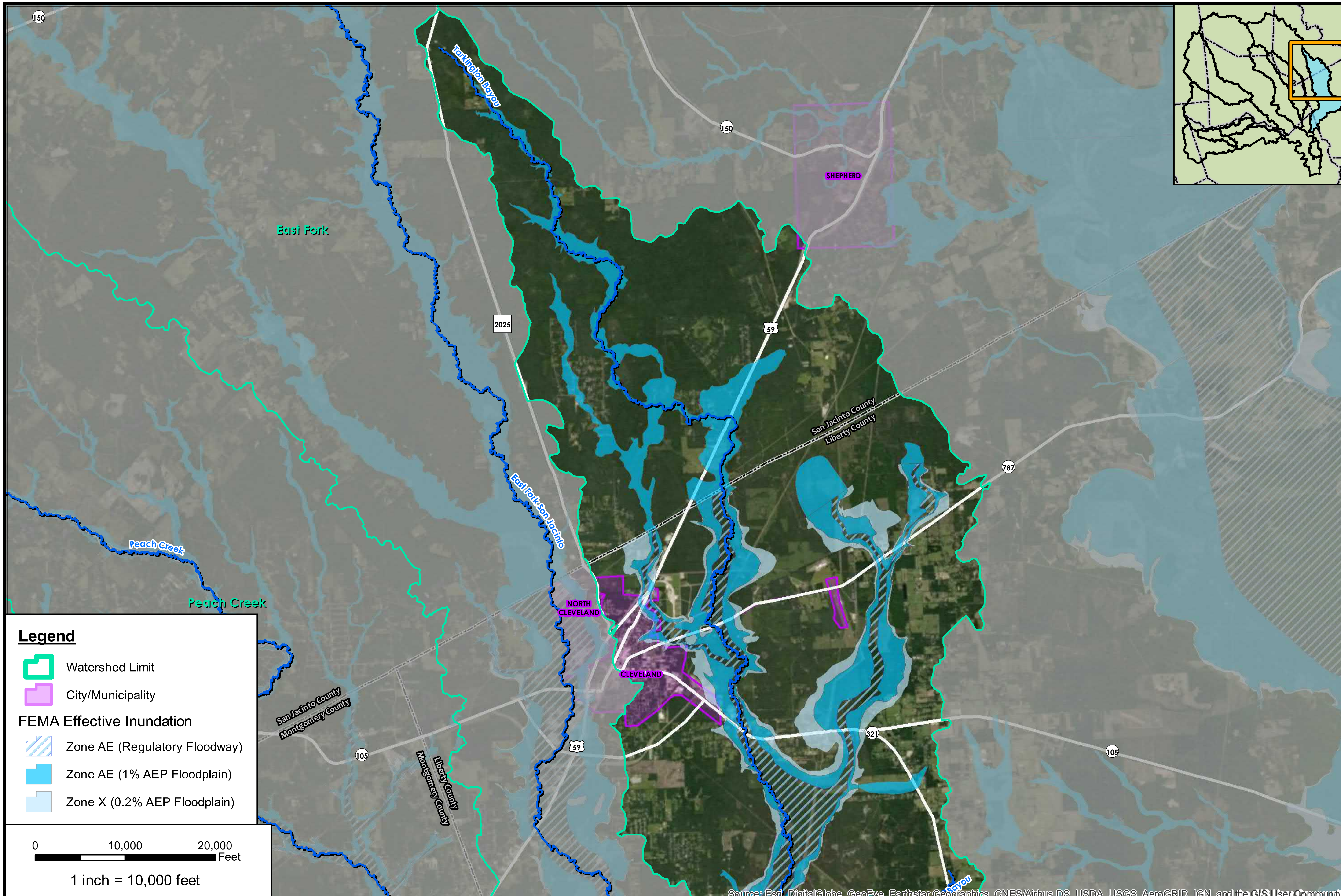
San Jacinto Regional Watershed Master Drainage Plan

FEMA Effective FIRM |

EAST FORK SAN JACINTO (DOWNSTREAM PORTION)

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C2-N



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HARRIS COUNTY FLOOD CONTROL DISTRICT

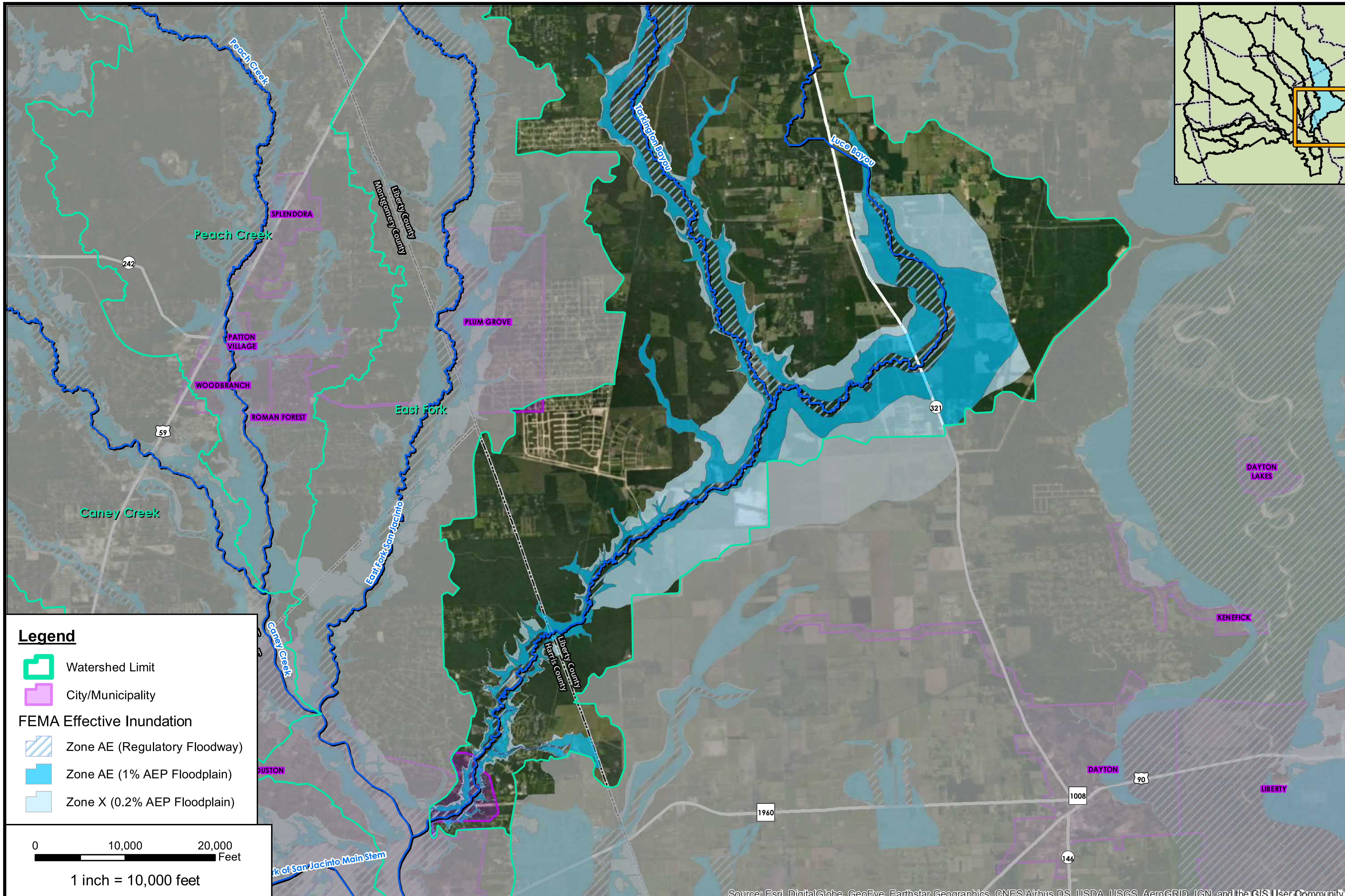
San Jacinto Regional Watershed Master Drainage Plan

FEMA Effective FIRM |

LUCE BAYOU (UPSTREAM PORTION)

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C2-O



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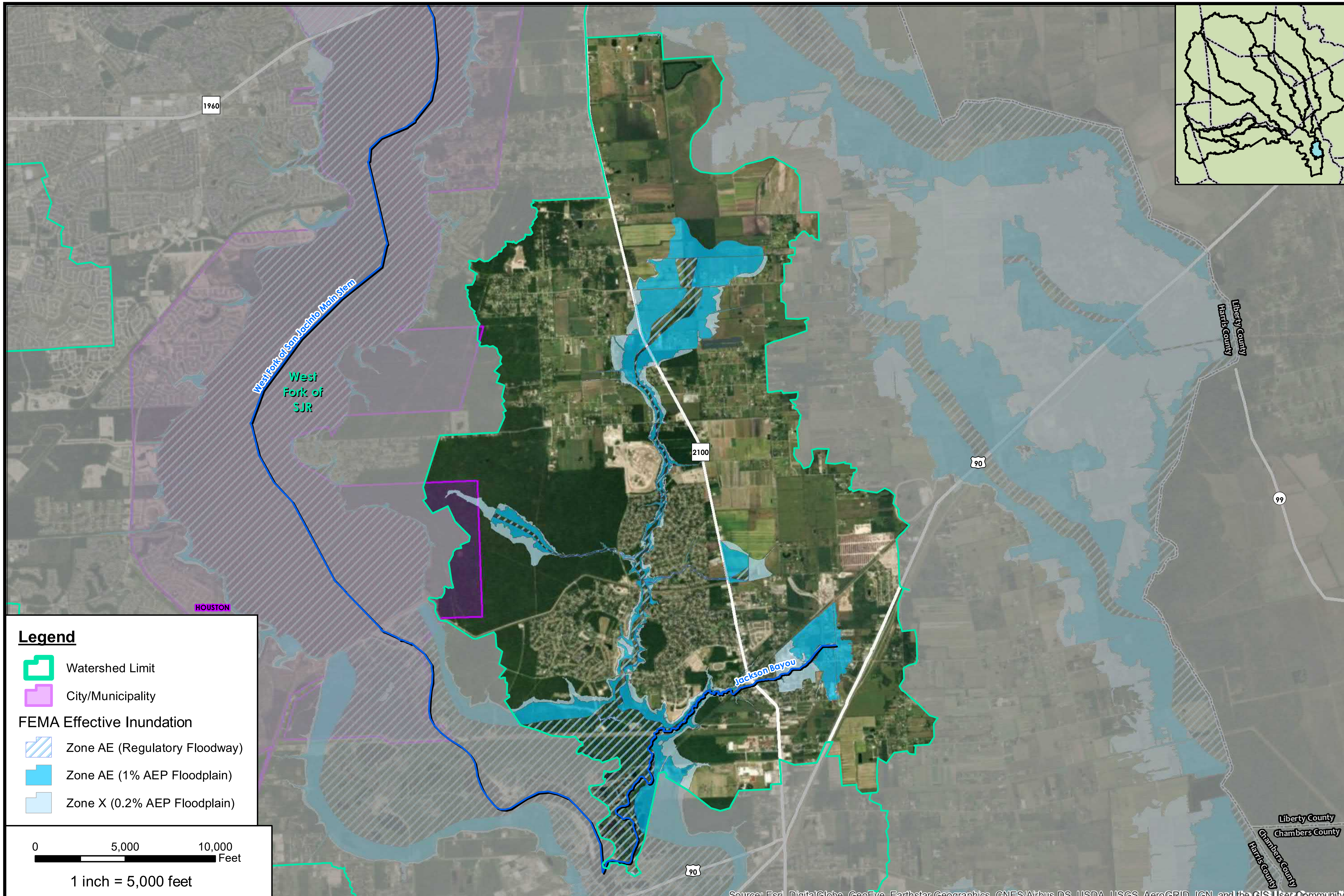
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

FEMA Effective FIRM |
LUCE BAYOU (DOWNSTREAM PORTION)

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C2-P



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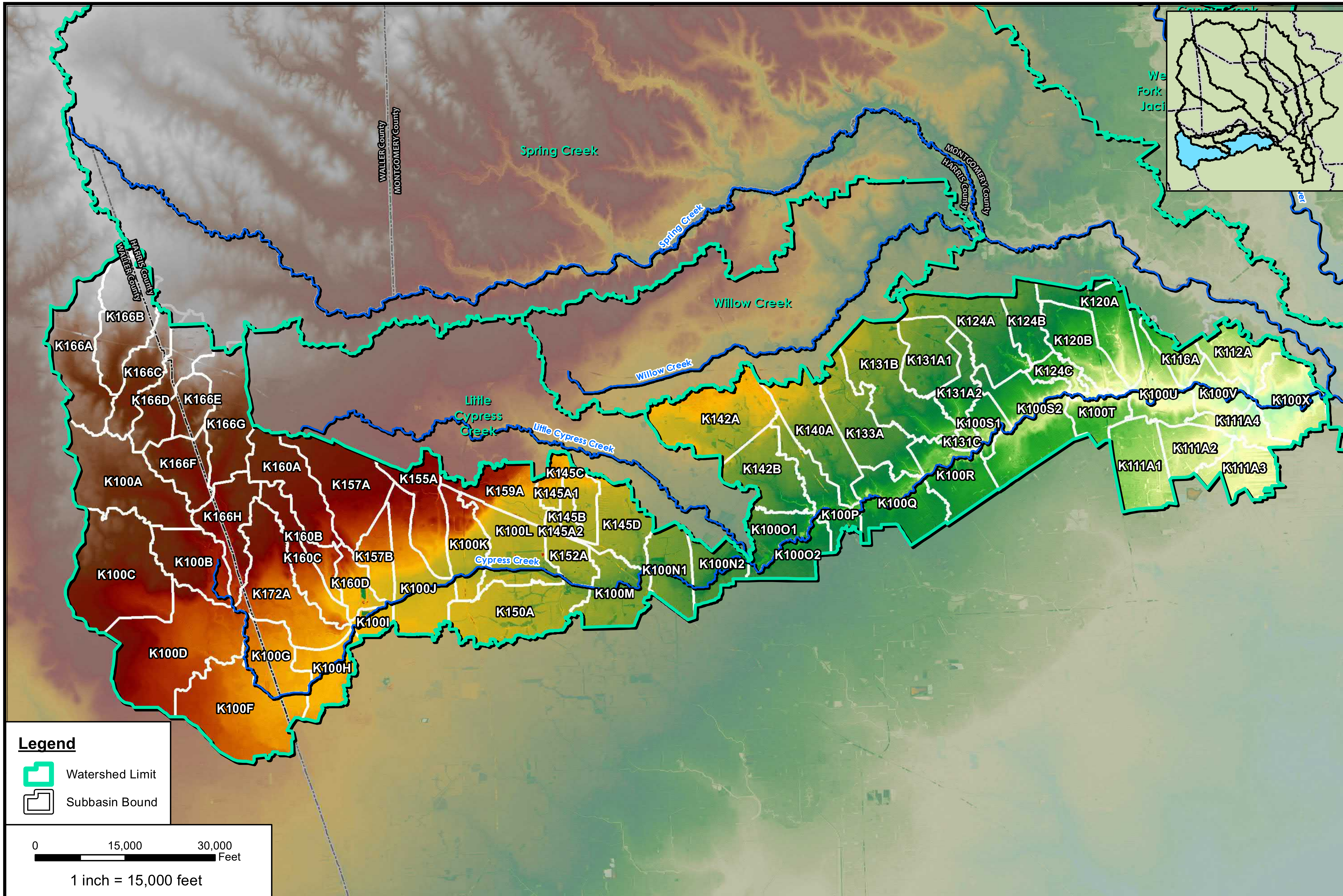
HARRIS COUNTY FLOOD CONTROL DISTRICT
San Jacinto Regional Watershed Master Drainage Plan

FEMA Effective FIRM | | JACKSON BAYOU

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C2-Q



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DATUM & COORDINATE SYSTEM
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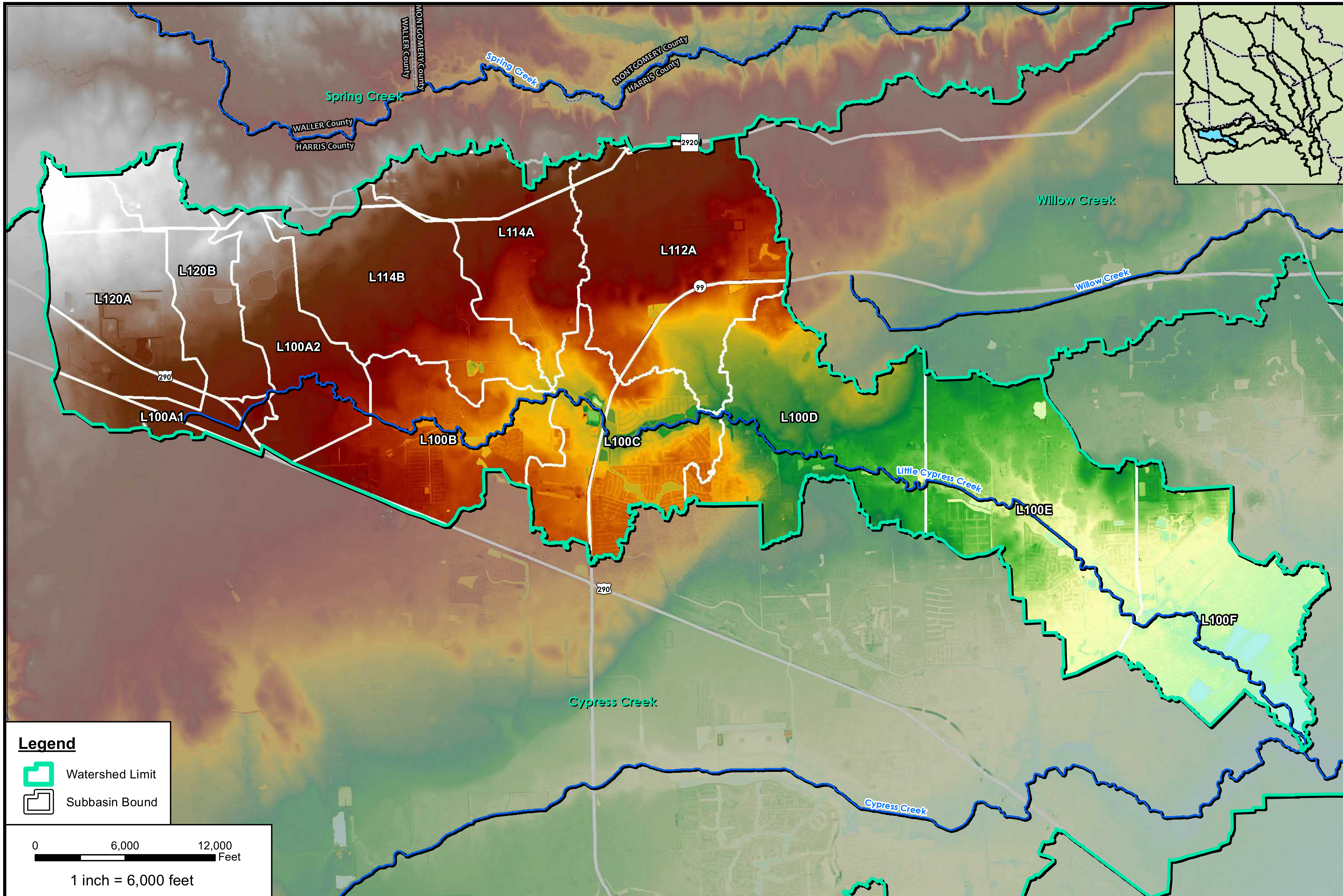
HARRIS COUNTRY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

SUBBASINS MAP | CYPRESS CREEK

SAN JACINTO
REGIONAL WATERSHED
MASTER DRAINAGE PLAN

Exhibit C3-A



PROJECT AVO 33465

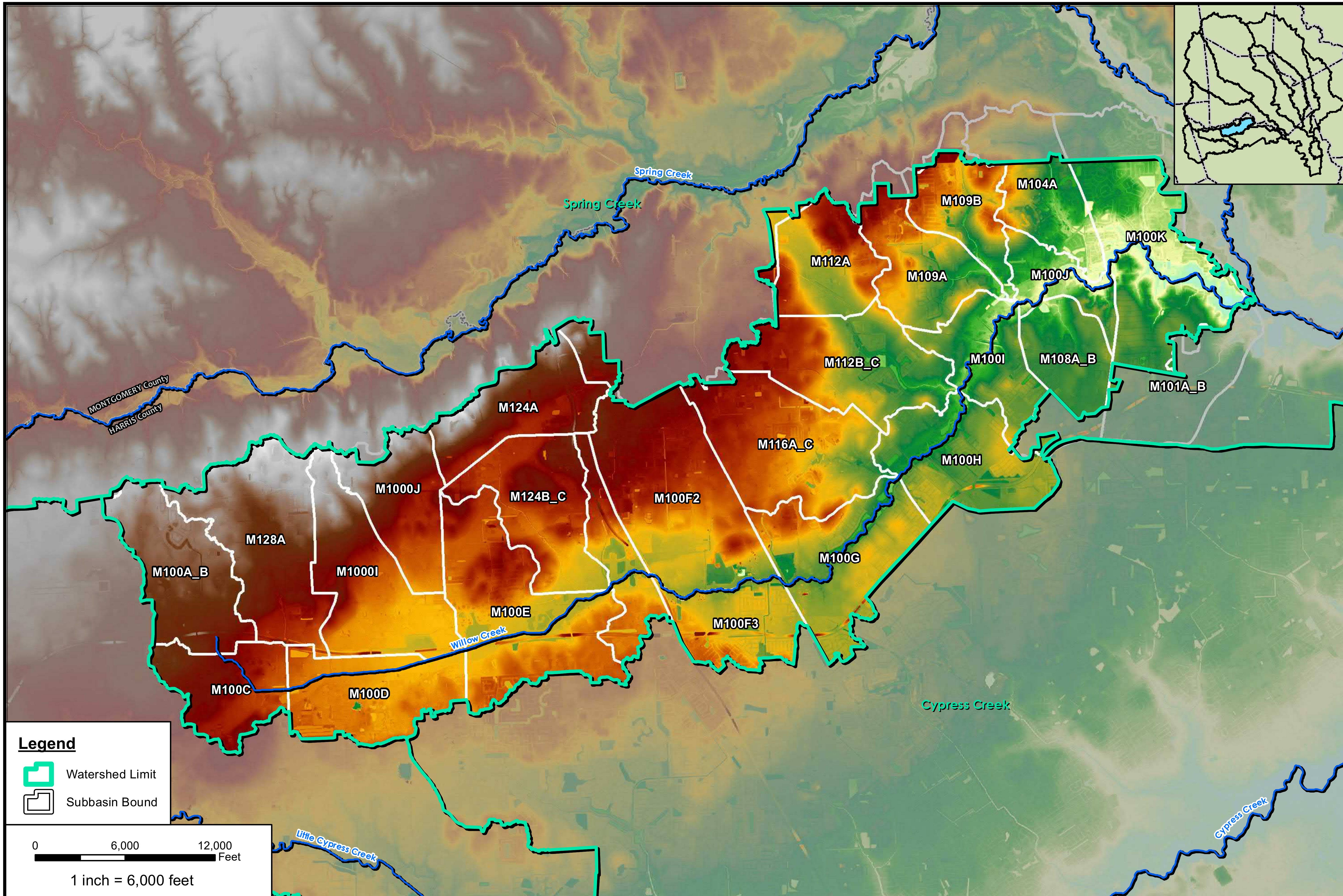
DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

HARRIS COUNTY FLOOD CONTROL DISTRICT
San Jacinto Regional Watershed Master Drainage Plan

SUBBASINS MAP | LITTLE CYPRESS CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C3-B



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FtUS

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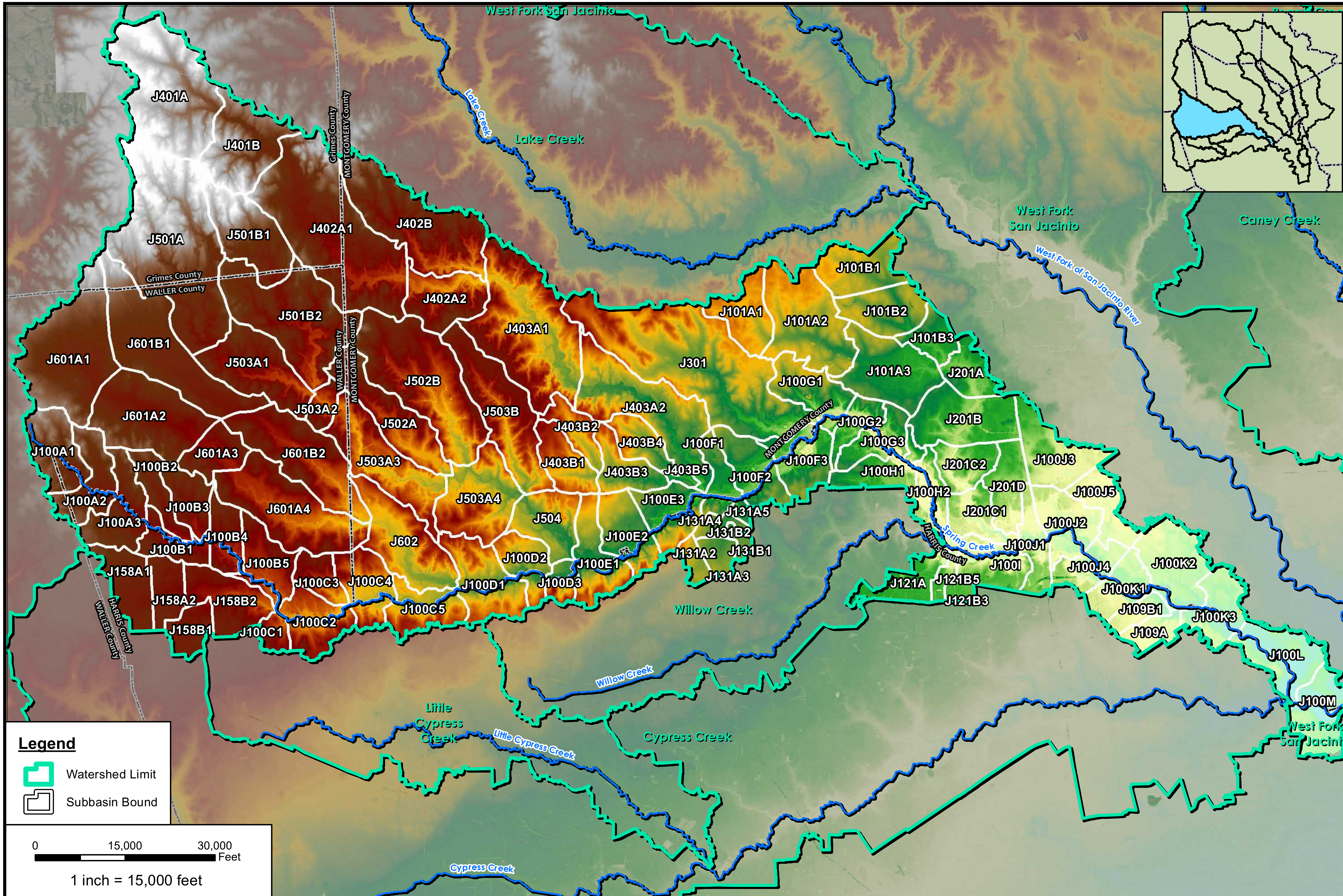
HARRIS COUNTY FLOOD CONTROL DISTRICT
San Jacinto Regional Watershed Master Drainage Plan

SUBBASINS MAP | WILLOW CREEK

SAN JACINTO
REGIONAL WATERSHED
MASTER DRAINAGE PLAN

Exhibit
C3-C



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

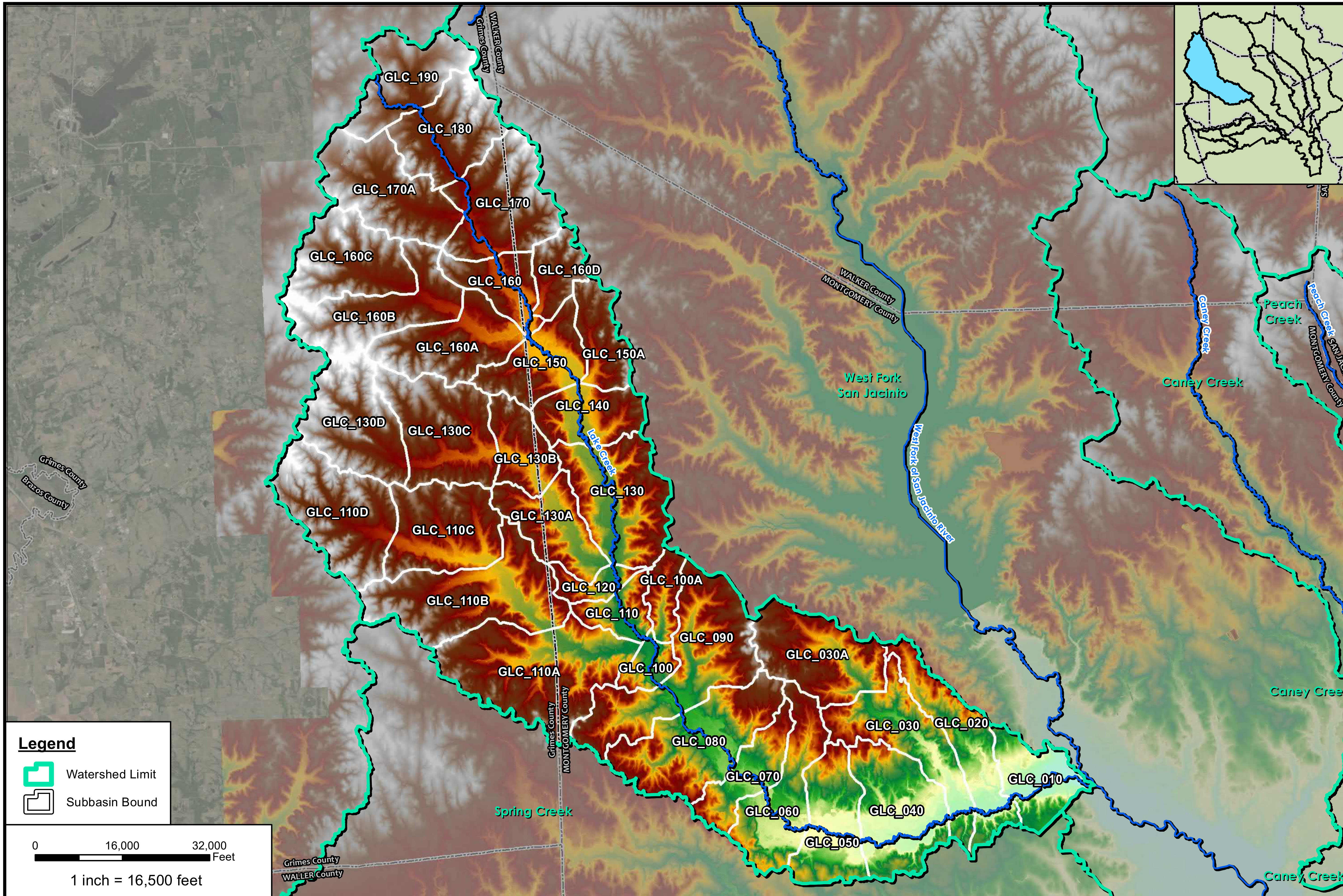
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

SUBBASINS MAP | SPRING CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C3-D



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

SUBBASINS MAP | LAKE CREEK

PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FtUS

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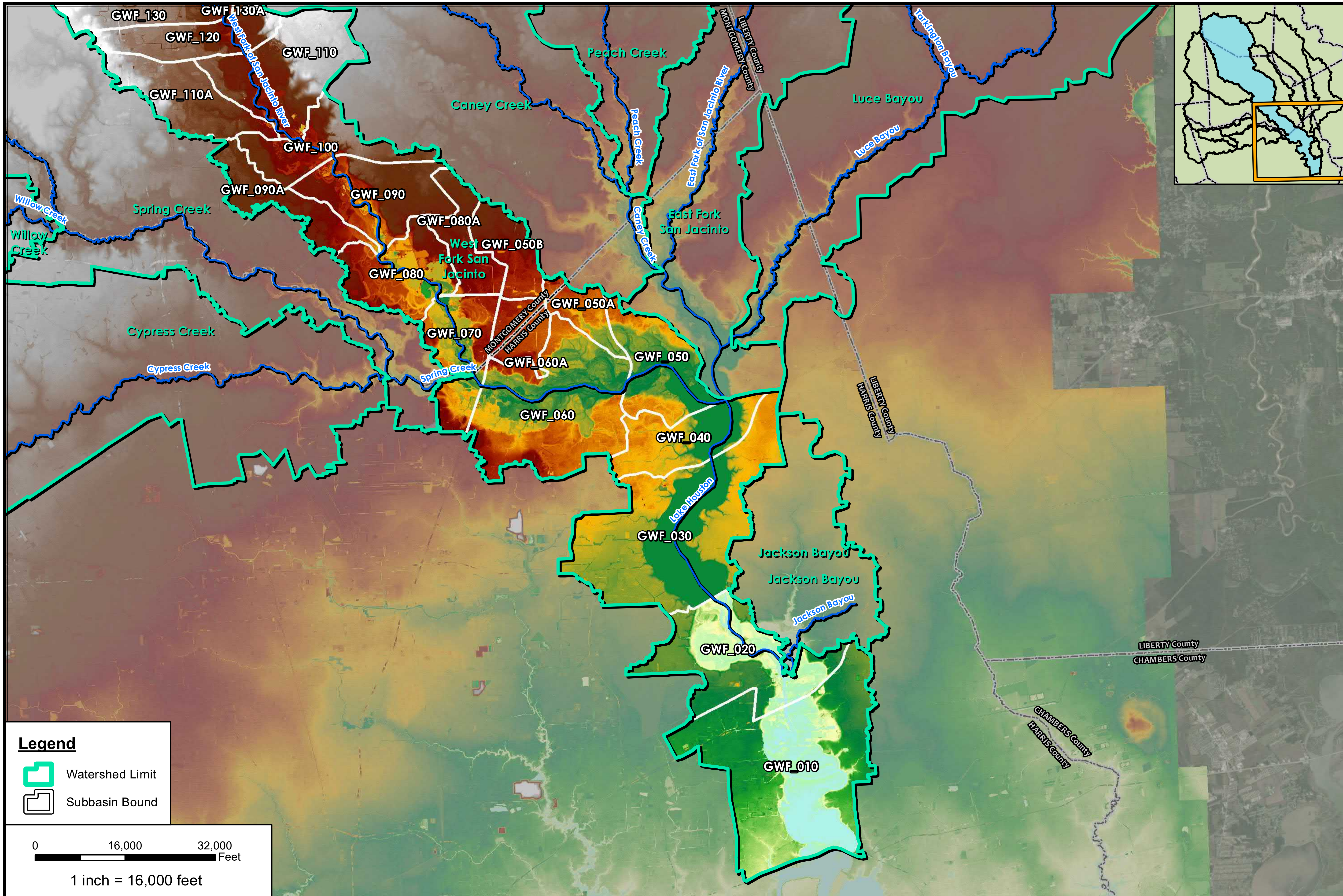
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C3-E



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

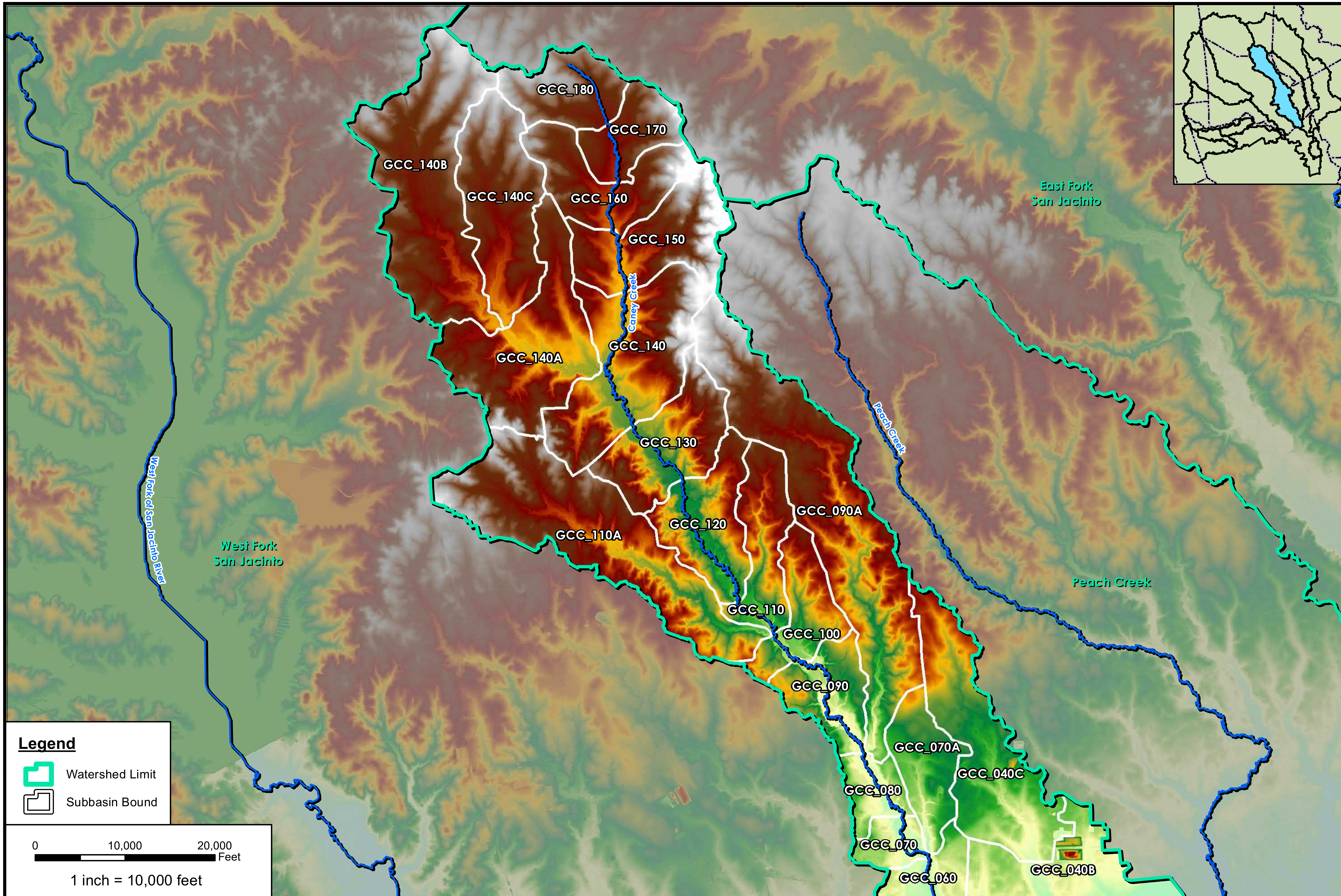
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

SUBBASINS MAP | WEST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C3-H



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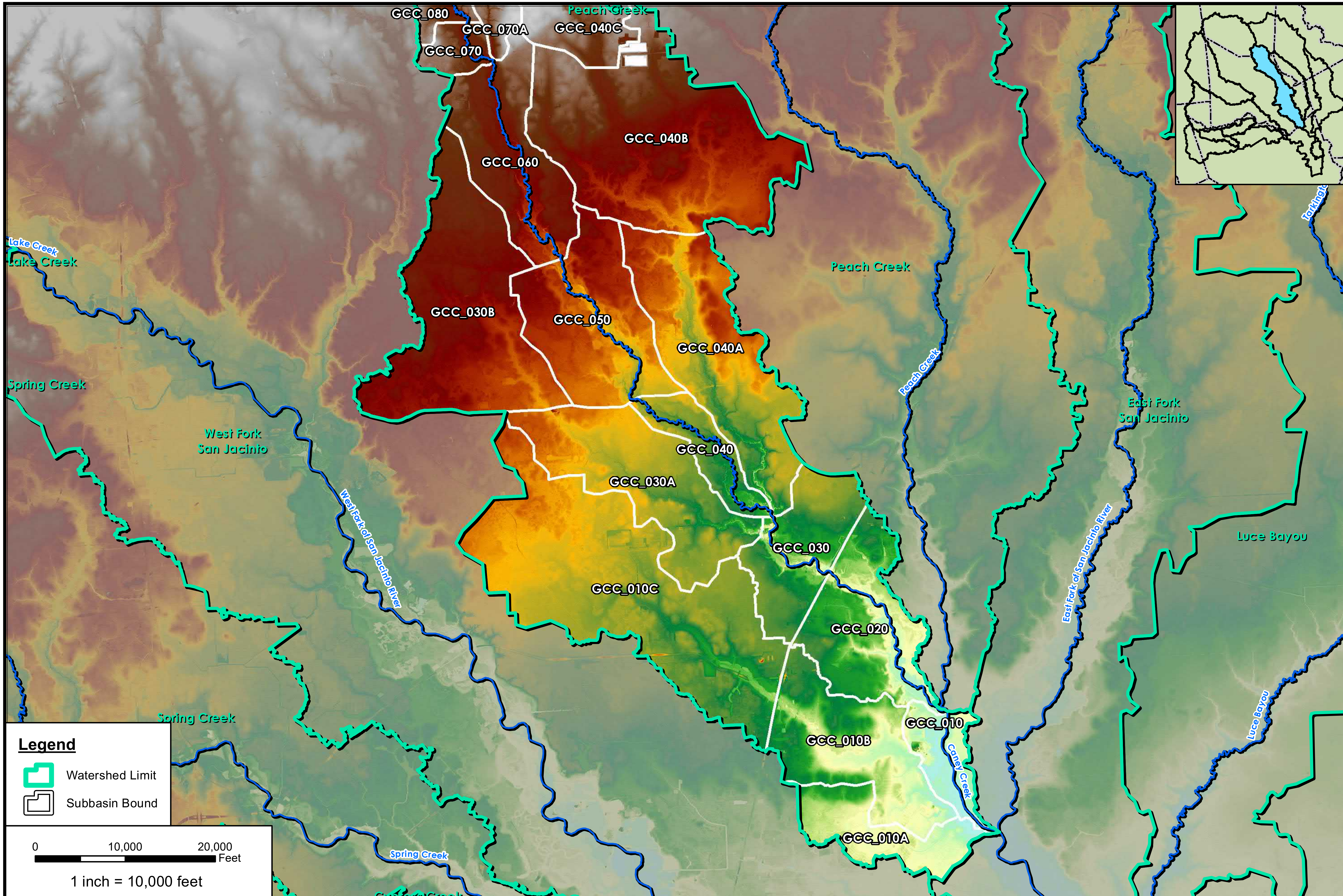
HARRIS COUNTY FLOOD CONTROL DISTRICT
San Jacinto Regional Watershed Master Drainage Plan

SUBBASINS MAP | CANEY CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C3-I



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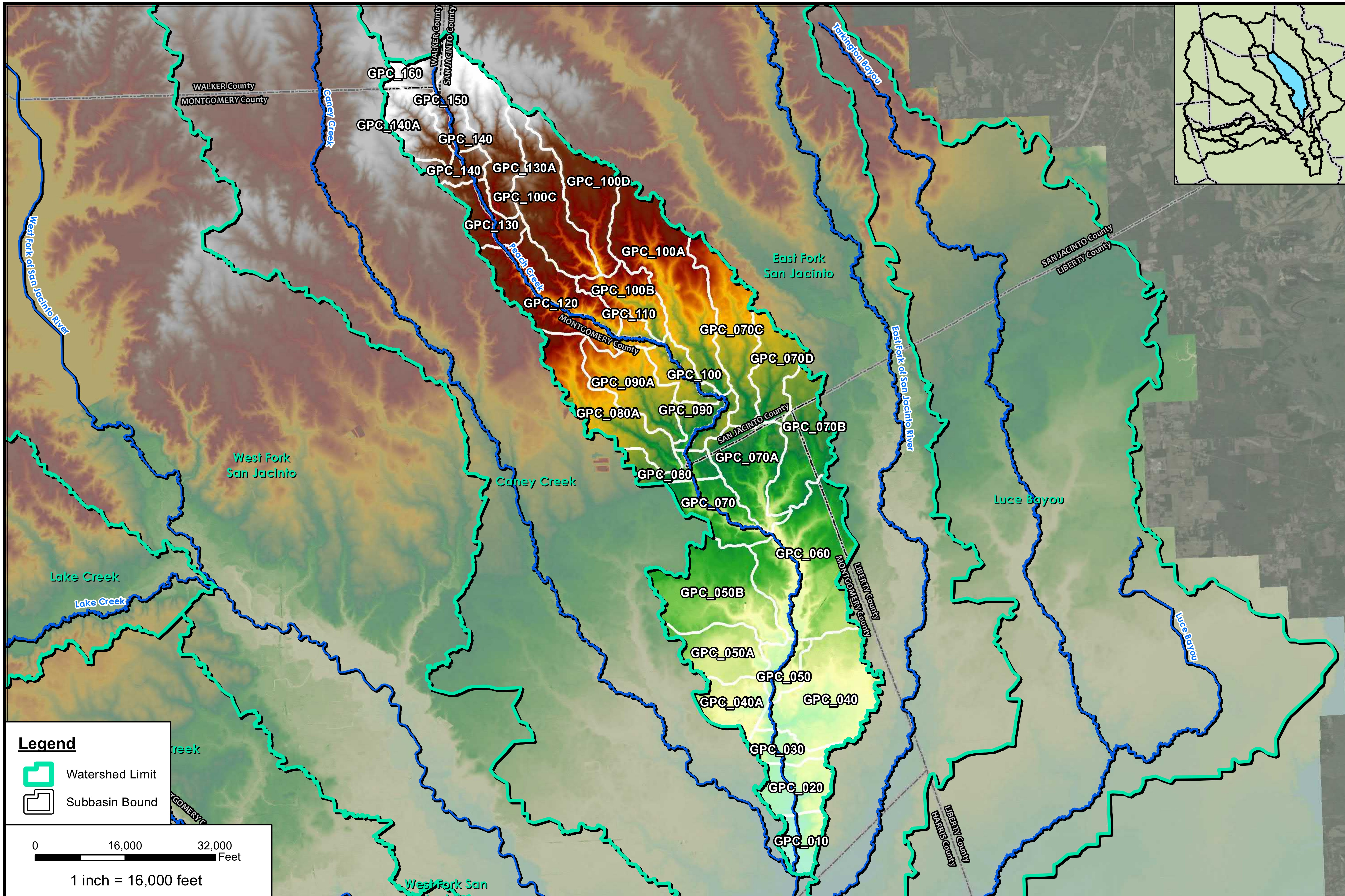
HARRIS COUNTY FLOOD CONTROL DISTRICT
San Jacinto Regional Watershed Master Drainage Plan

SUBBASINS MAP | CANEY CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C3-J



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DATUM & COORDINATE SYSTEM
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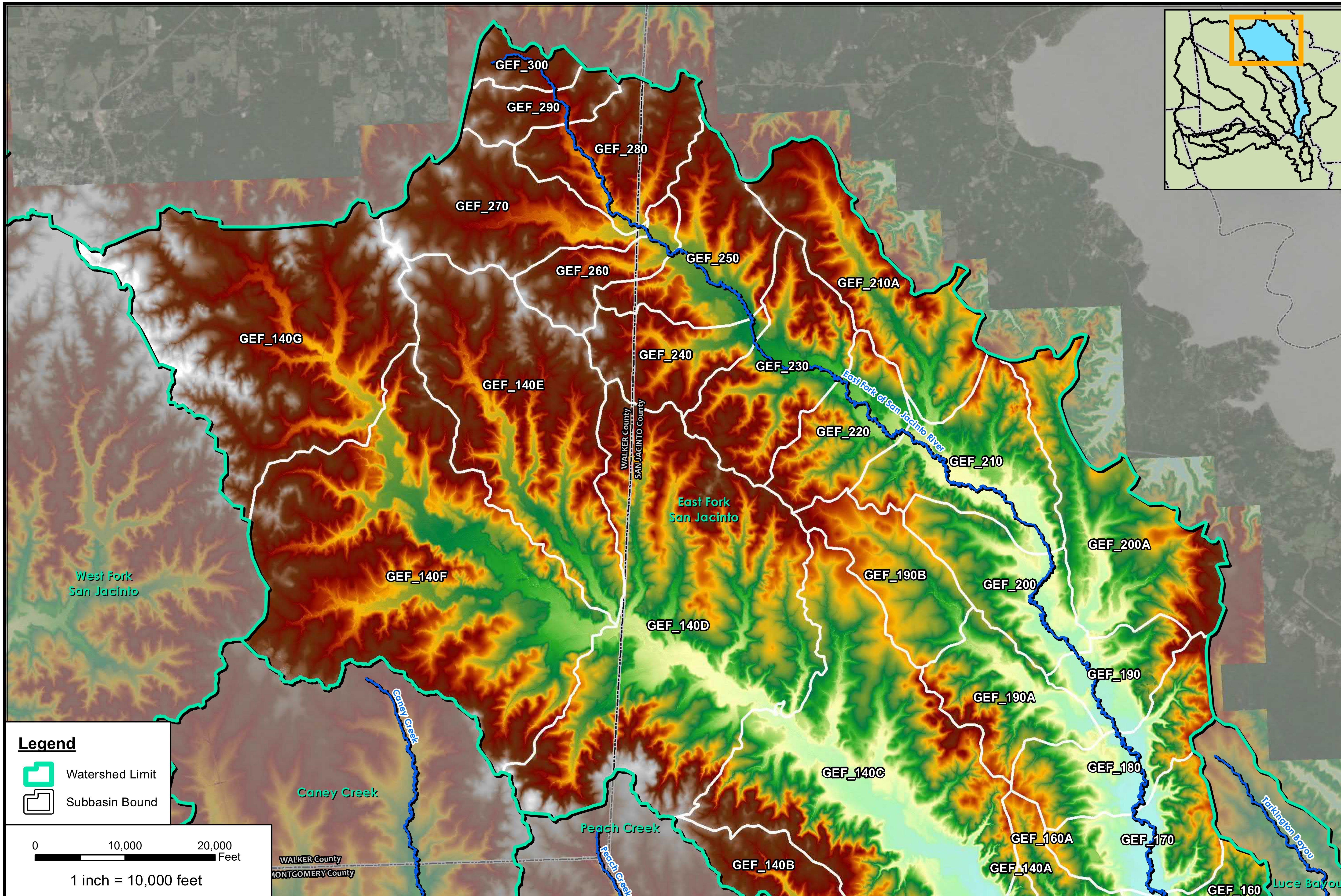
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

SUBBASINS MAP | PEACH CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C3-K



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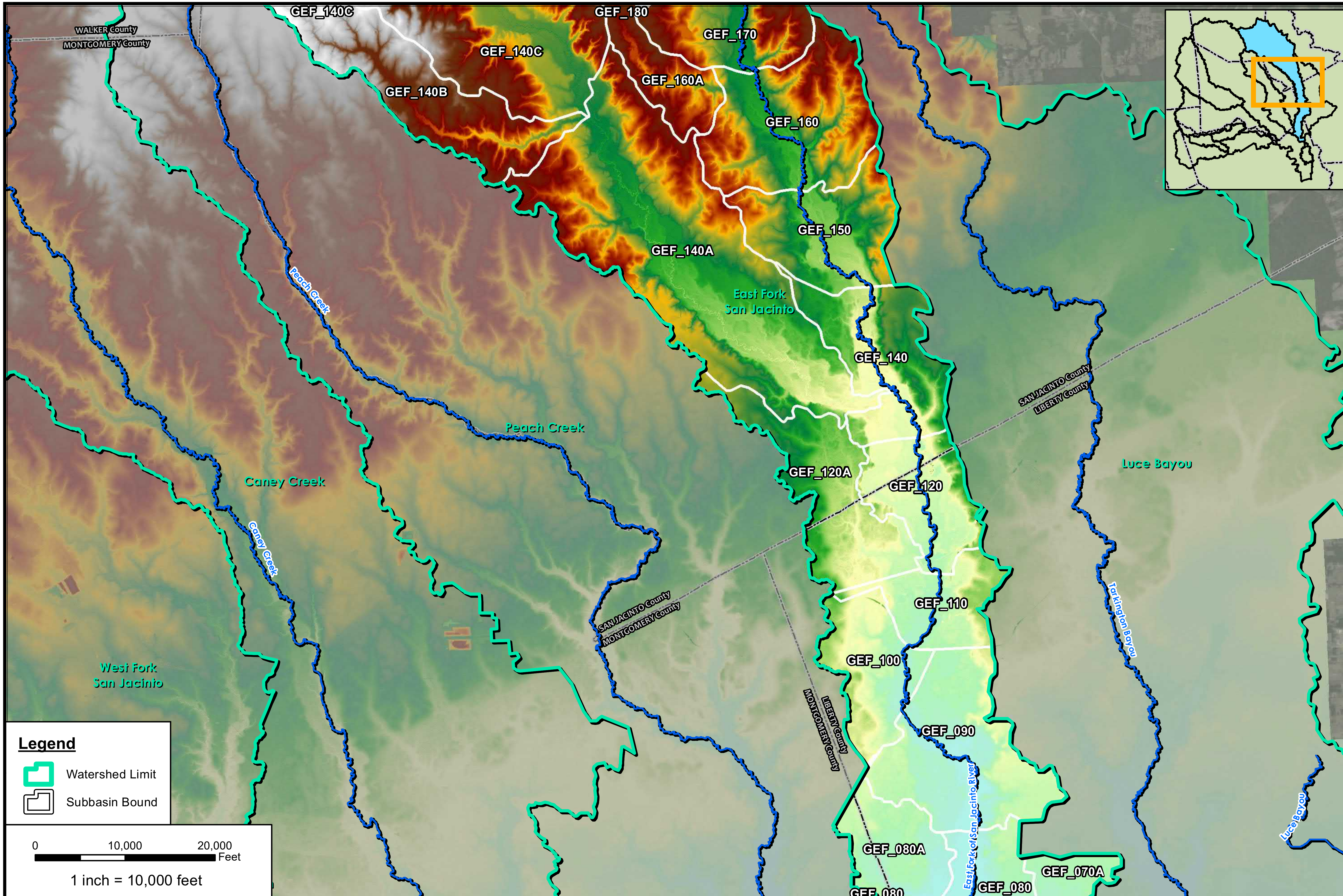
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

SUBBASINS MAP | EAST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C3-L



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ftus

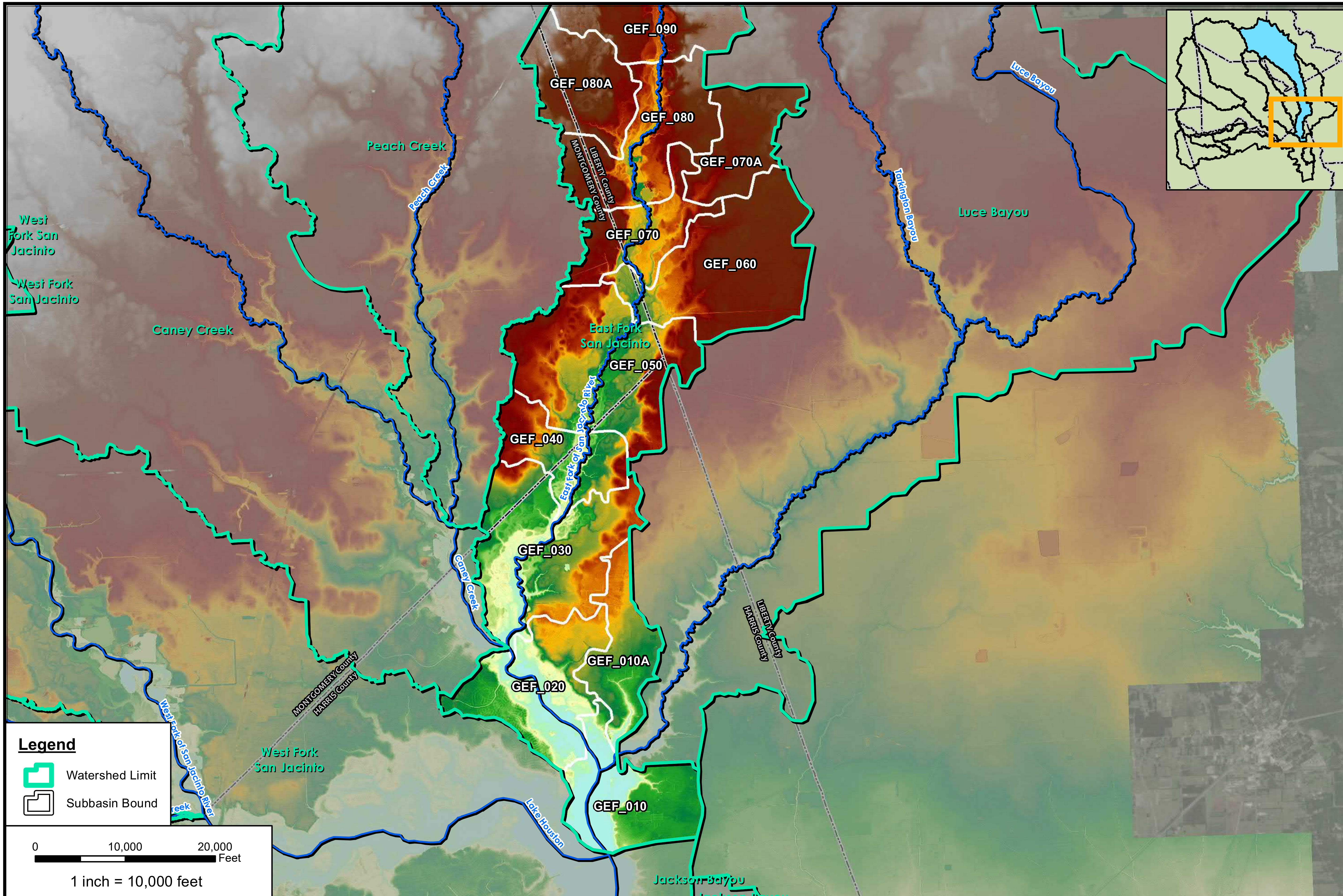
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

SUBBASINS MAP | EAST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C3-M



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

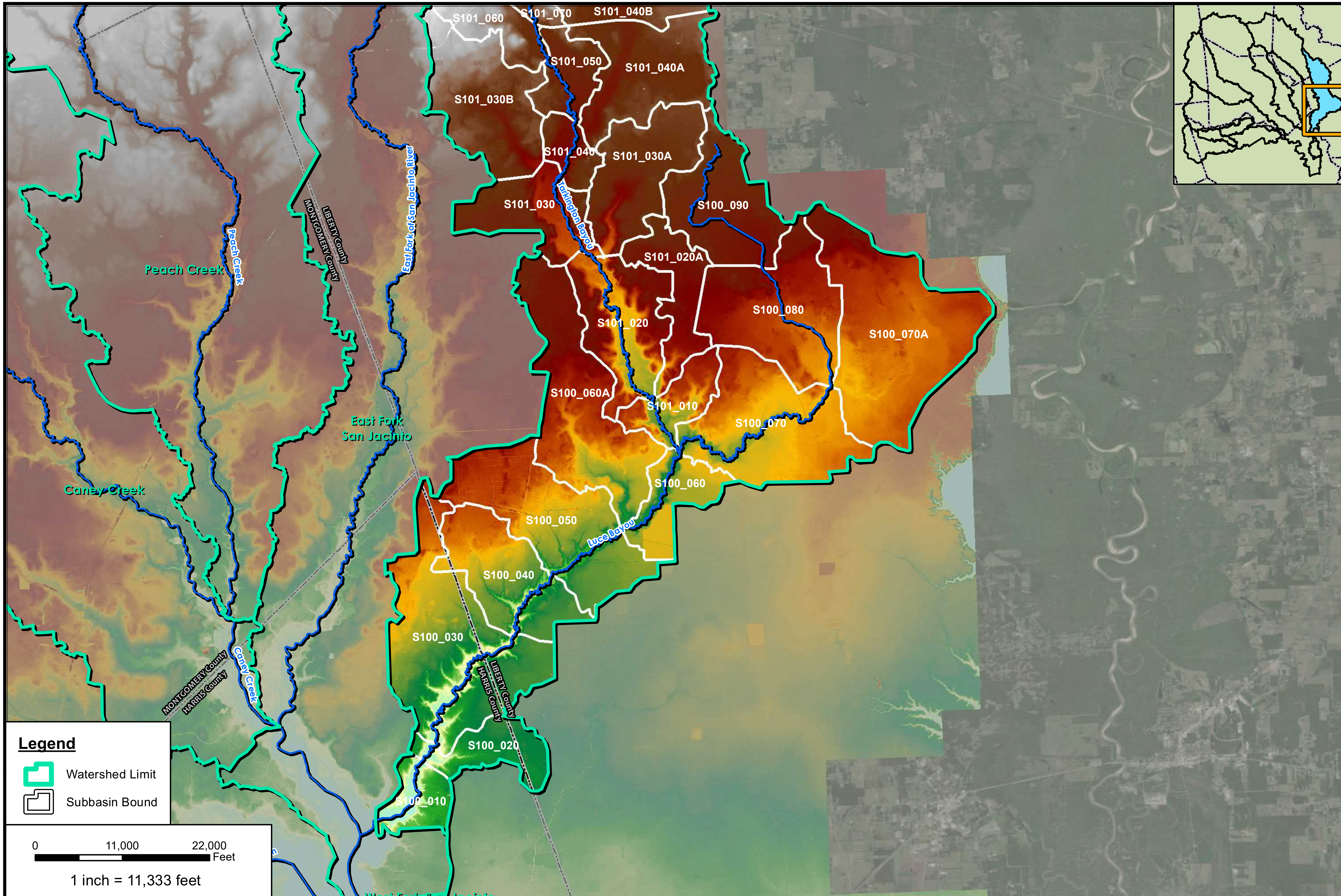
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

SUBBASINS MAP | EAST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C3-N



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

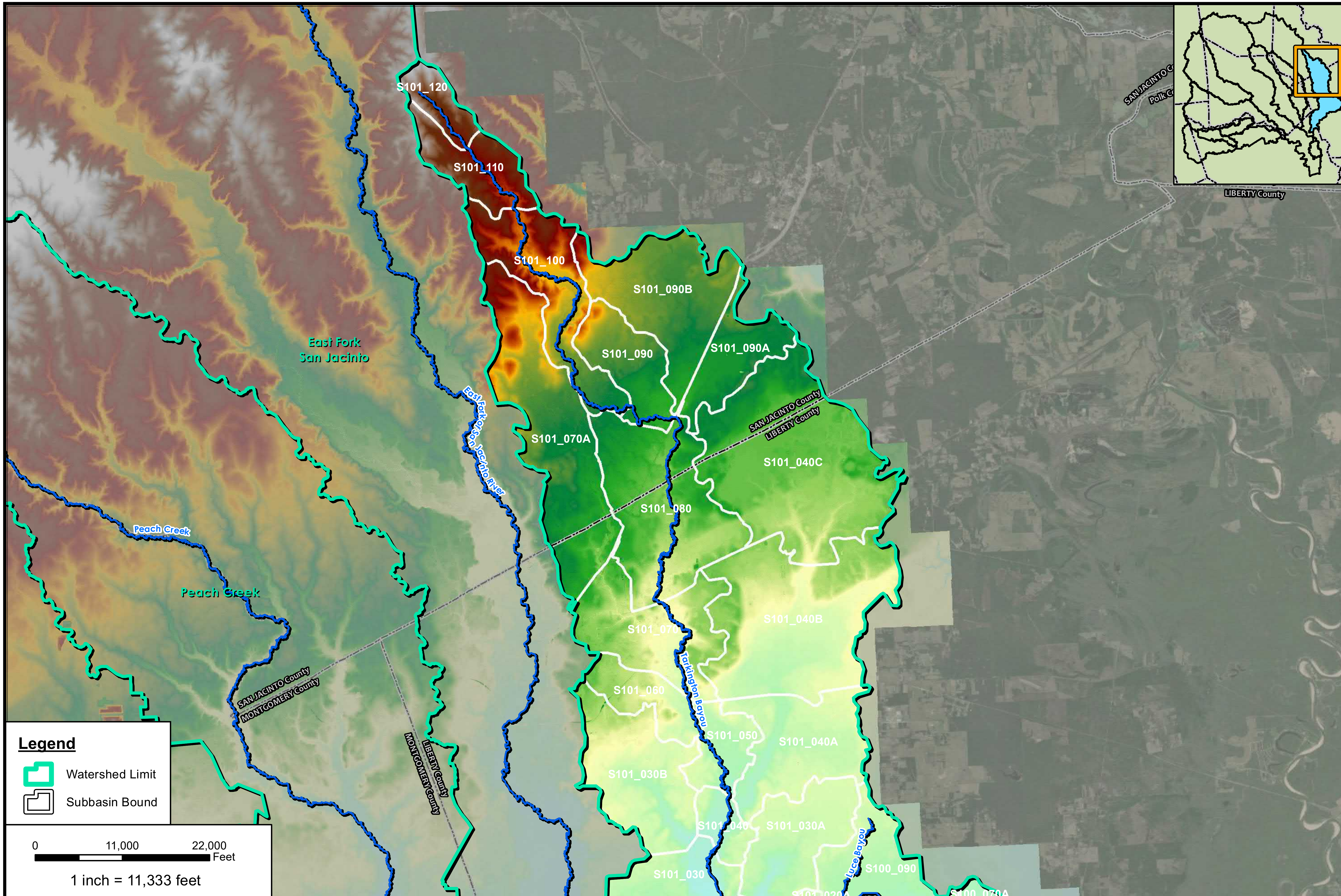
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

SUBBASINS MAP | LUCE AND TARKINGTON BAYOU

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C3-O



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

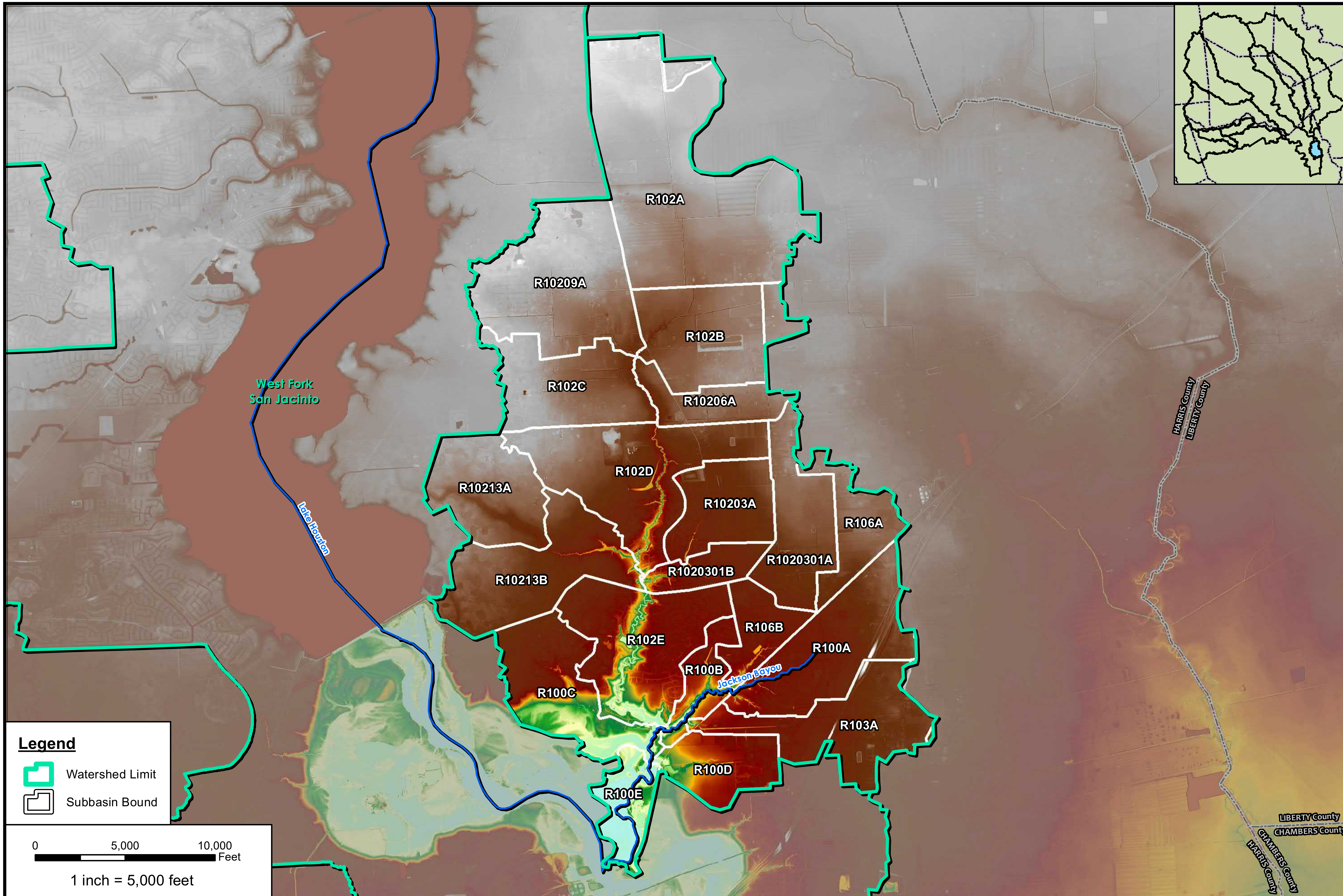
SUBBASINS MAP | LUCE AND TARKINGTON BAYOU

PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

Exhibit C3-P



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FtUS

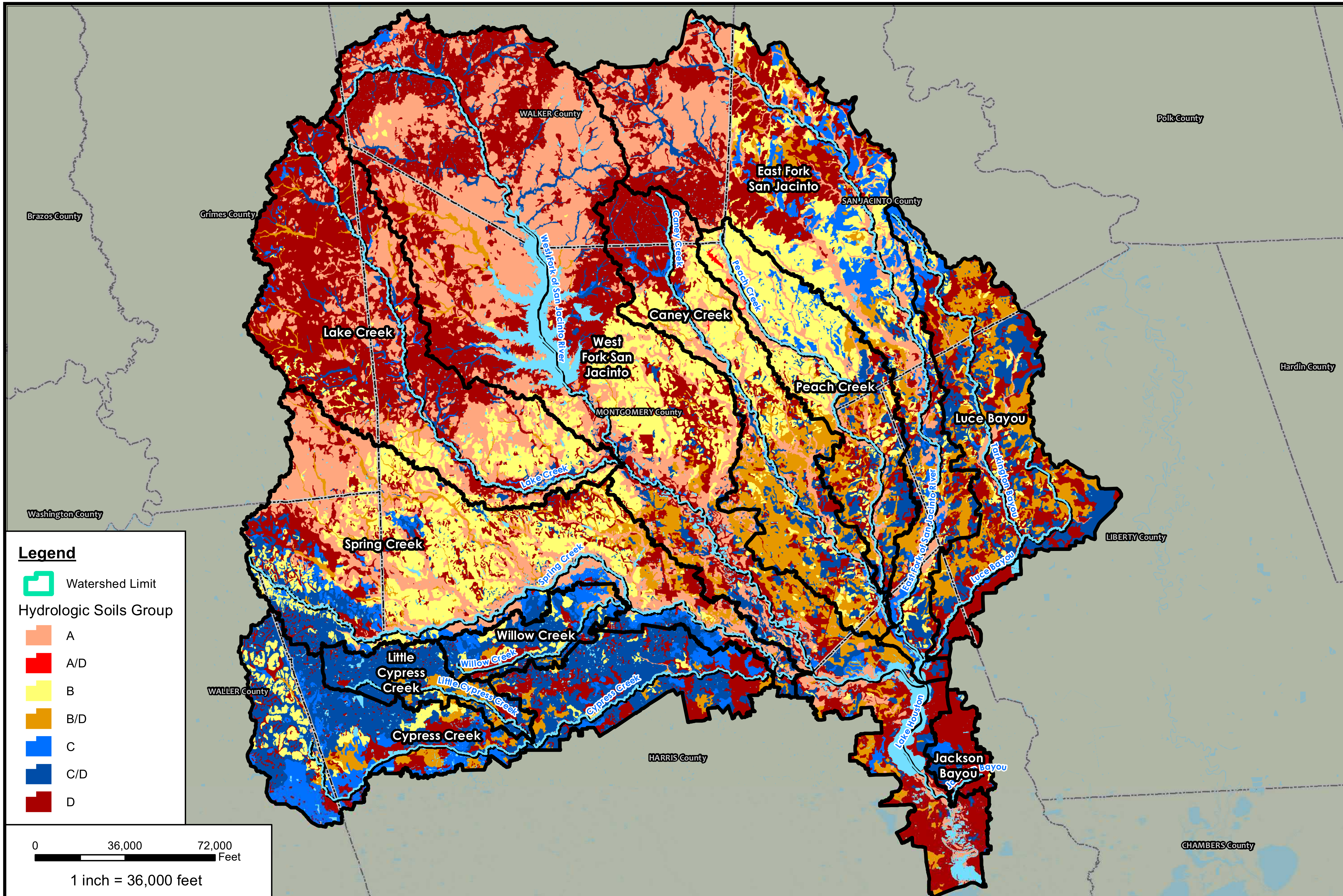
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

SUBBASINS MAP | JACKSON BAYOU

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C3-Q



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

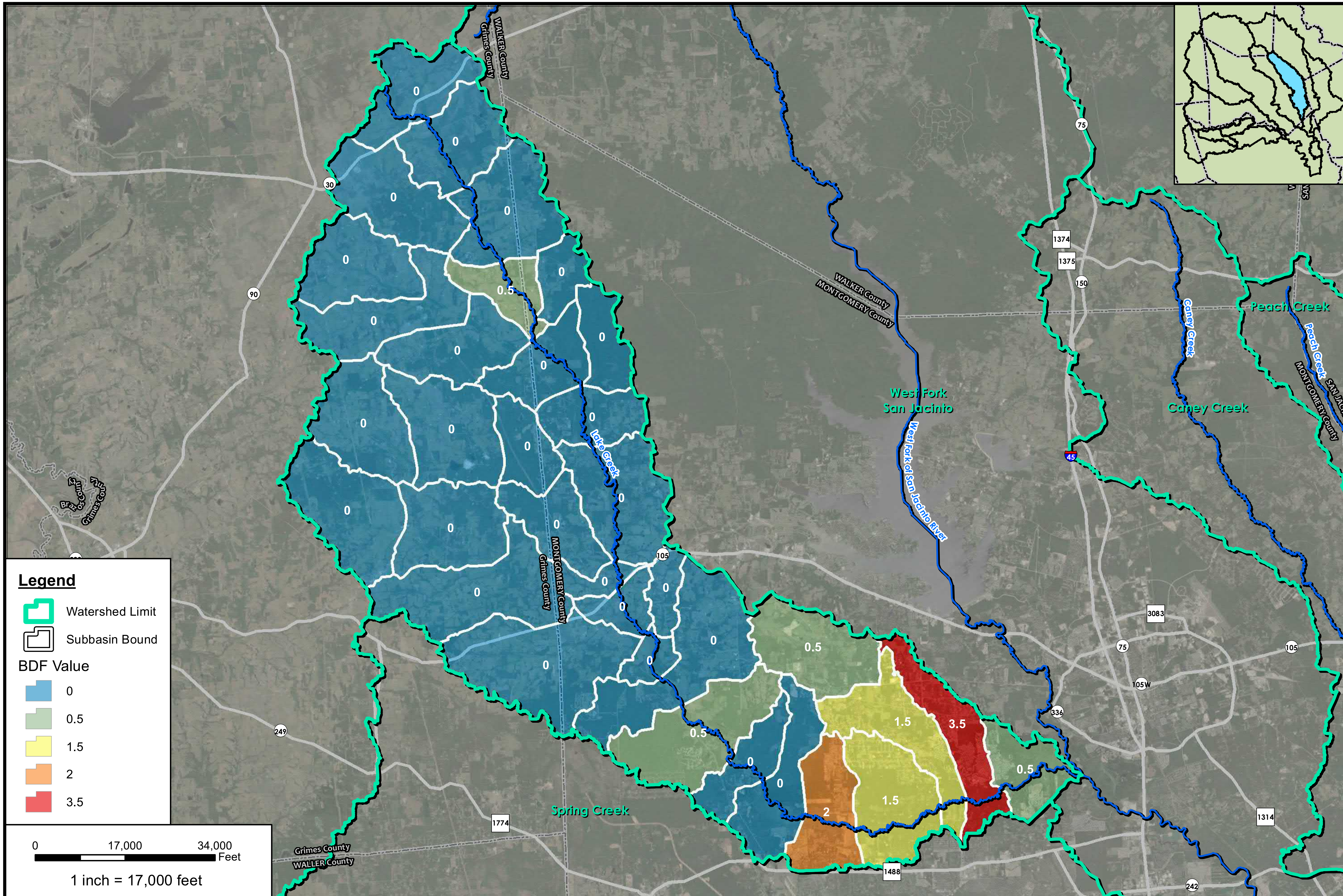
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

SOILS MAP

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C4



PROJECT AVO 33465

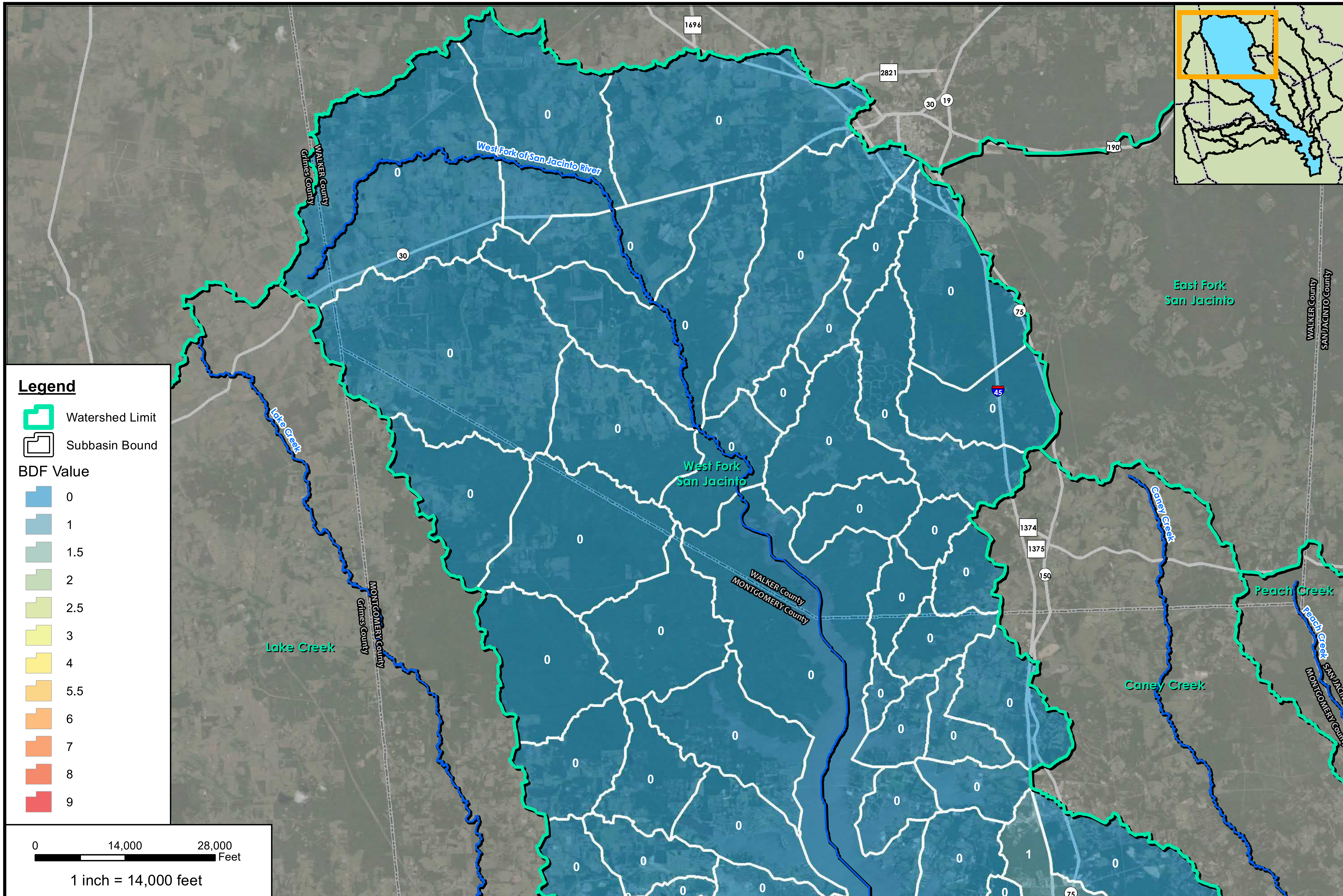
DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FtUS

HARRIS COUNTY FLOOD CONTROL DISTRICT
San Jacinto Regional Watershed Master Drainage Plan

BDF VALUES MAP | LAKE CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C5-A



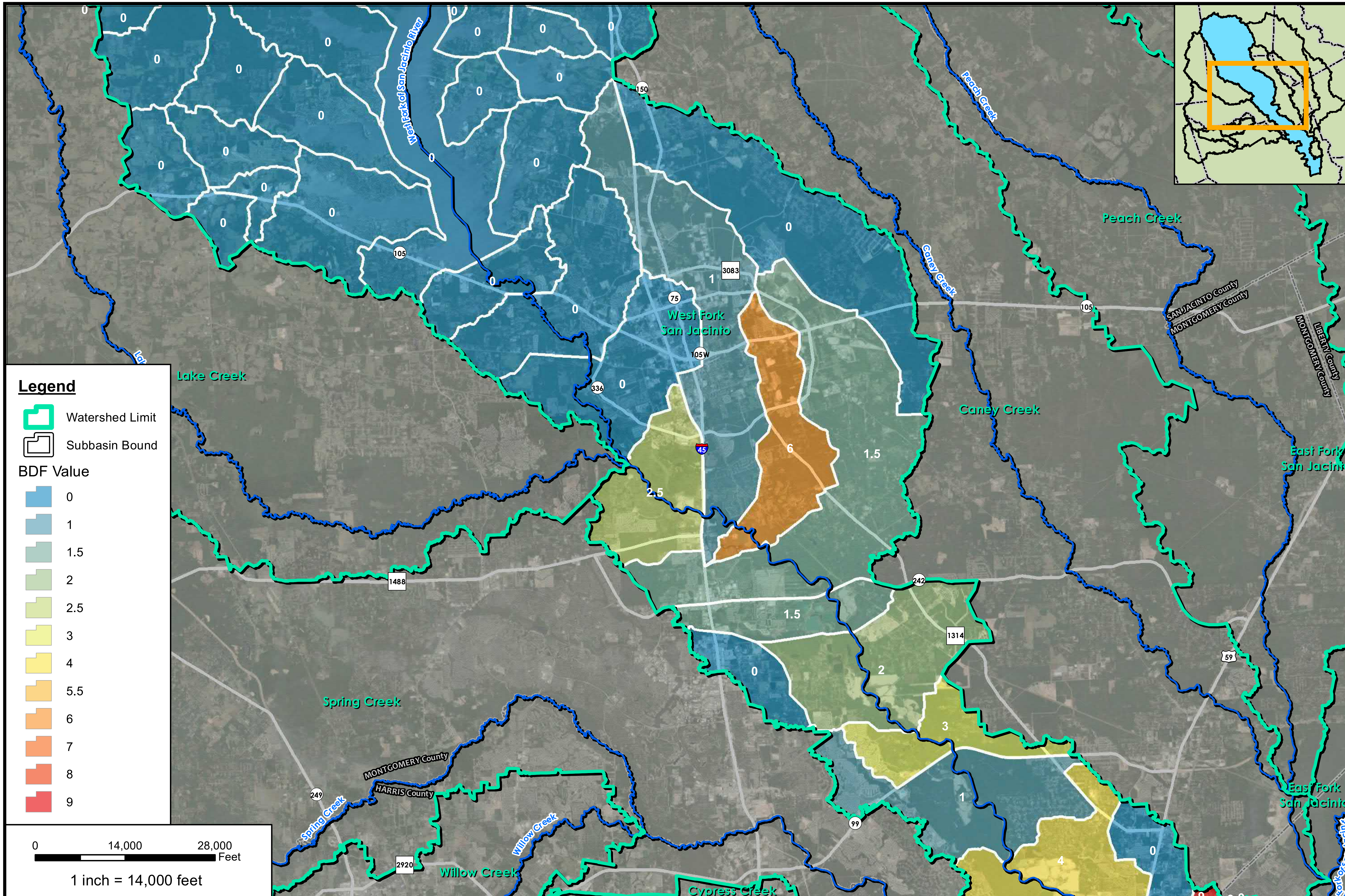
PROJECT AVO
33465
DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

HARRIS COUNTY FLOOD CONTROL DISTRICT
San Jacinto Regional Watershed Master Drainage Plan

BDF VALUES MAP | WEST FORK SAN JACINTO

SAN JACINTO
REGIONAL WATERSHED
MASTER DRAINAGE PLAN

Exhibit C5-B



PROJECT AVO

33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

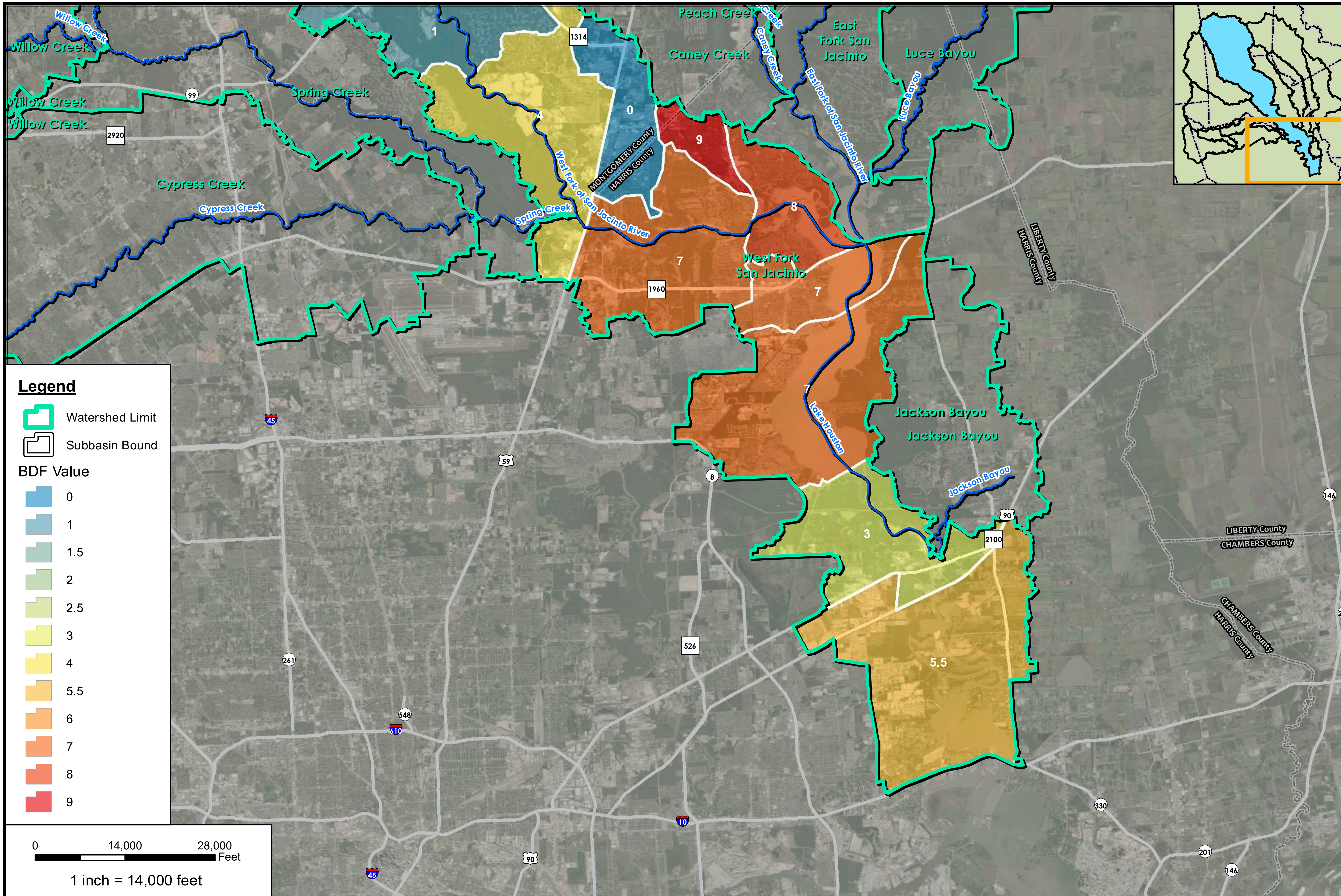
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

BDF VALUES MAP | WEST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C5-C



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

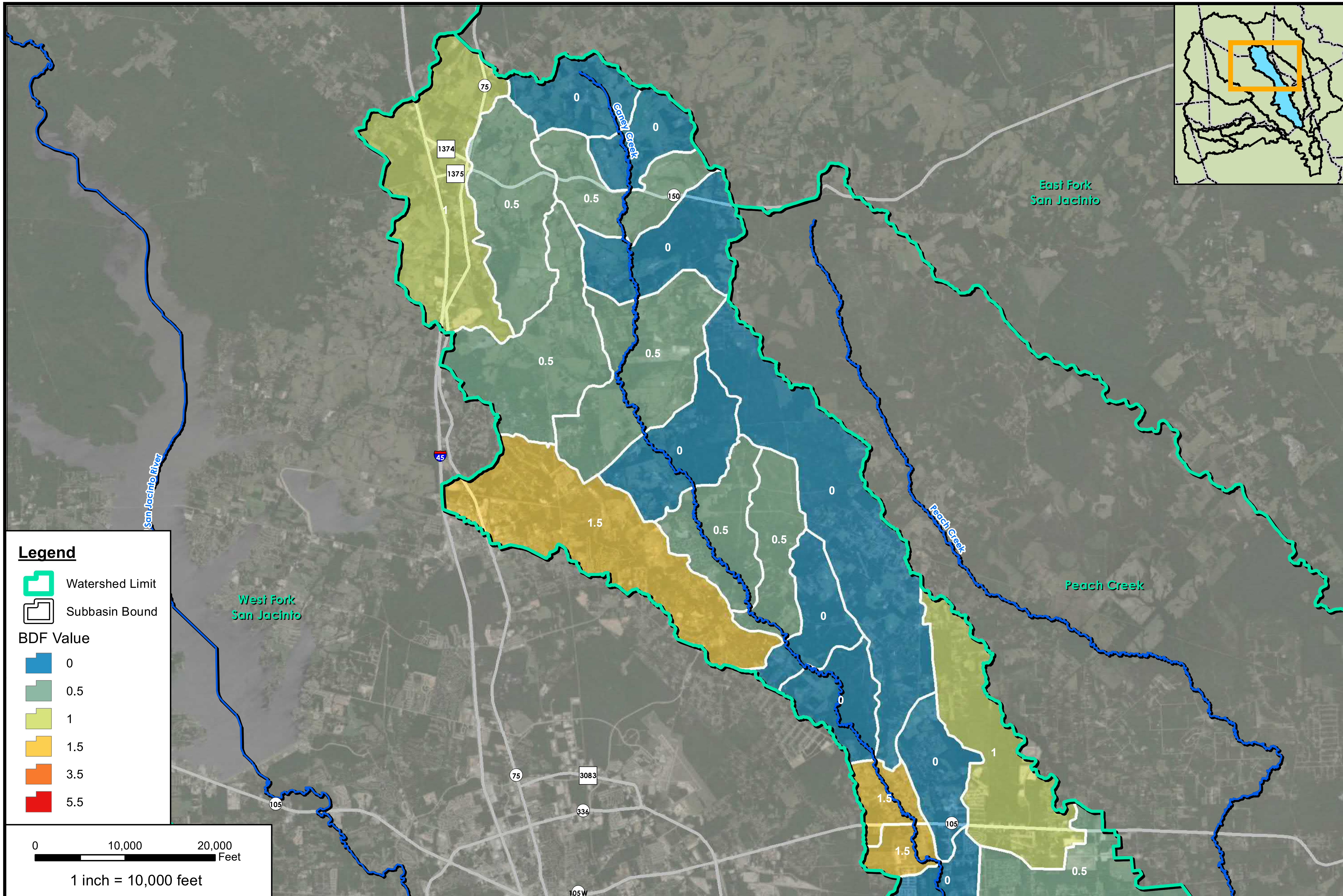
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

BDF VALUES MAP | WEST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C5-D



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FtUS

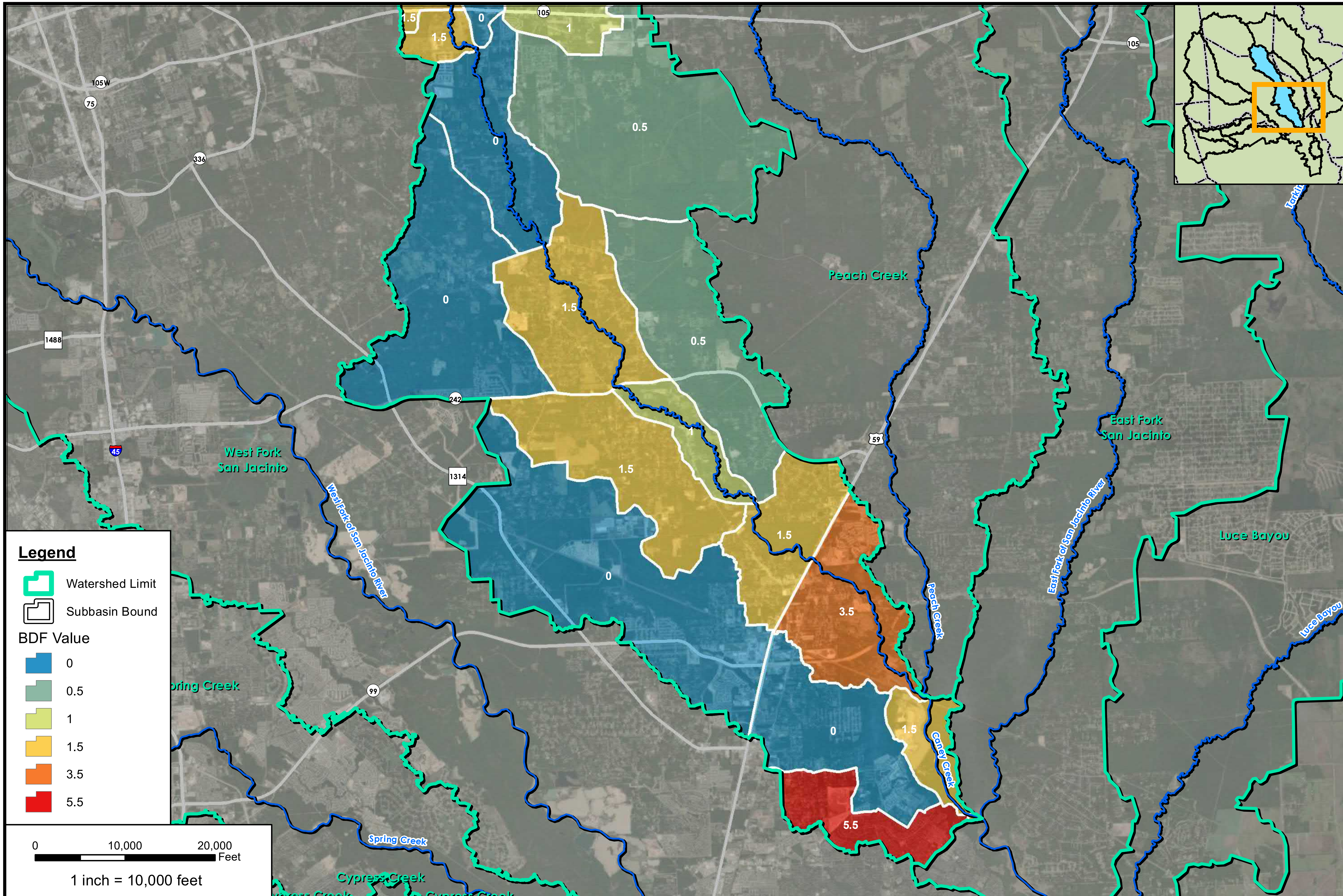
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

BDF VALUES MAP | CANEY CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C5-E



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

BDF VALUES MAP | CANEY CREEK

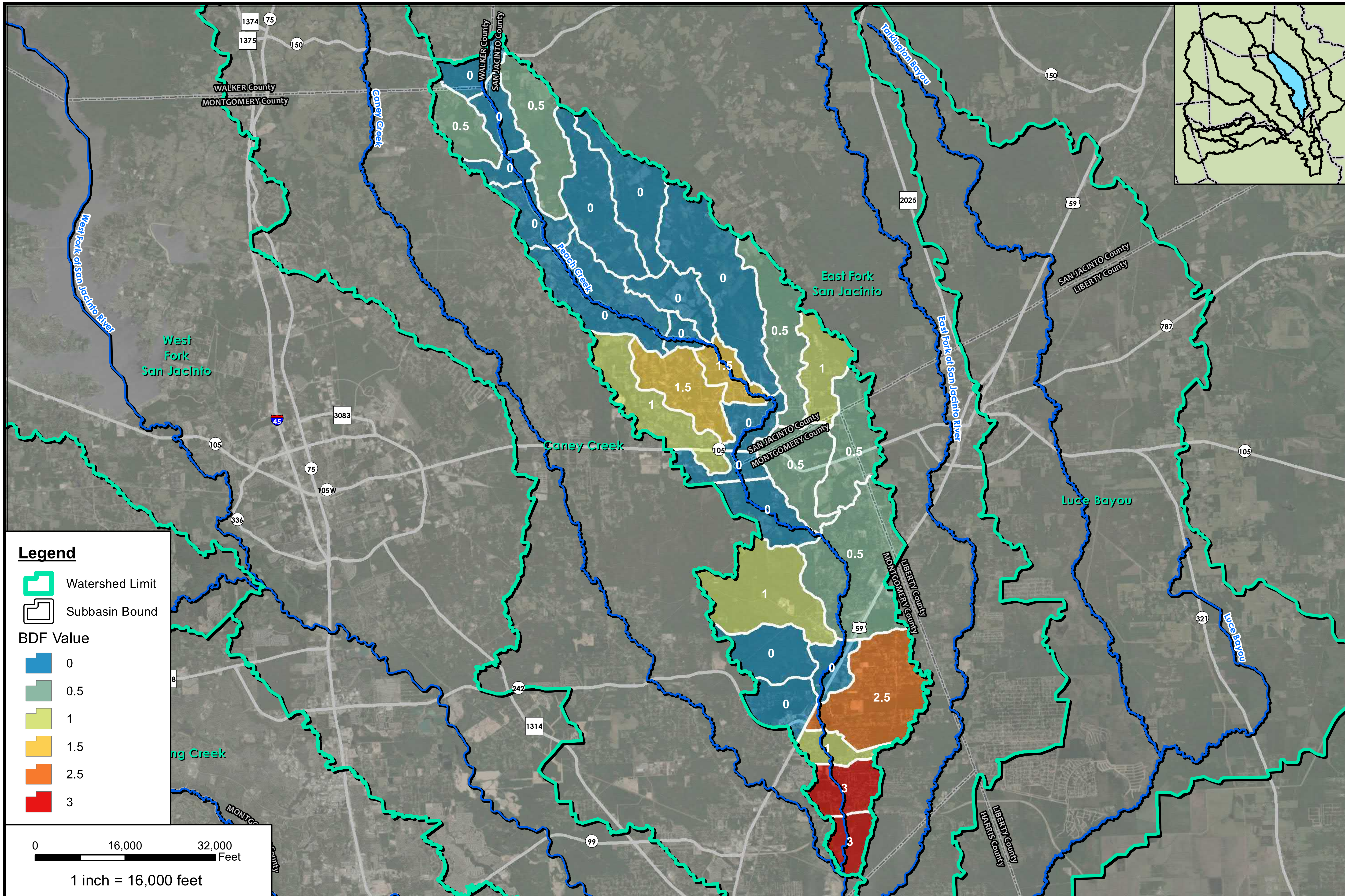
PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C5-F



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

BDF VALUES MAP | PEACH CREEK

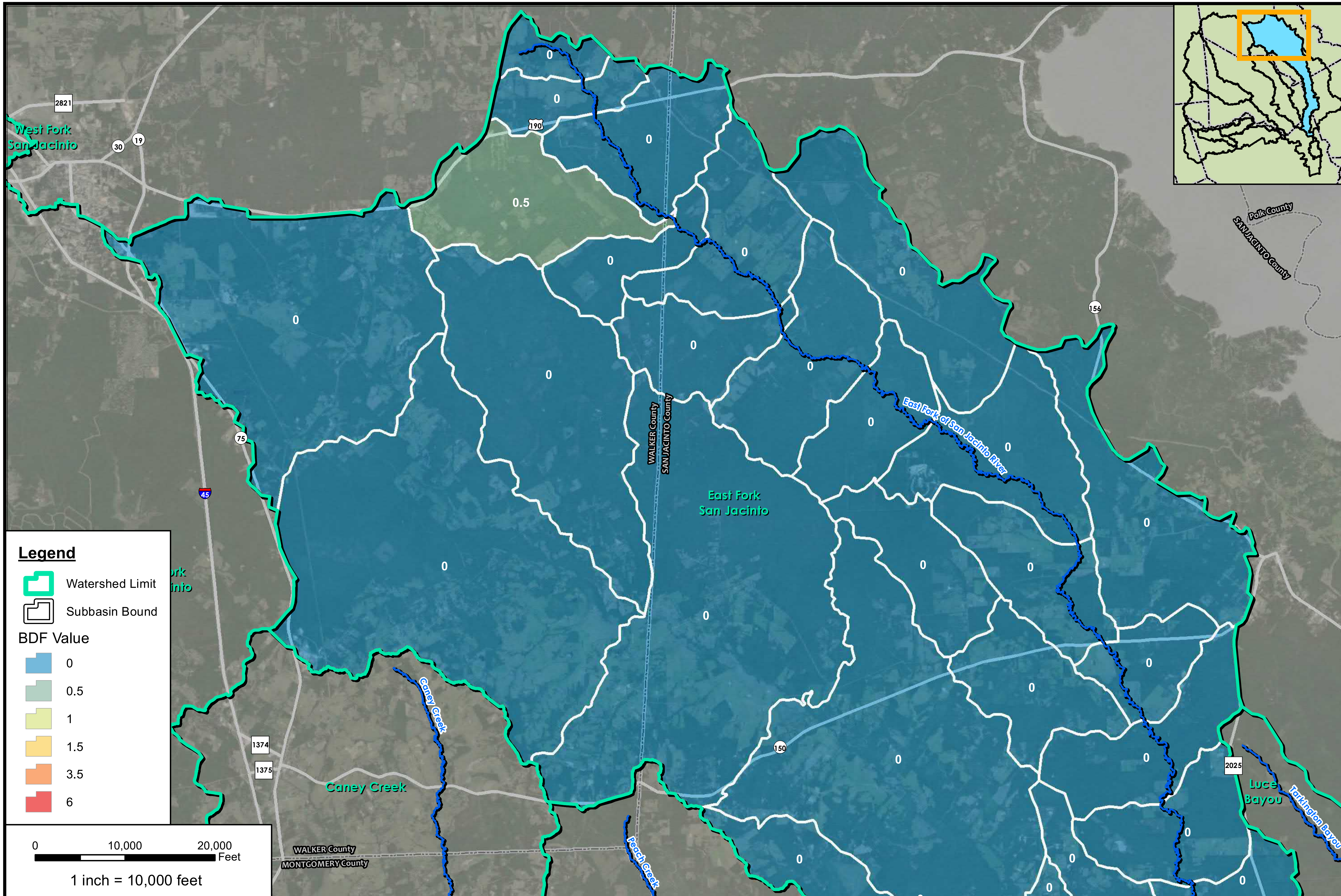
PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C5-G



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FtUS

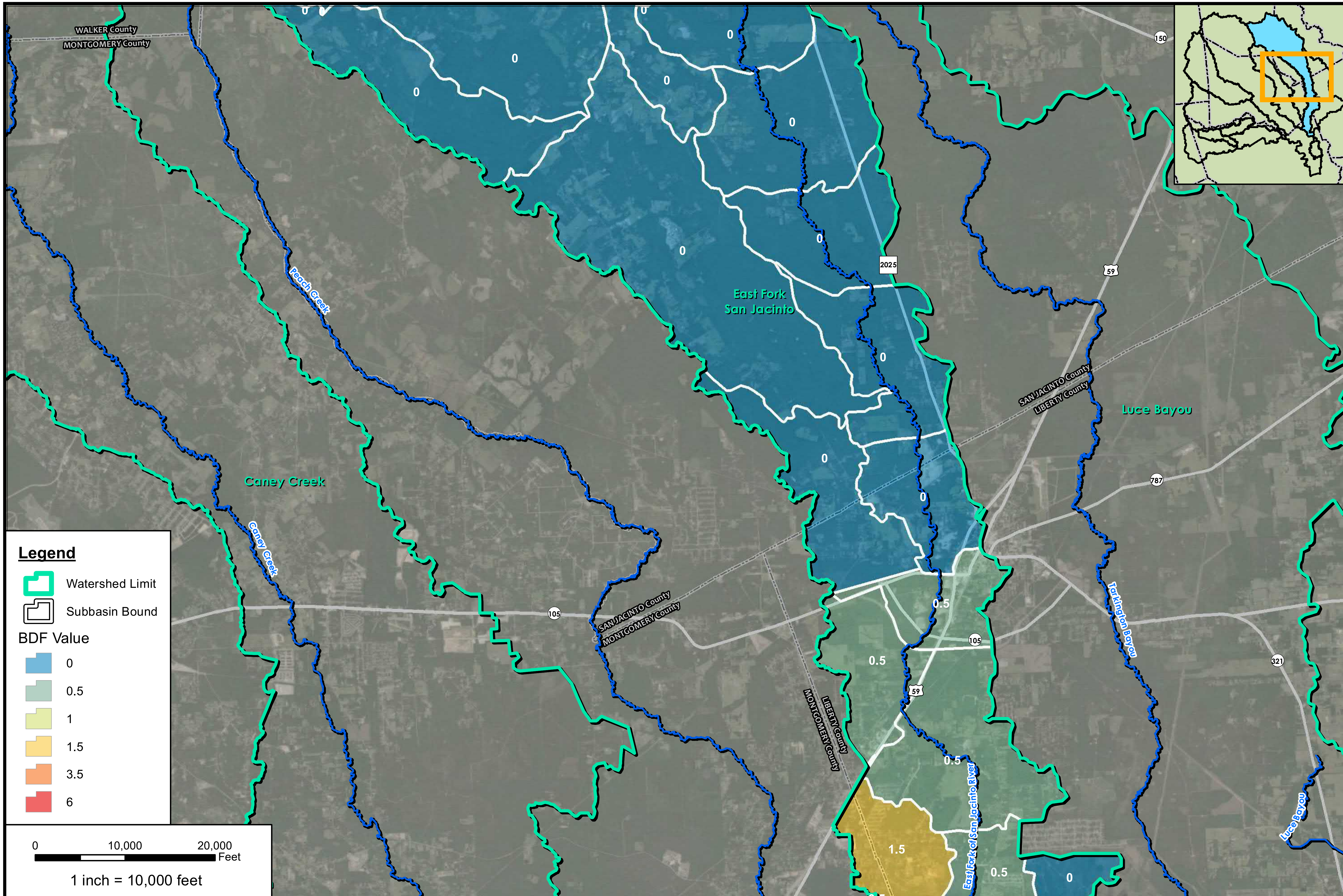
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

BDF VALUES MAP | EAST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C5-H



PROJECT AVO

33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

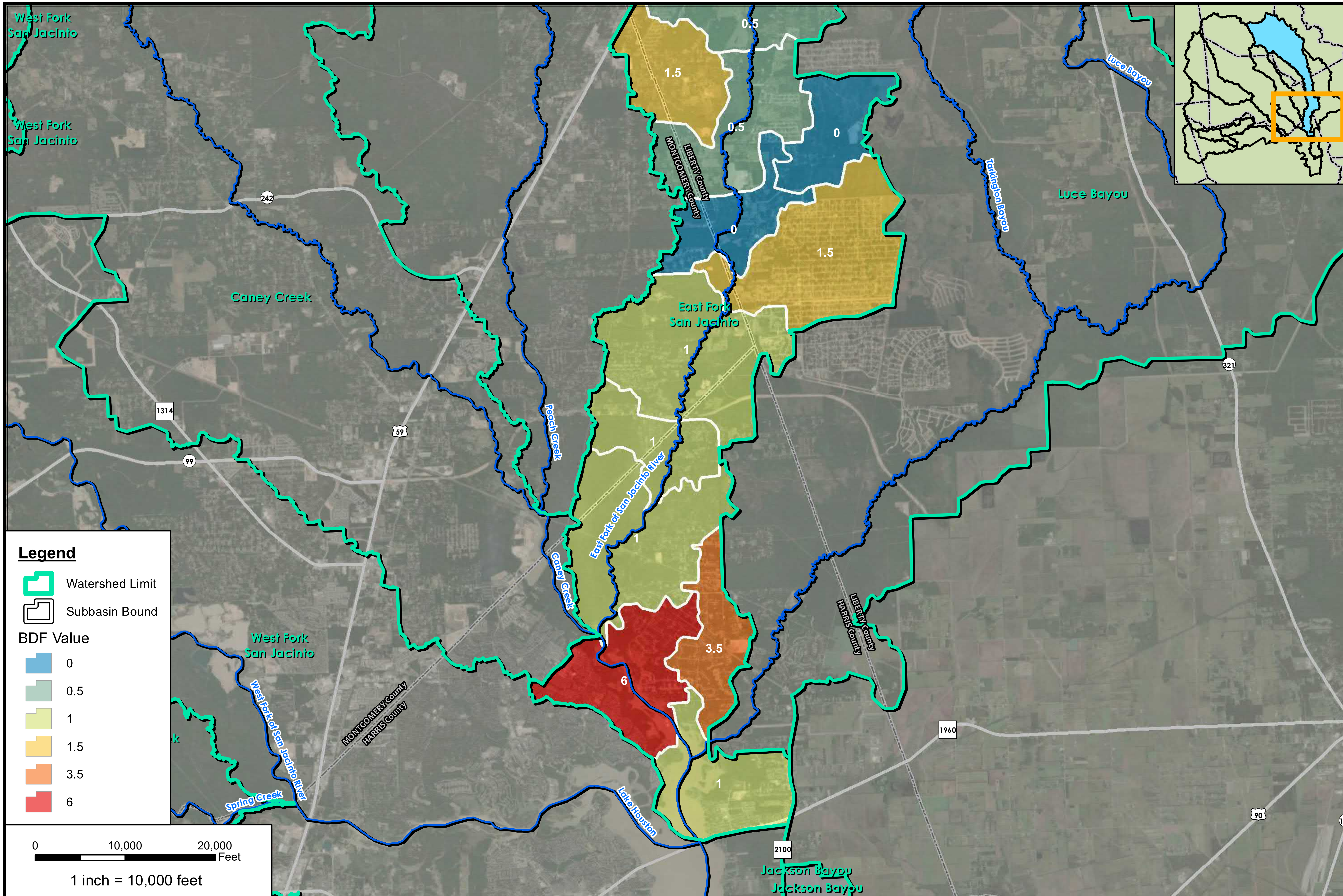
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

BDF VALUES MAP | EAST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C5-I



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

BDF VALUES MAP | EAST FORK SAN JACINTO

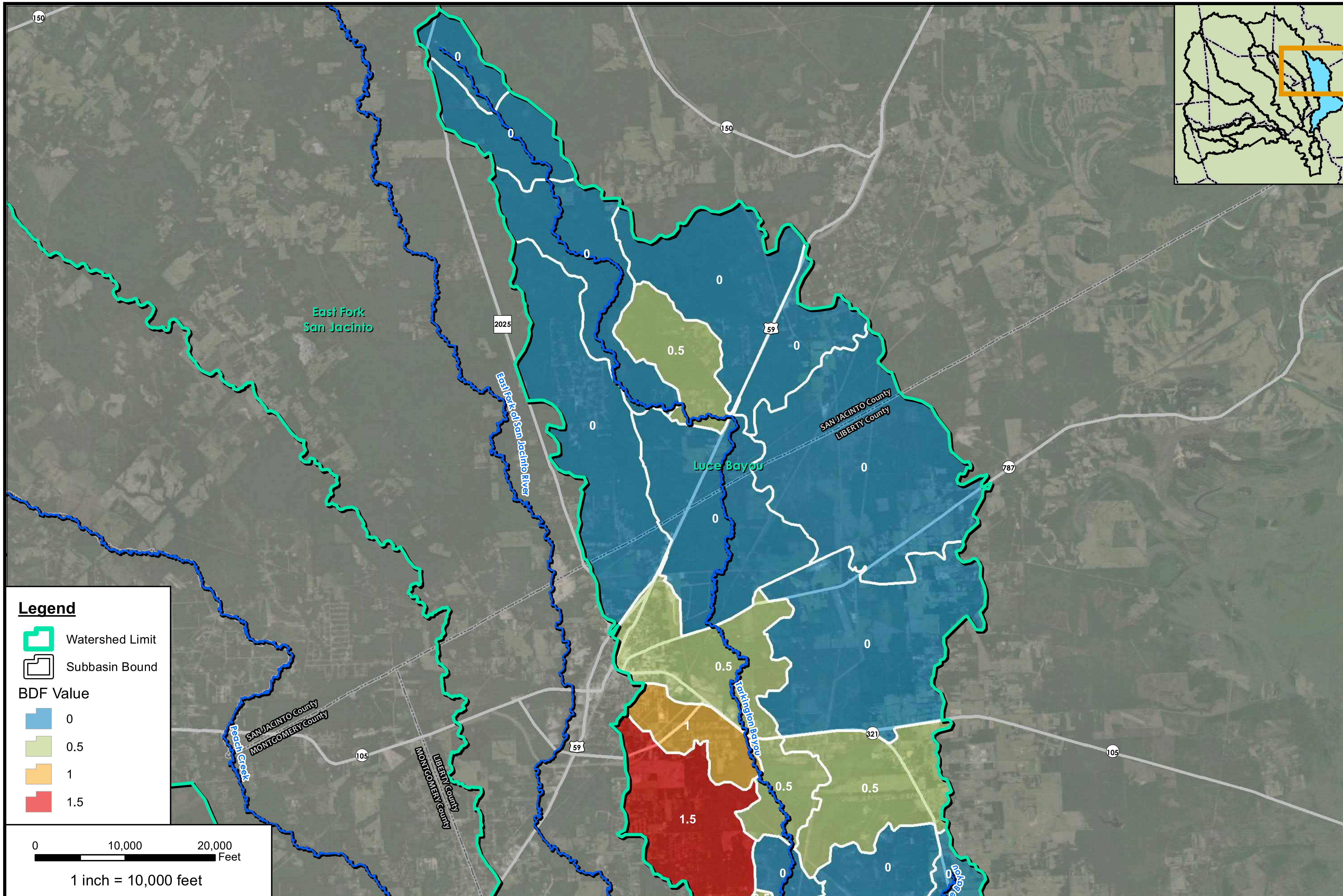
PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C5-J



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

BDF VALUES MAP | LUCE BAYOU

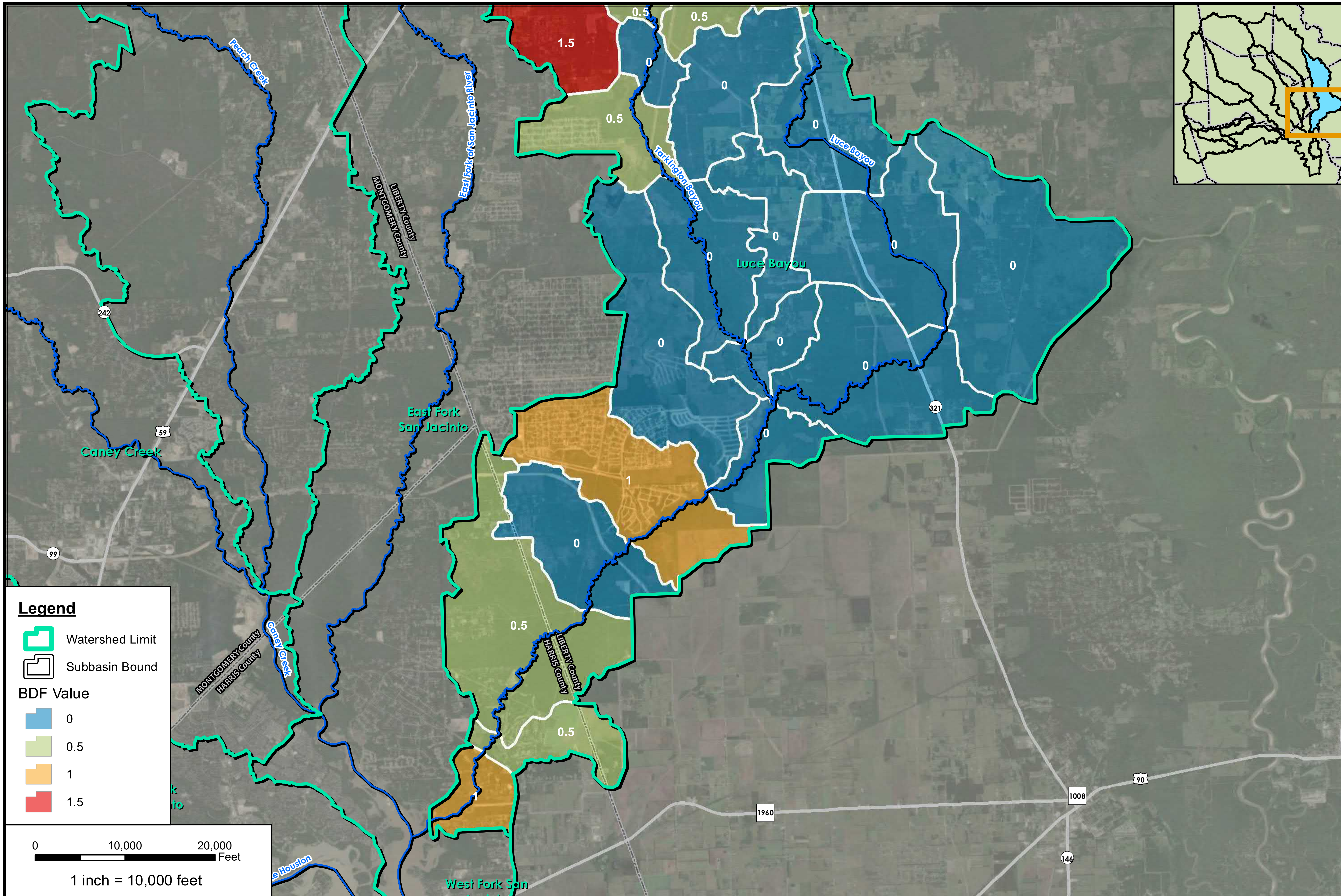
PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FtUS

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C5-K



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FtUS

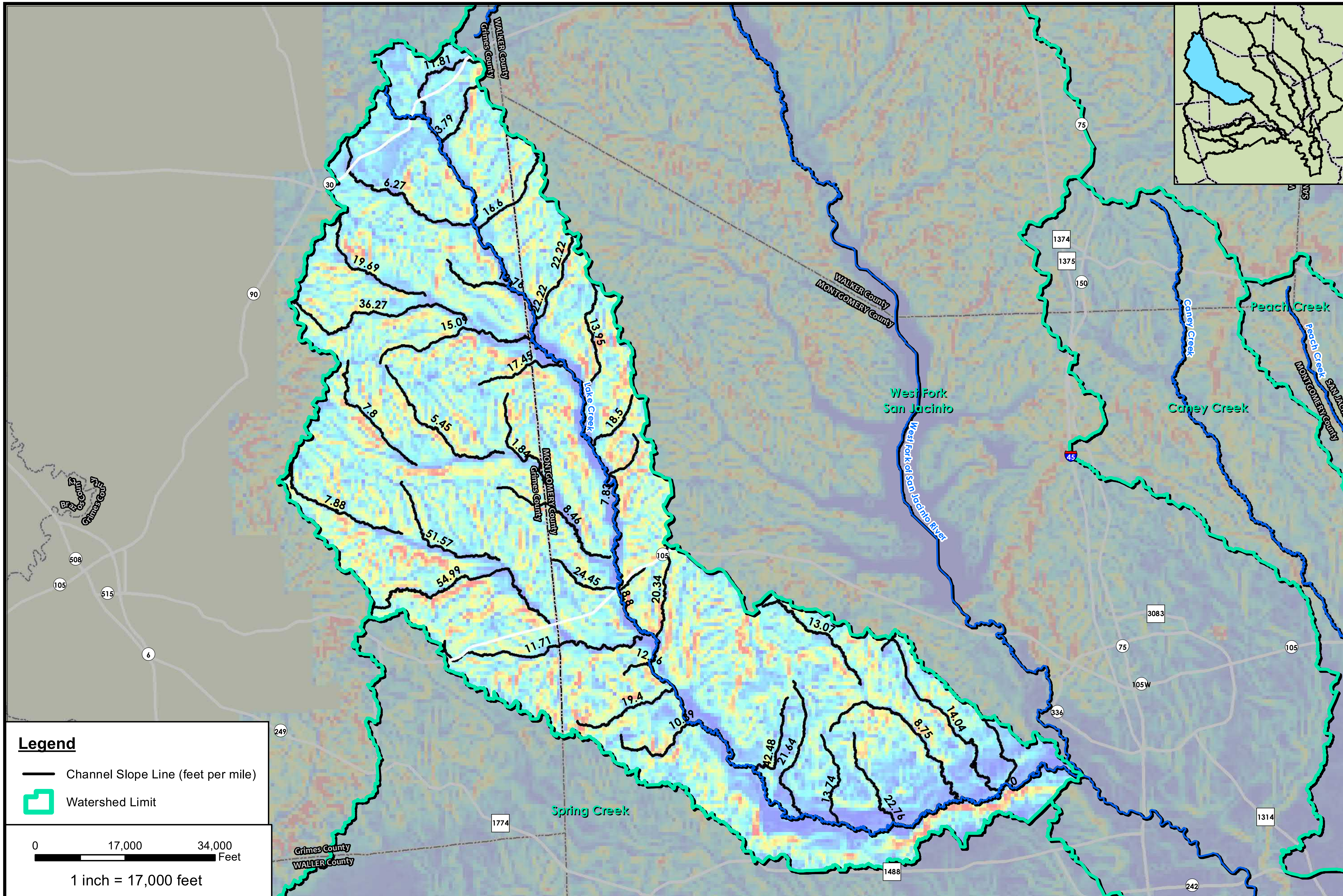
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

BDF VALUES MAP | LUCE BAYOU

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C5-L



PROJECT AVO

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DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

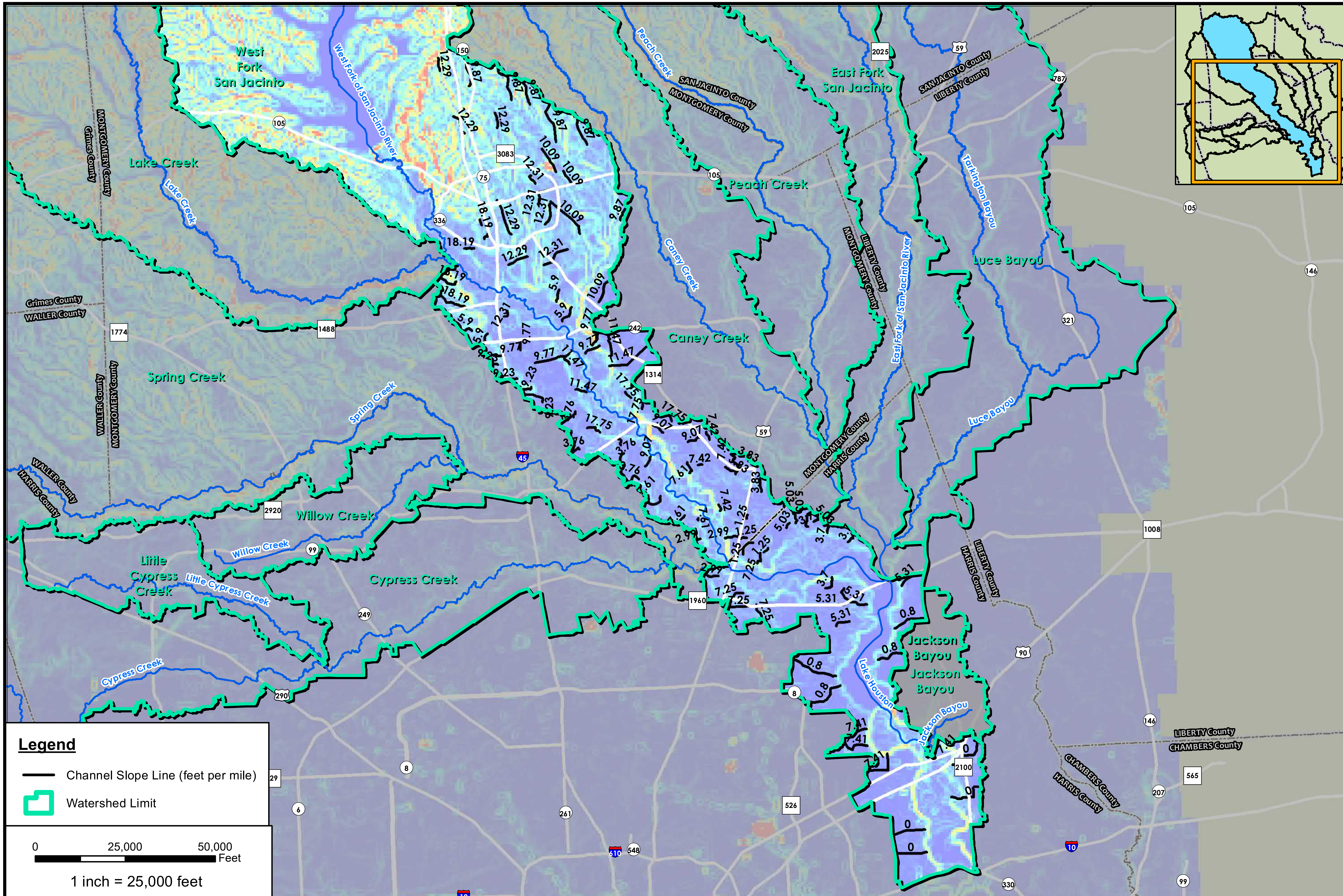
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

CHANNEL SLOPE MAP | LAKE CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C6-A



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

CHANNEL SLOPE MAP | WEST FORK SAN JACINTO

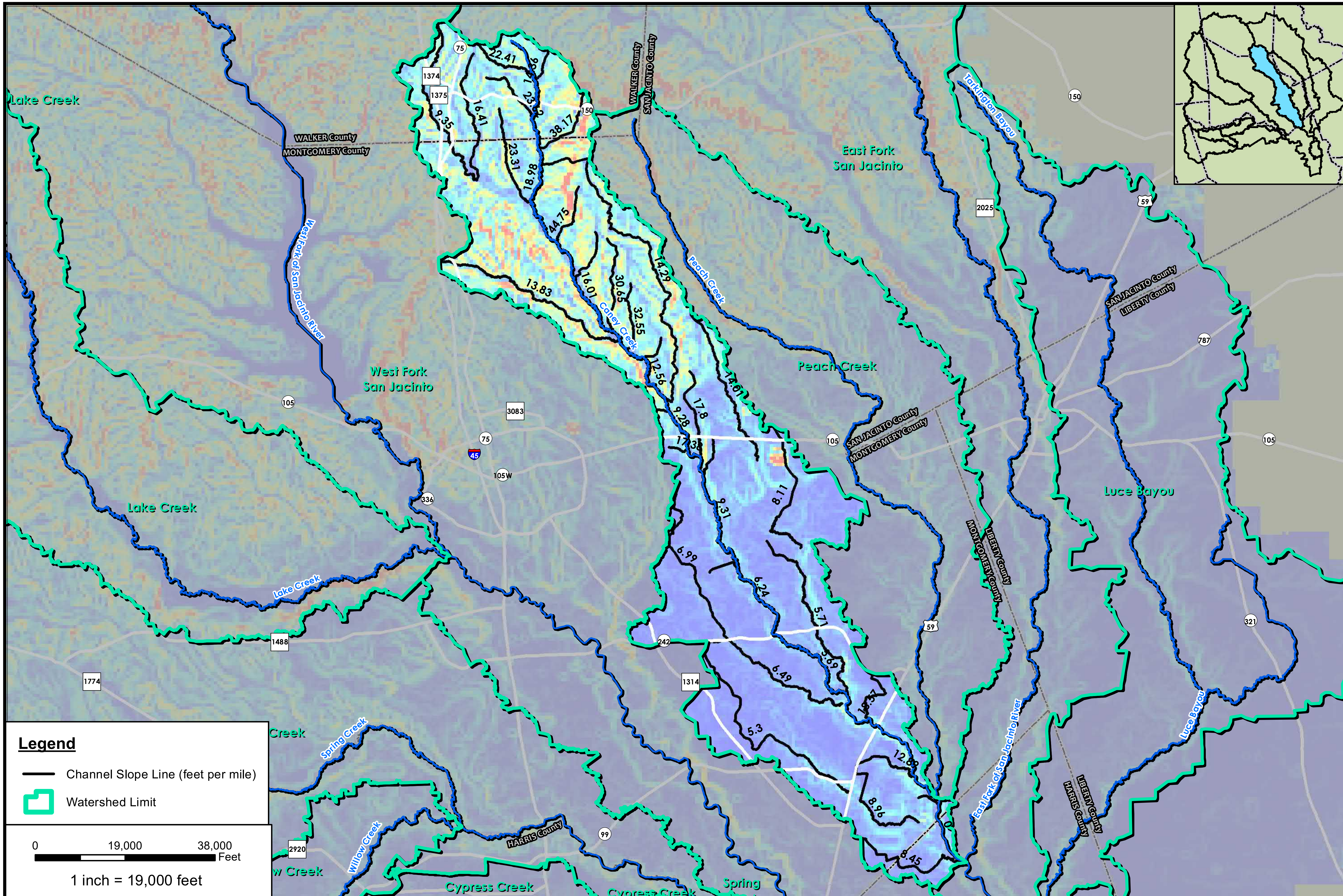
PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C6-B



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

CHANNEL SLOPE MAP | CANEY CREEK

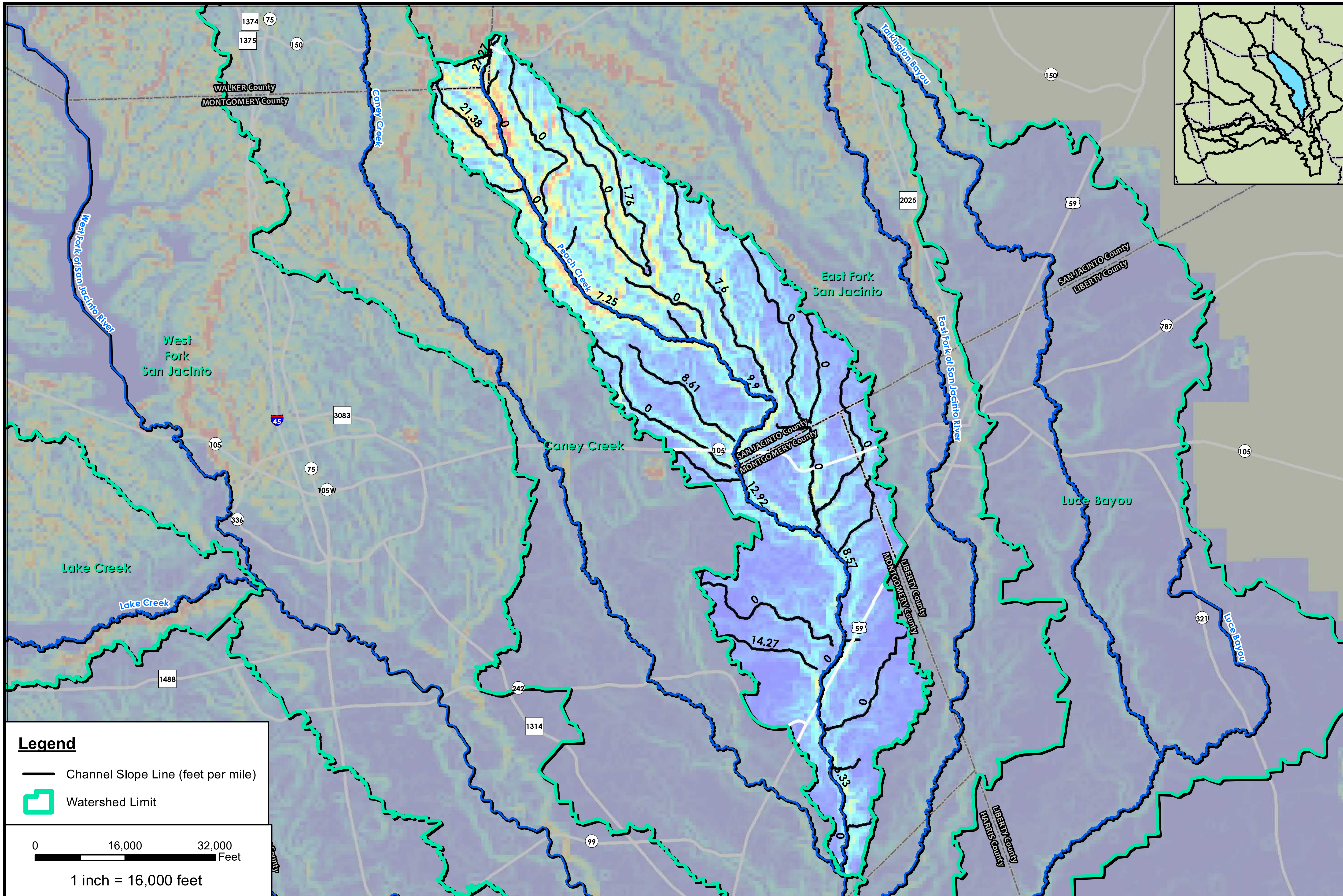
PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C6-C



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

CHANNEL SLOPE MAP | PEACH CREEK

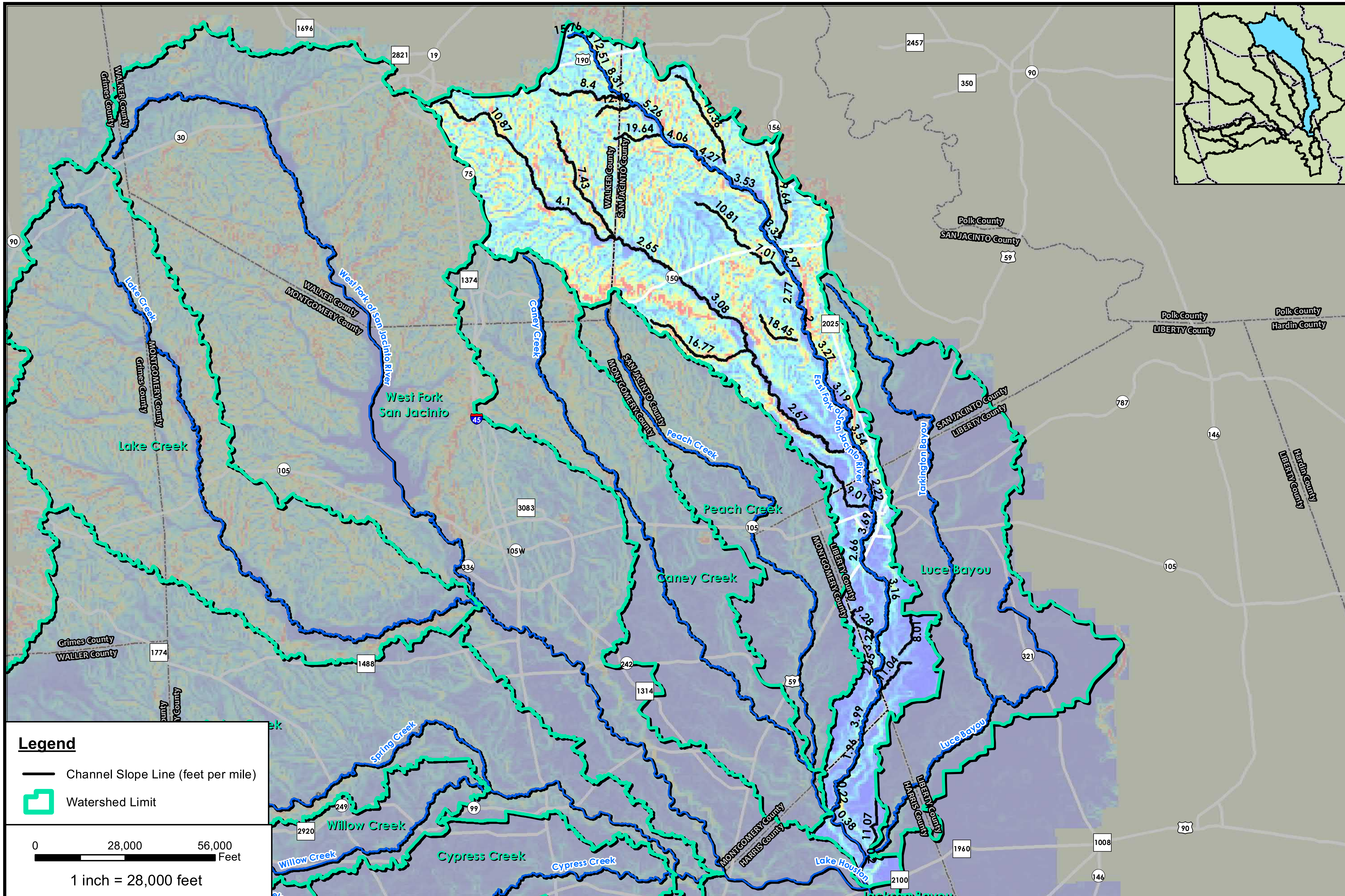
PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C6-D



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

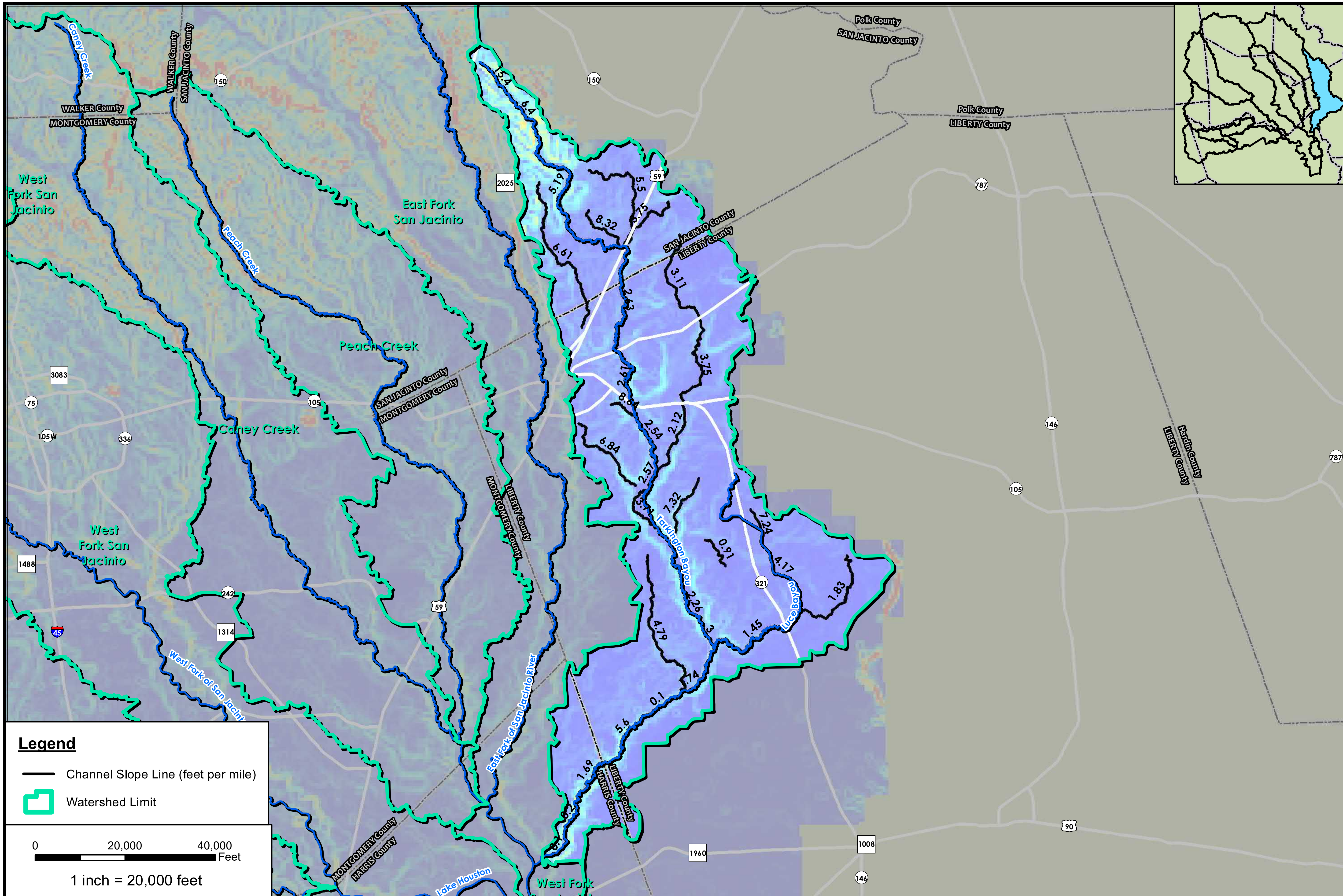
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

CHANNEL SLOPE MAP | EAST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C6-E



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

CHANNEL SLOPE MAP | LUCE BAYOU

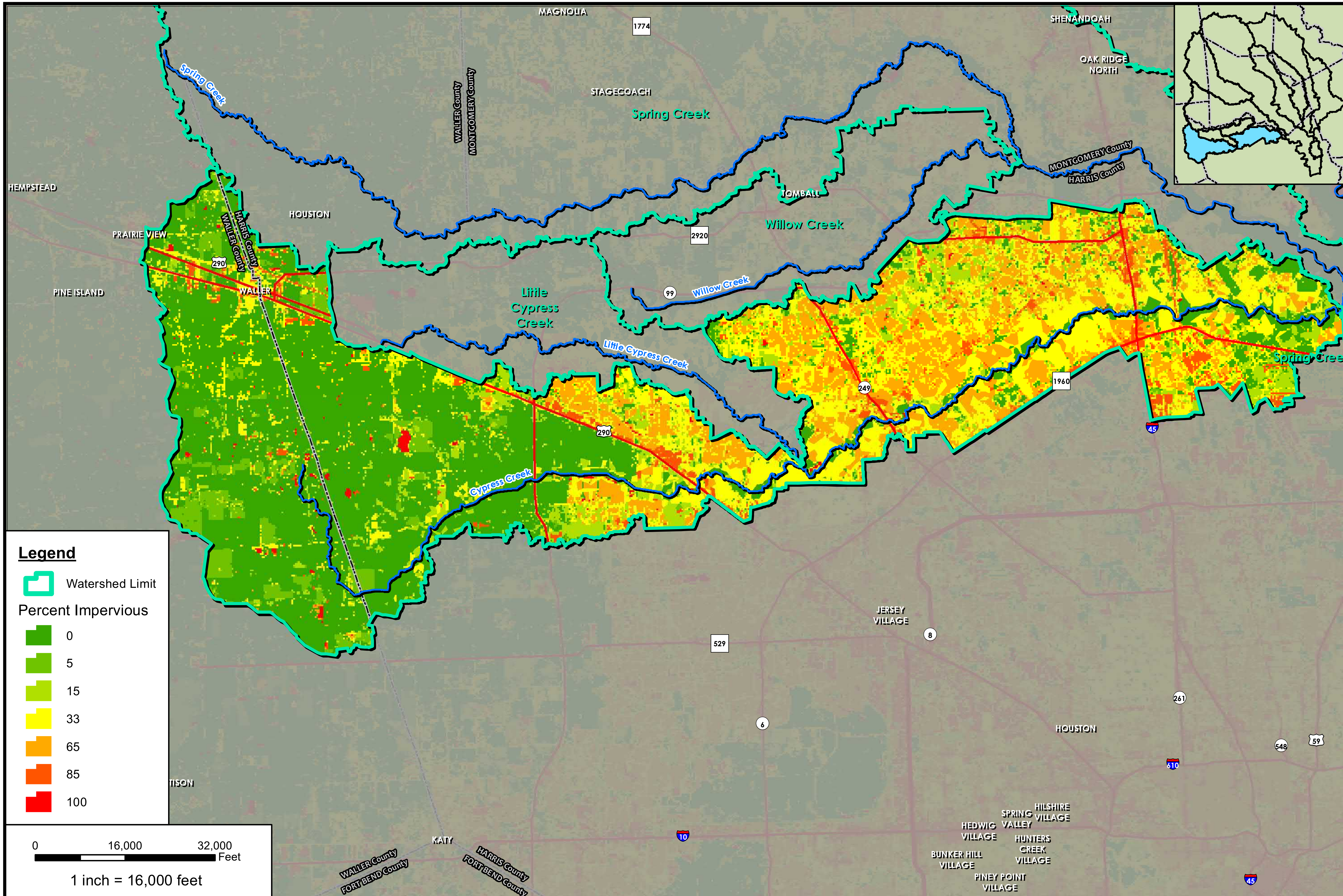
PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C6-F



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

PERCENT IMPERVIOUS MAP | CYPRESS CREEK

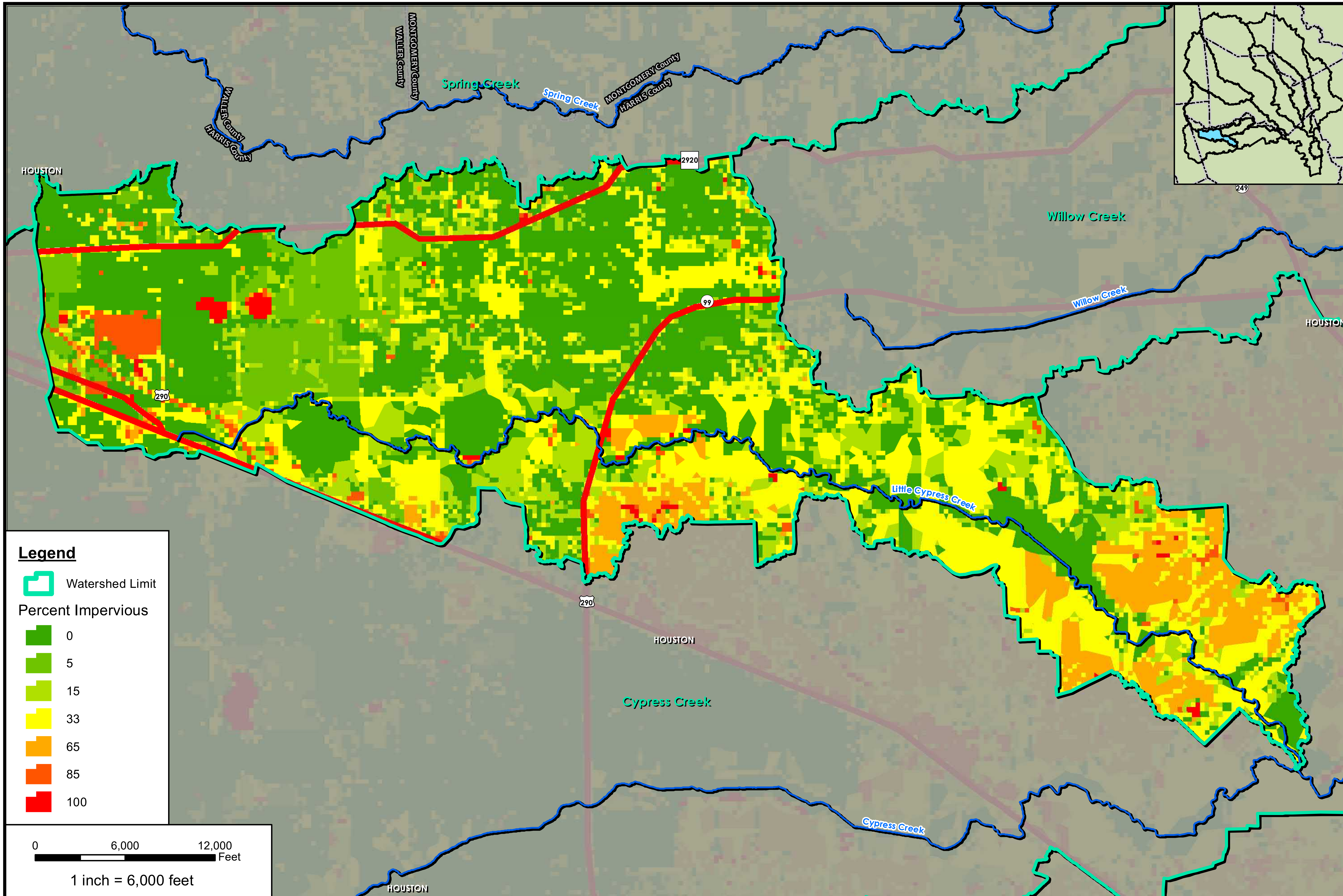
PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FtUS

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C7-A



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FtUS

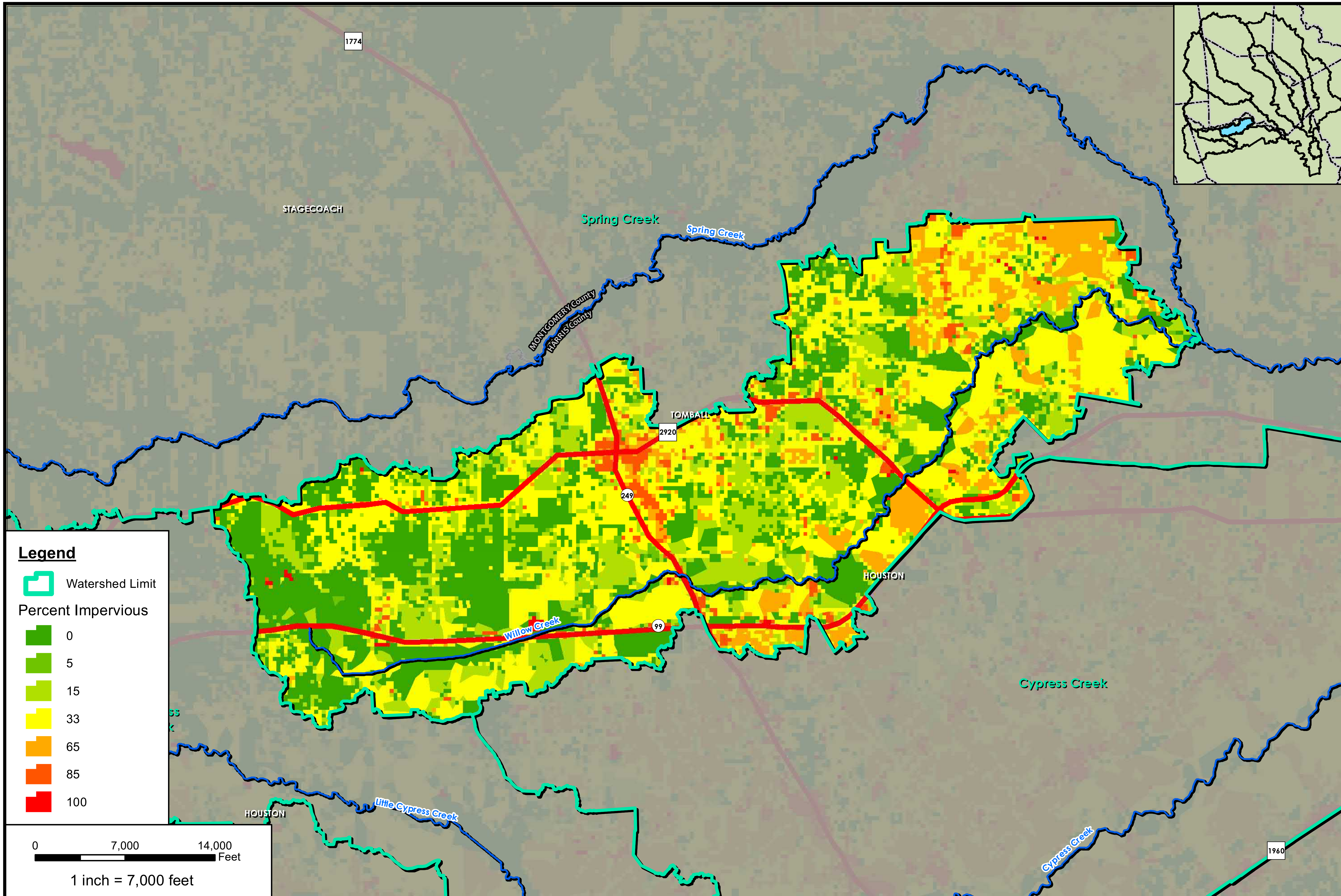
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

PERCENT IMPERVIOUS MAP | LITTLE CYPRESS CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C7-B



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FtUS

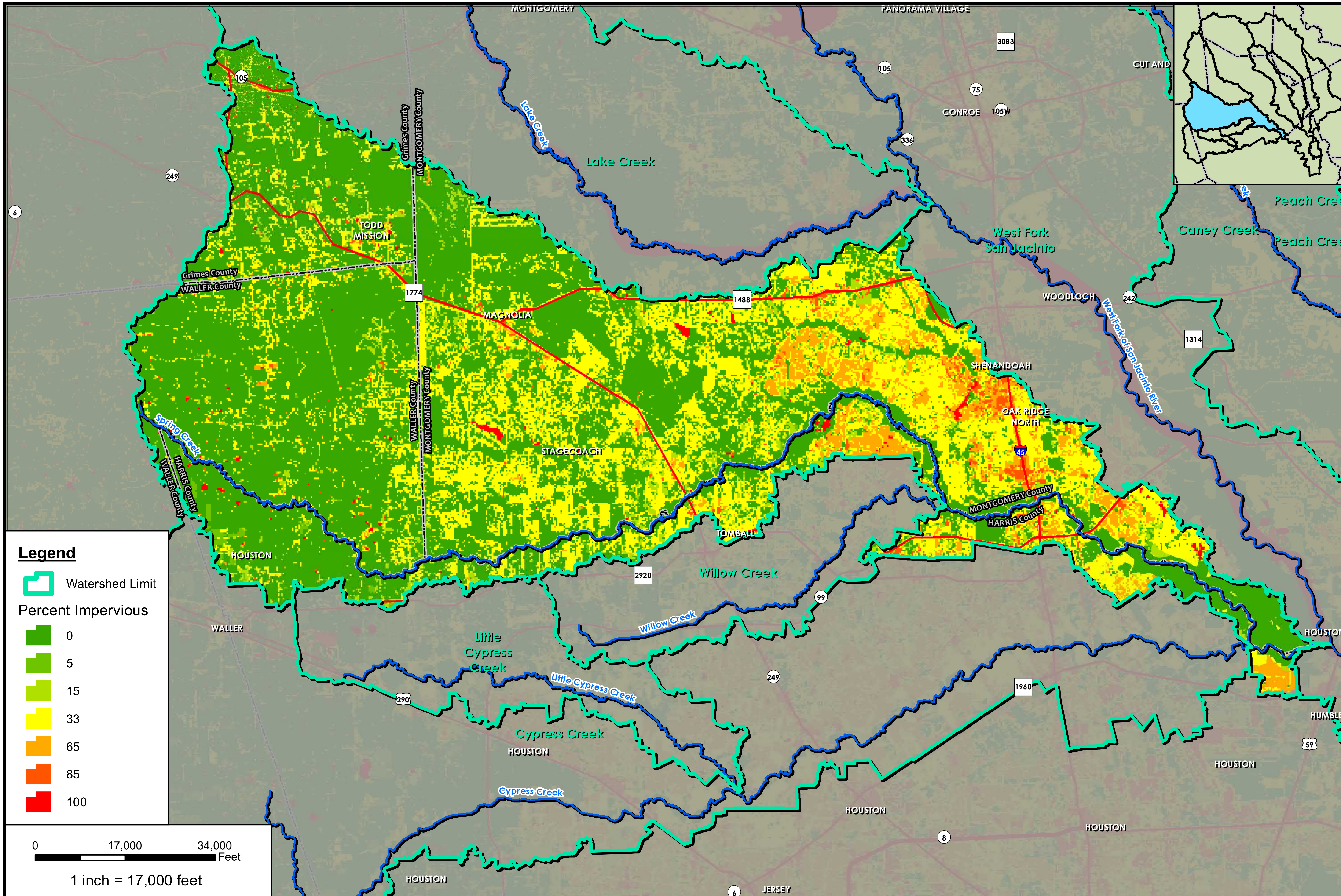
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

PERCENT IMPERVIOUS MAP | WILLOW CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C7-C



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

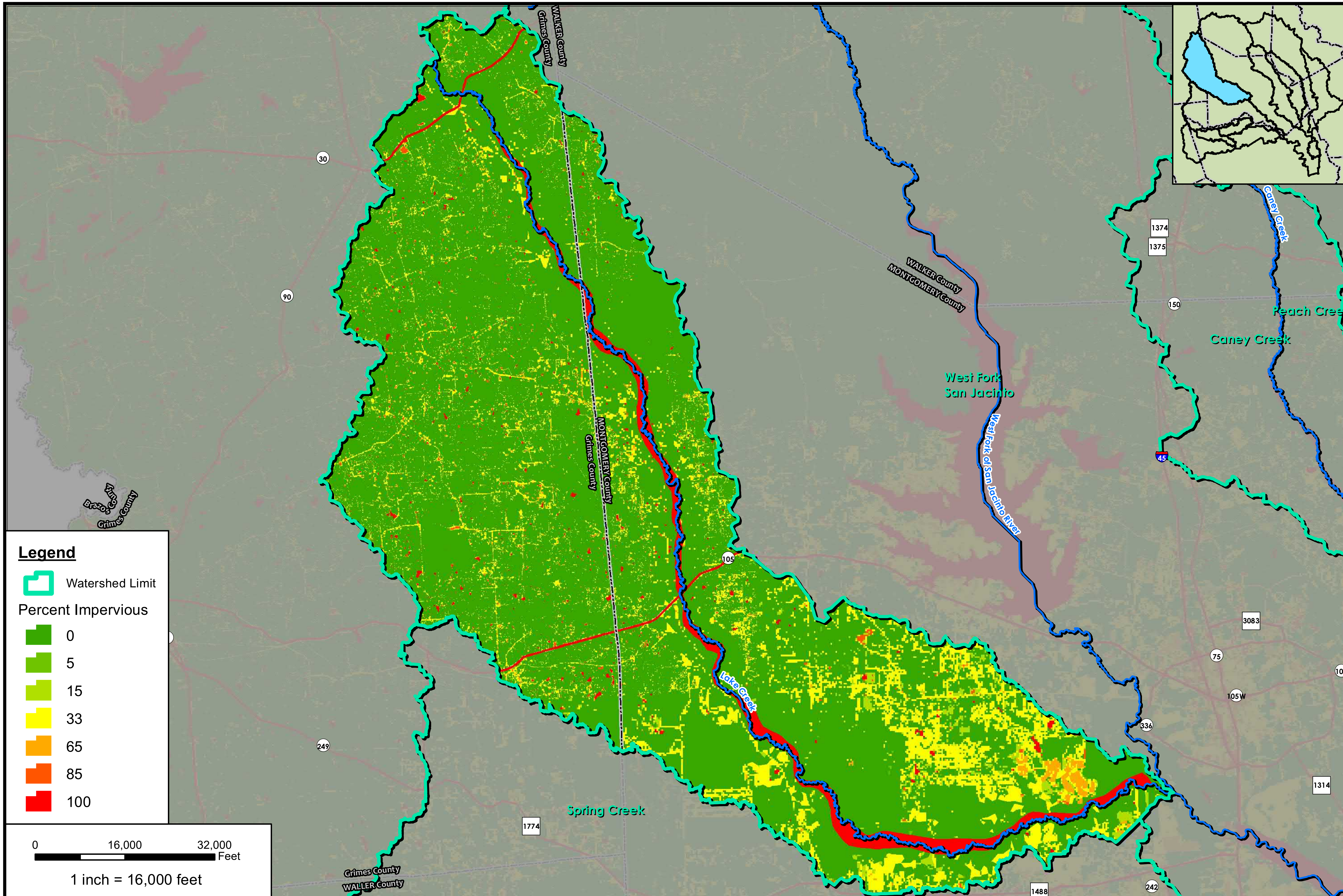
PERCENT IMPERVIOUS MAP | SPRING CREEK

PROJECT AVO 33465

DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C7-D



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ftus

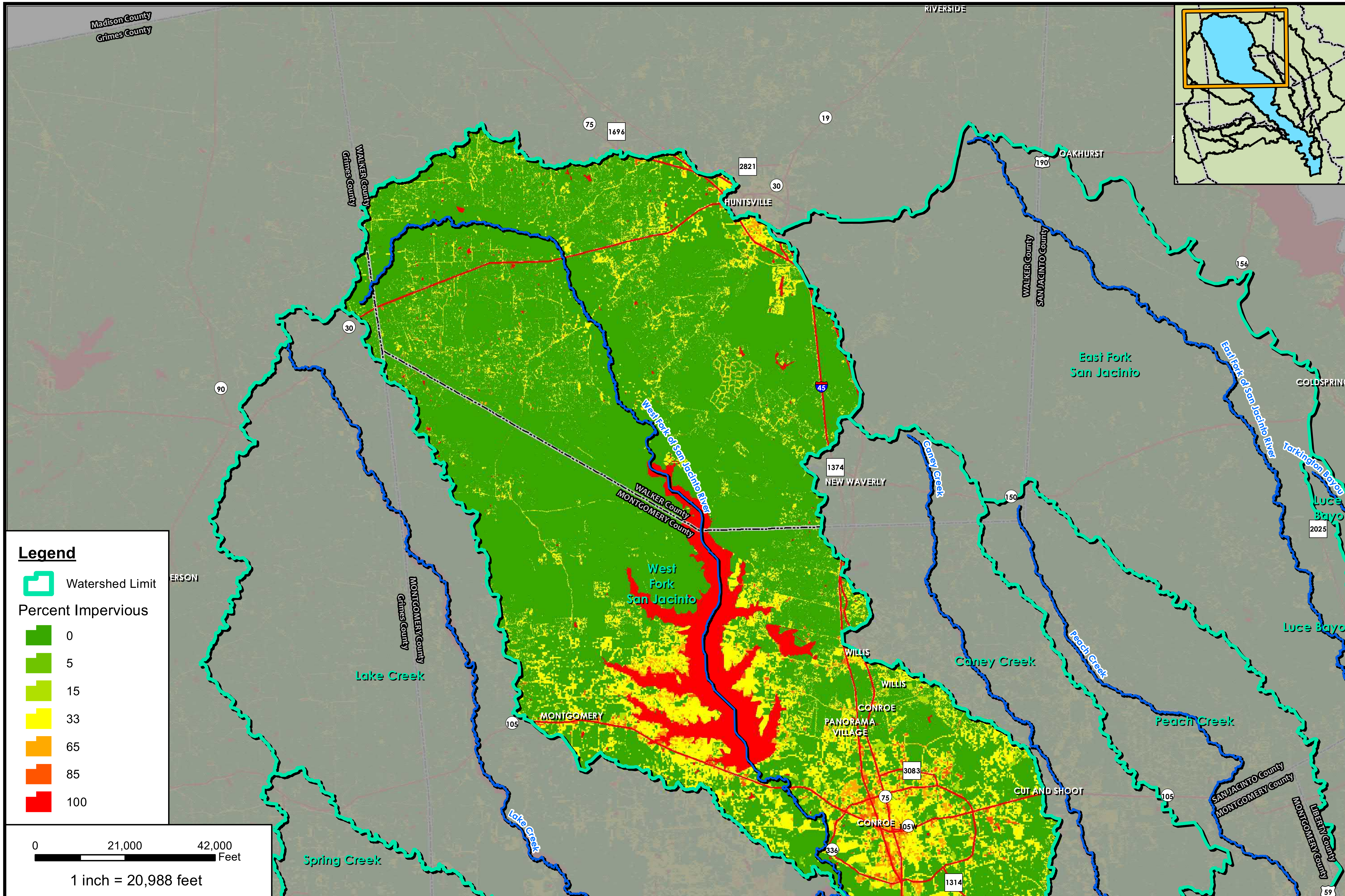
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

MANNING'S N VALUE MAP | LAKE CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C7-E



PROJECT AVO 33465

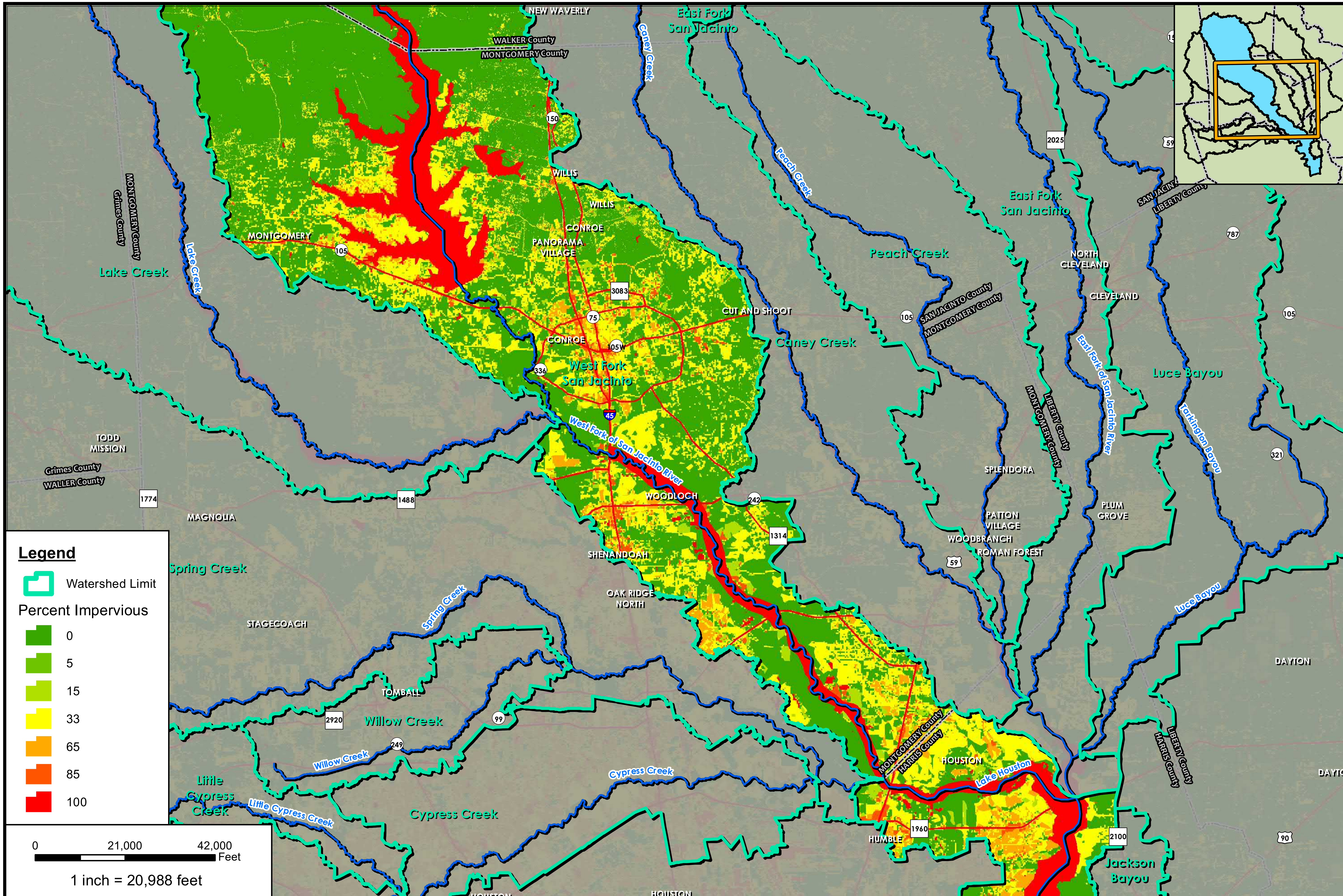
DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

HARRIS COUNTY FLOOD CONTROL DISTRICT
San Jacinto Regional Watershed Master Drainage Plan

PERCENT IMPERVIOUS MAP | WEST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C7-F



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HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

PERCENT IMPERVIOUS MAP | WEST FORK SAN JACINTO

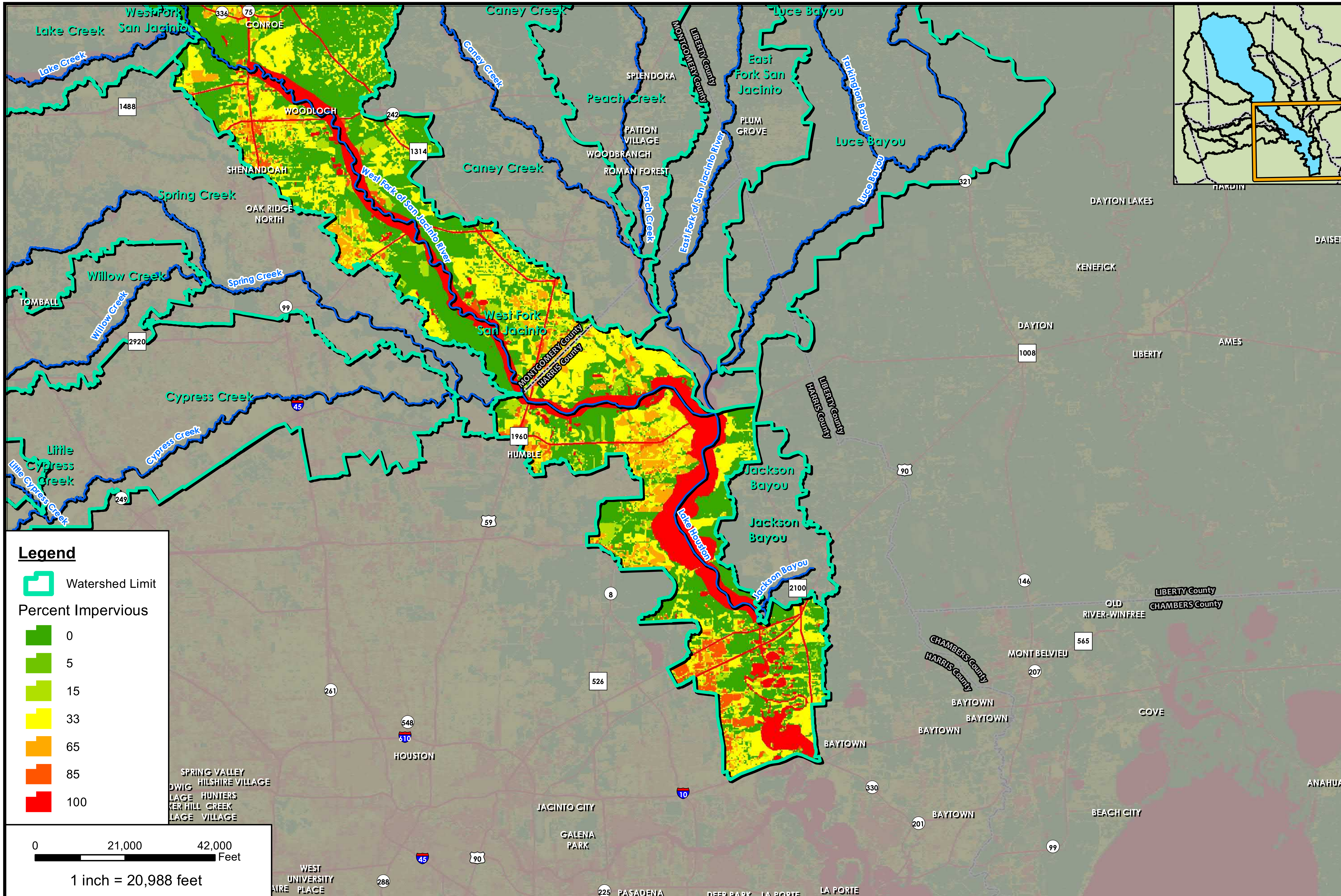
PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C7-G



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

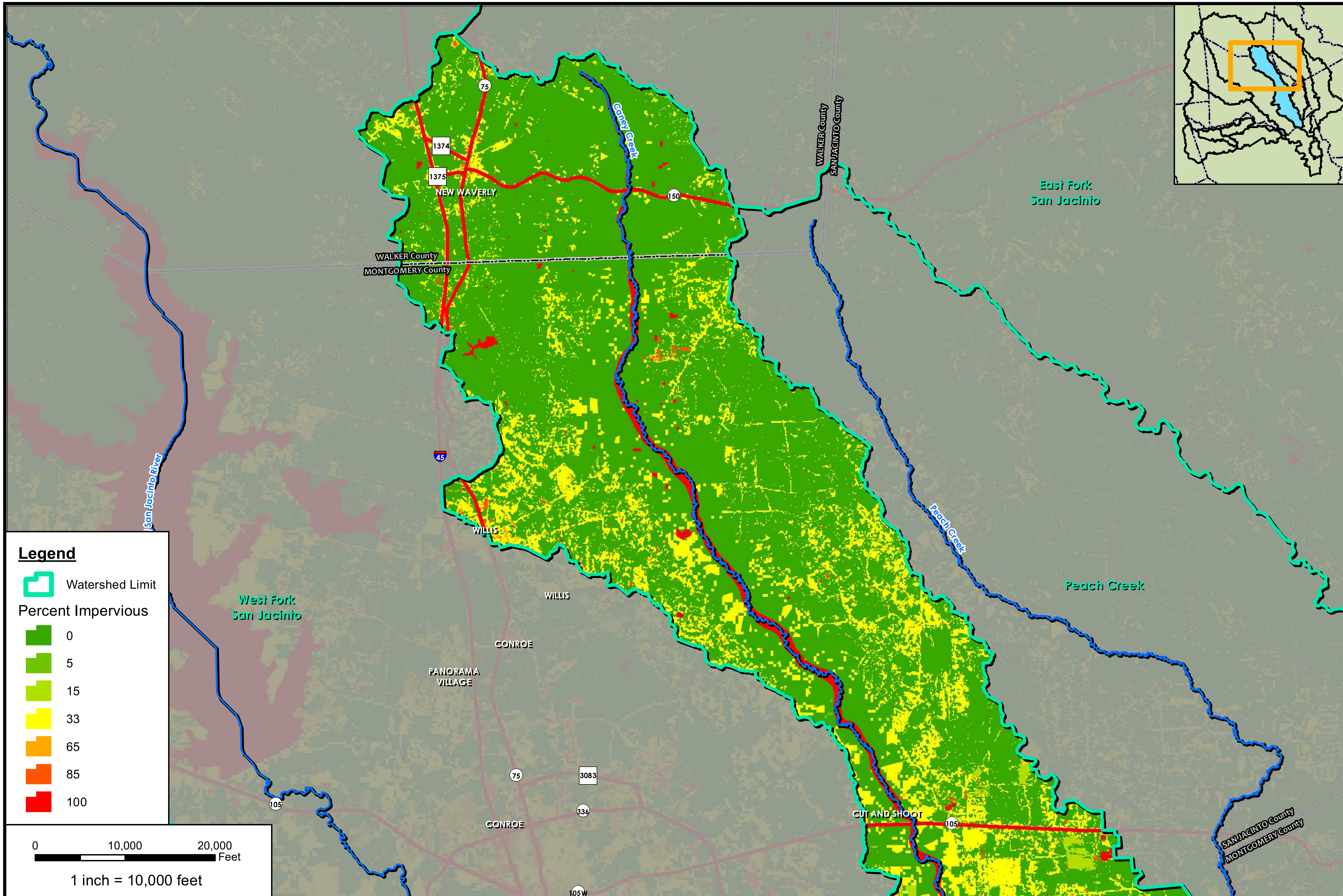
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

PERCENT IMPERVIOUS MAP | WEST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C7-H



PROJECT AVO 33465

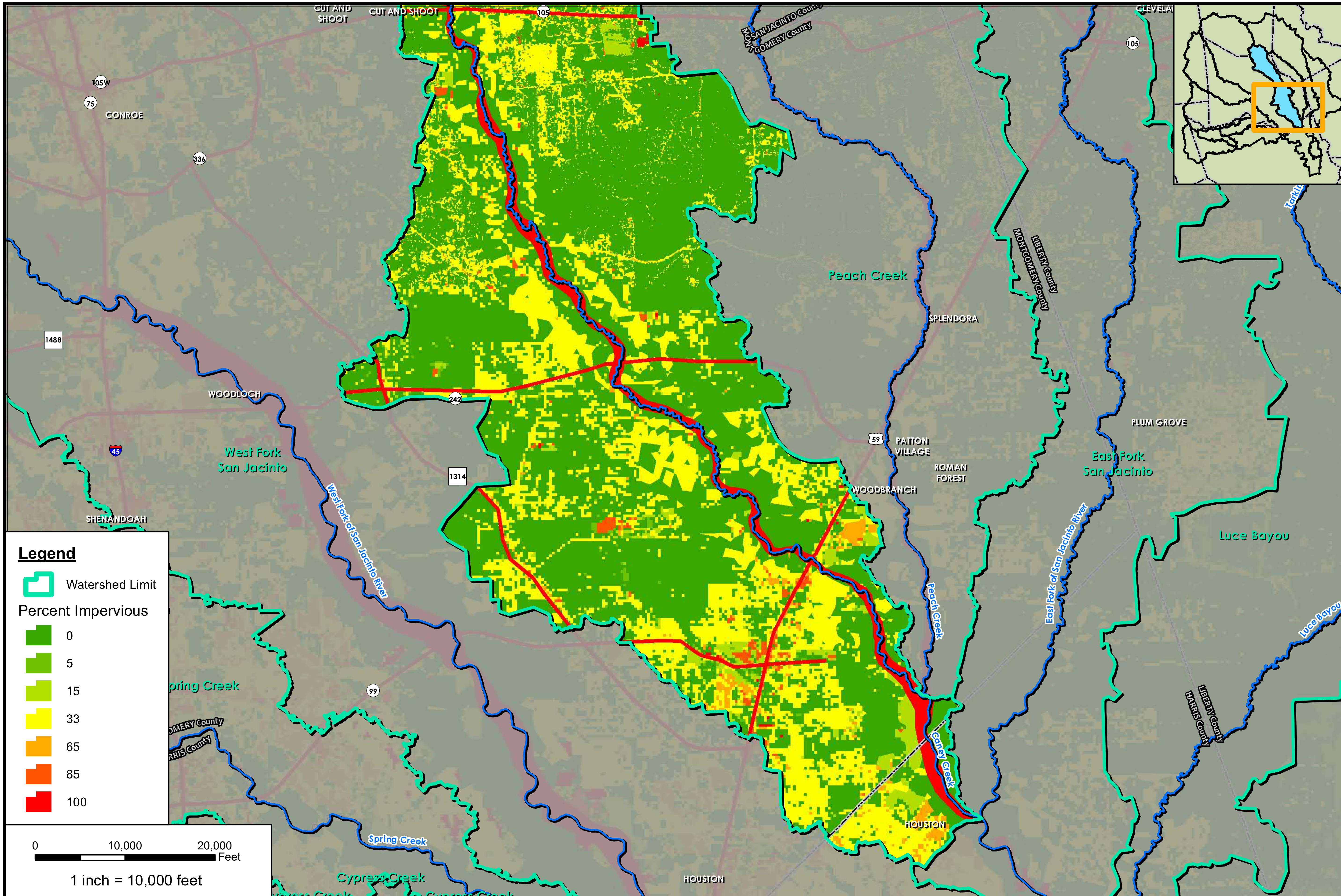
DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FtUS

HARRIS COUNTY FLOOD CONTROL DISTRICT
San Jacinto Regional Watershed Master Drainage Plan

PERCENT IMPERVIOUS MAP | CANEY CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C7-I



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

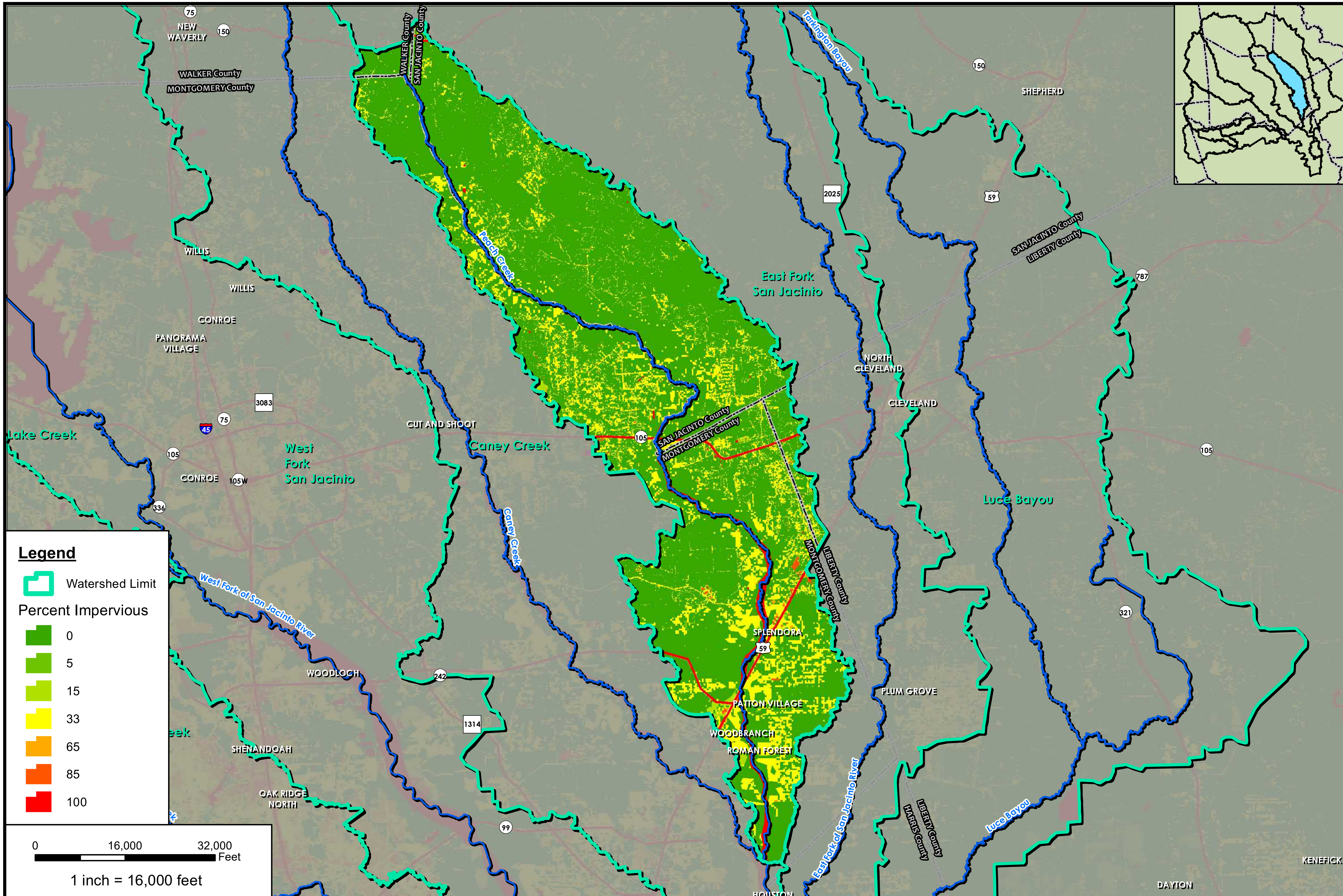
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

PERCENT IMPERVIOUS MAP | CANEY CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C7-J



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

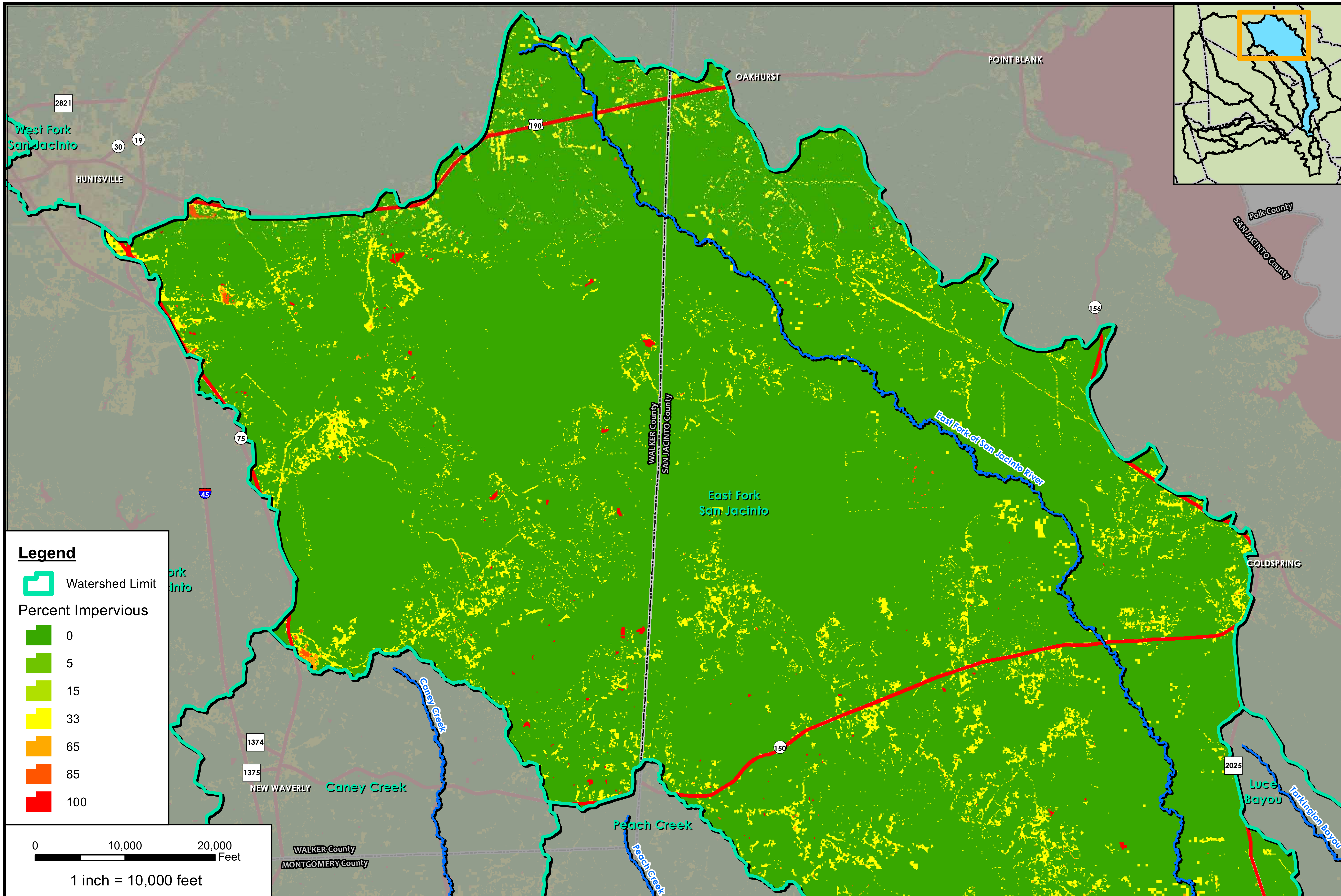
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

PERCENT IMPERVIOUS MAP | PEACH CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C7-K



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FtUS

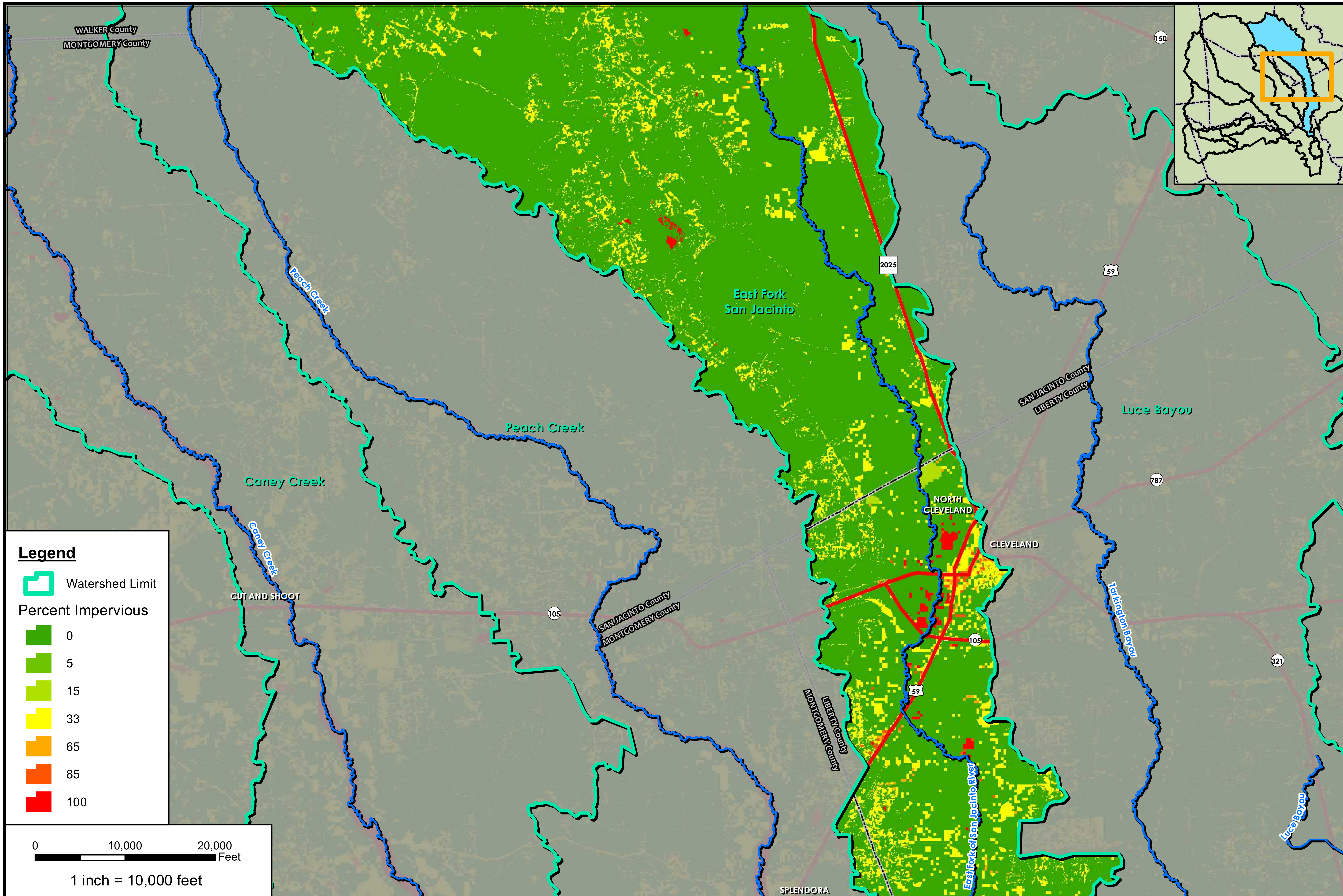
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

PERCENT IMPERVIOUS MAP | EAST FORK SAN JACINTO

SAN JACINTO
REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C7-L



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

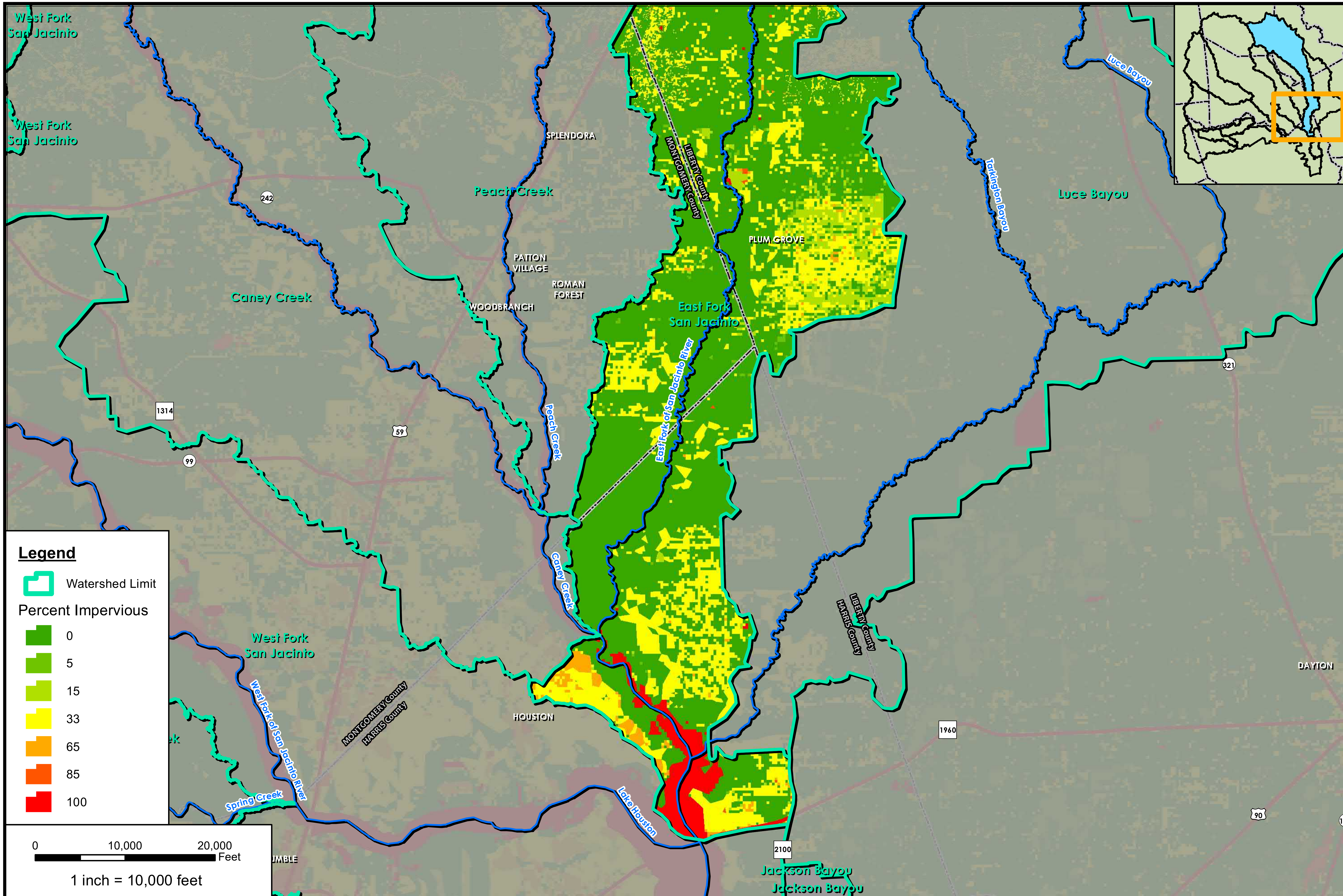
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

PERCENT IMPERVIOUS MAP | EAST FORK SAN JACINTO

SAN JACINTO
REGIONAL WATERSHED
MASTER DRAINAGE PLAN

Exhibit C7-M



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

N S E W

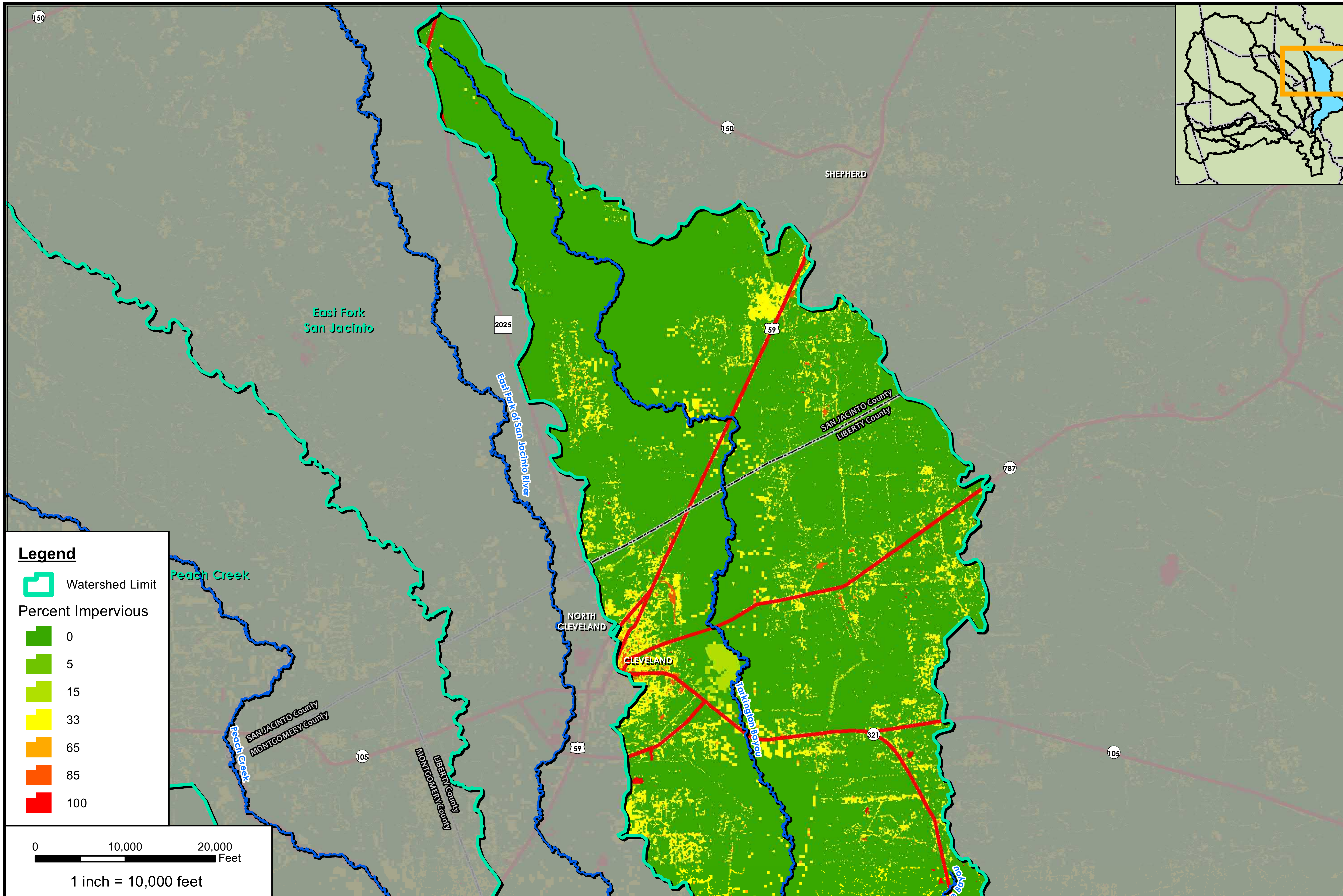
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

PERCENT IMPERVIOUS MAP | EAST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C7-N



PROJECT AVO 33465

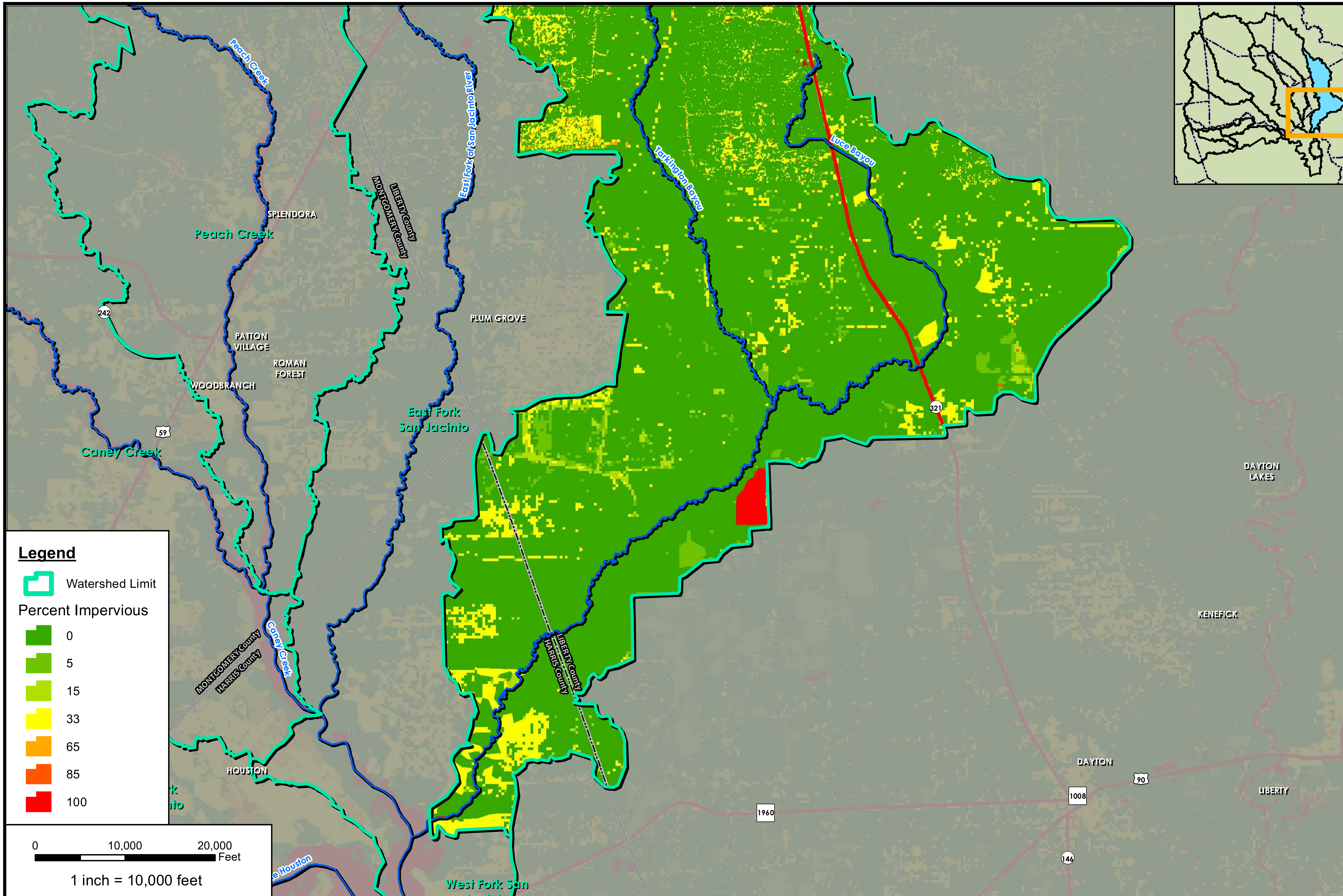
DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FtUS

HARRIS COUNTY FLOOD CONTROL DISTRICT
San Jacinto Regional Watershed Master Drainage Plan

PERCENT IMPERVIOUS MAP | LUCE AND TARKINGTON

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C7-O



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

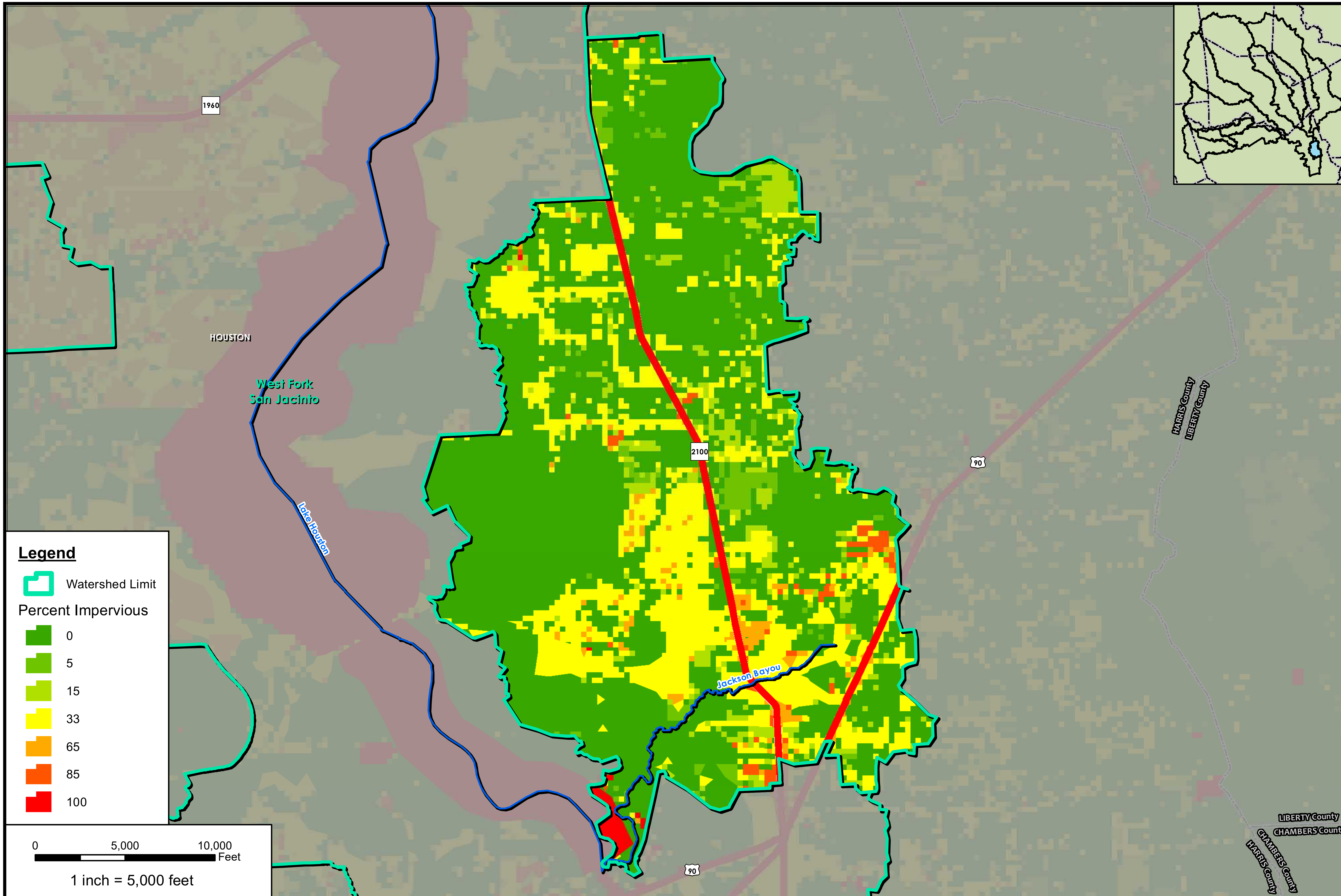
PERCENT IMPERVIOUS MAP | LUCE AND TARKINGTON

PROJECT AVO 33465

DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FtUS

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C7-P



PROJECT AVO 33465

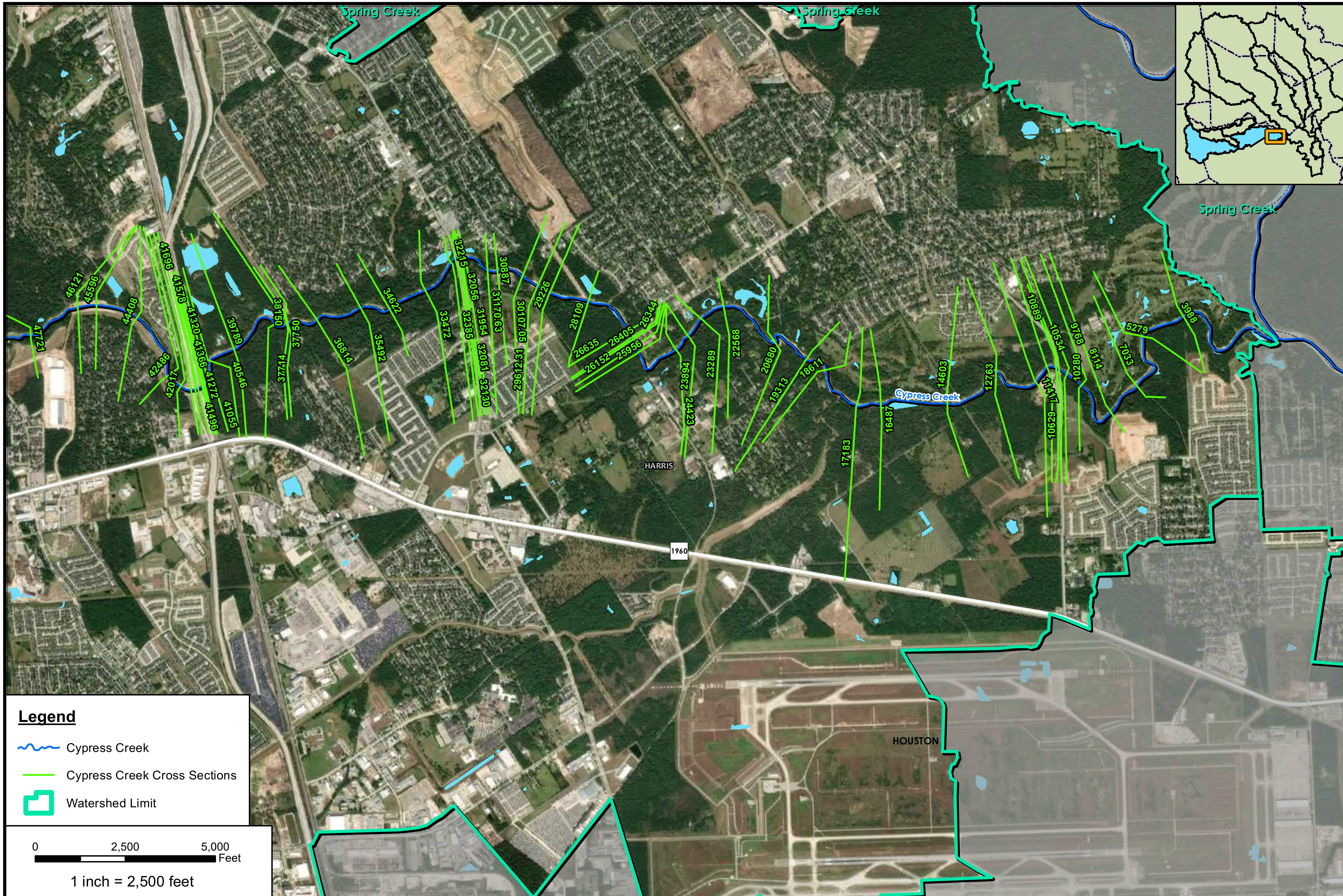
DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

HARRIS COUNTY FLOOD CONTROL DISTRICT
San Jacinto Regional Watershed Master Drainage Plan

PERCENT IMPERVIOUS MAP | JACKSON BAYOU

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C7-Q



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

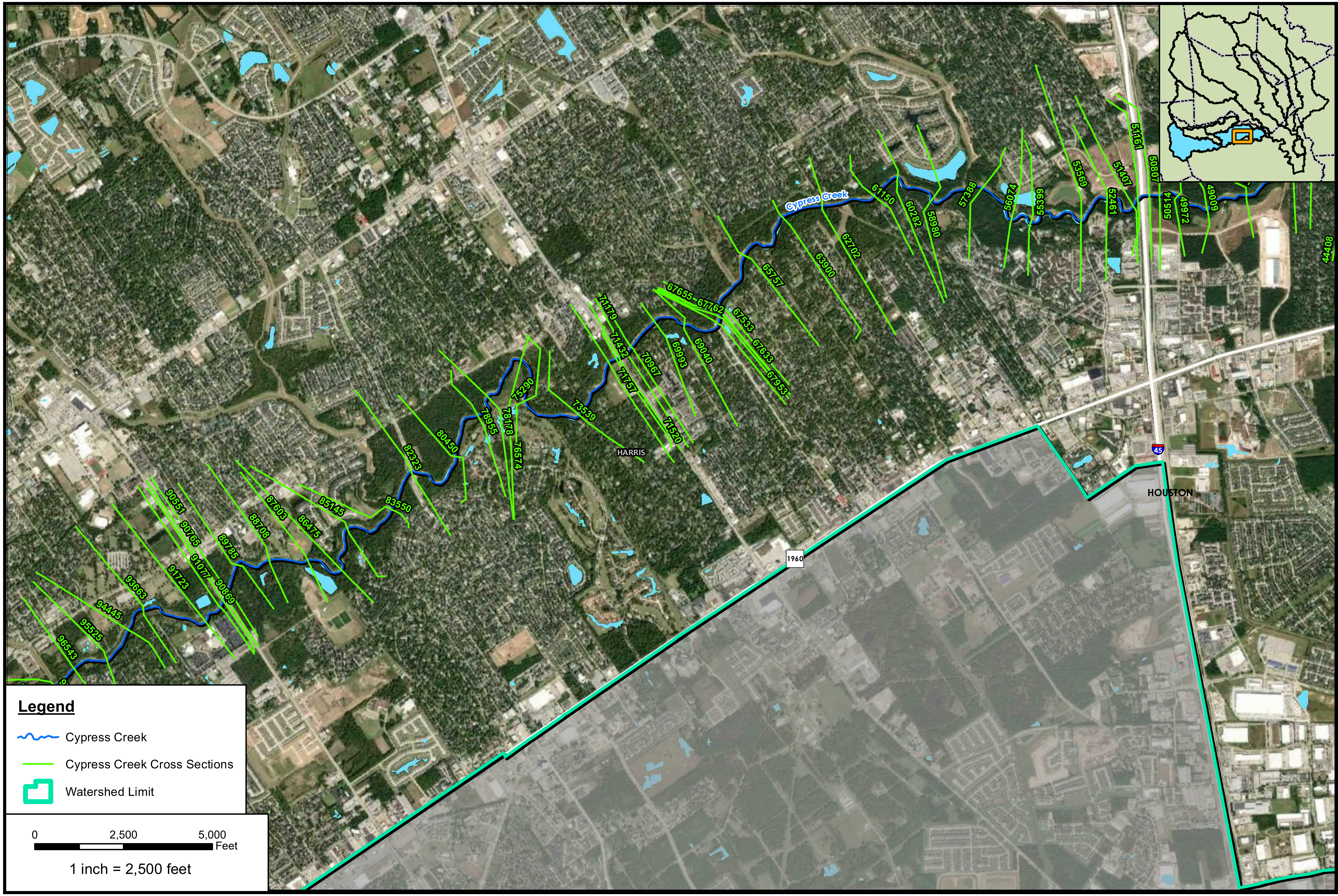
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | CYPRESS CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - A1



Legend

- Cypress Creek
- Cypress Creek Cross Sections
- Watershed Limit

0 2,500 5,000 Feet

1 inch = 2,500 feet

PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FtUS

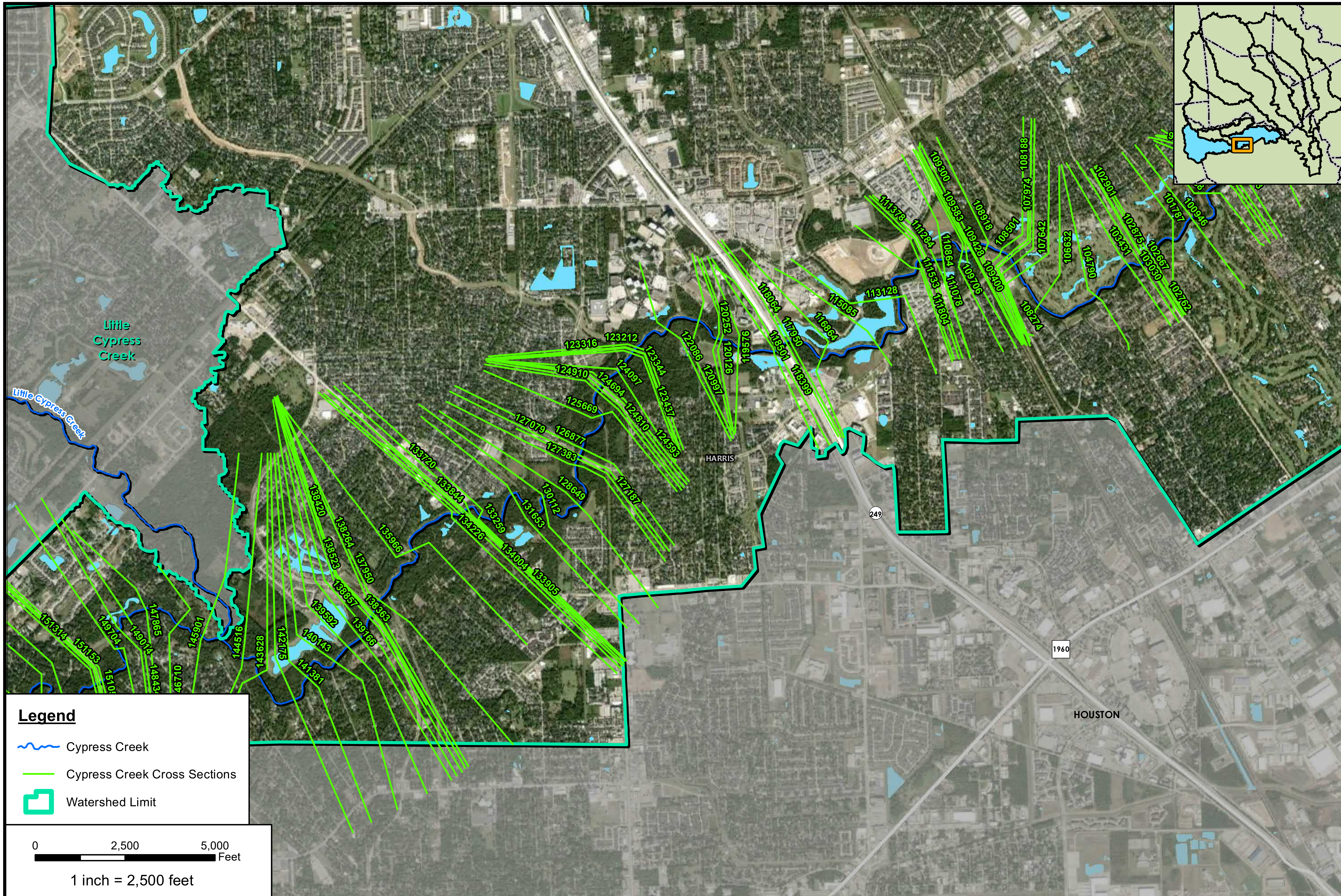
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | CYPRESS CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - A2



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | CYPRESS CREEK

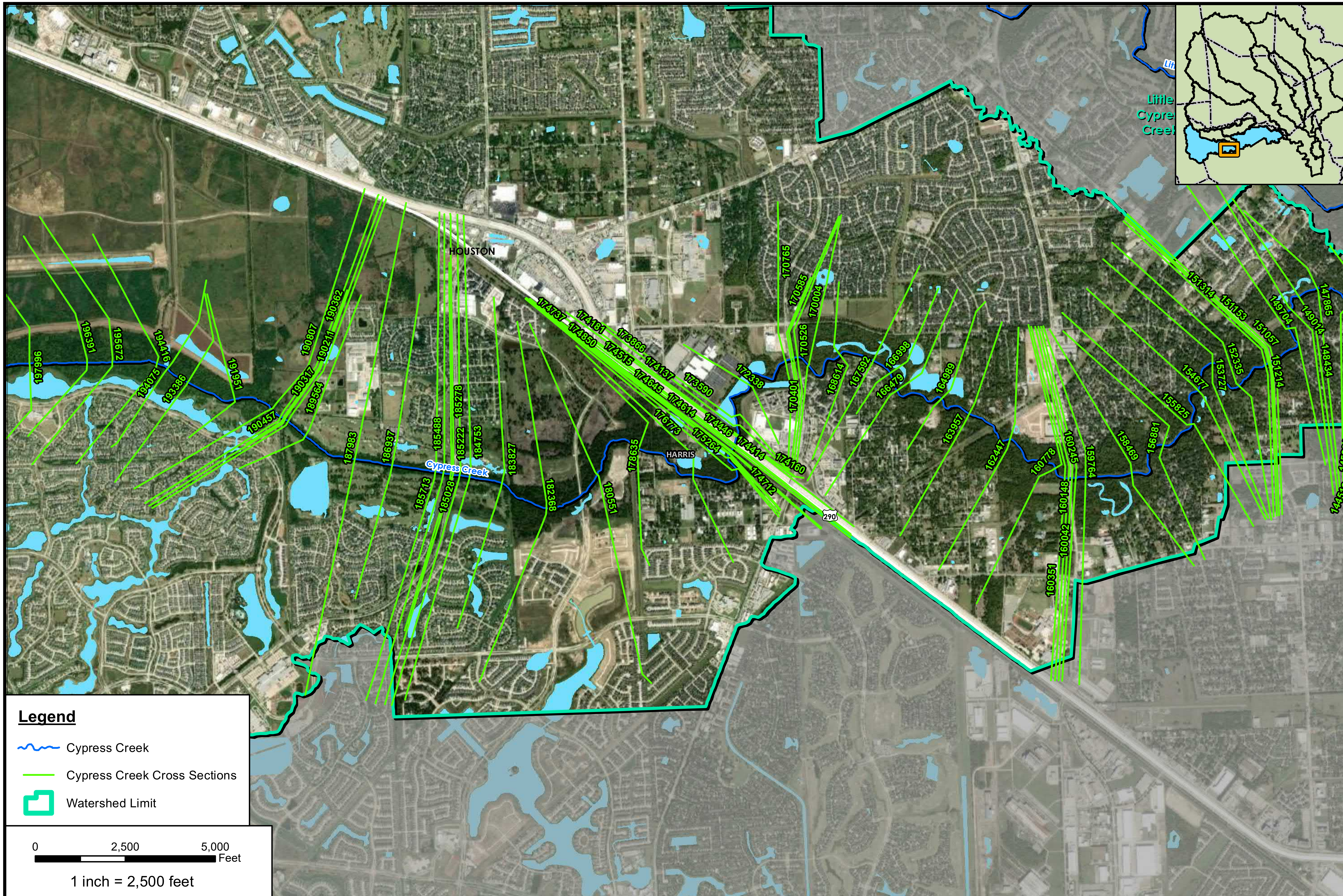
PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - A3



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

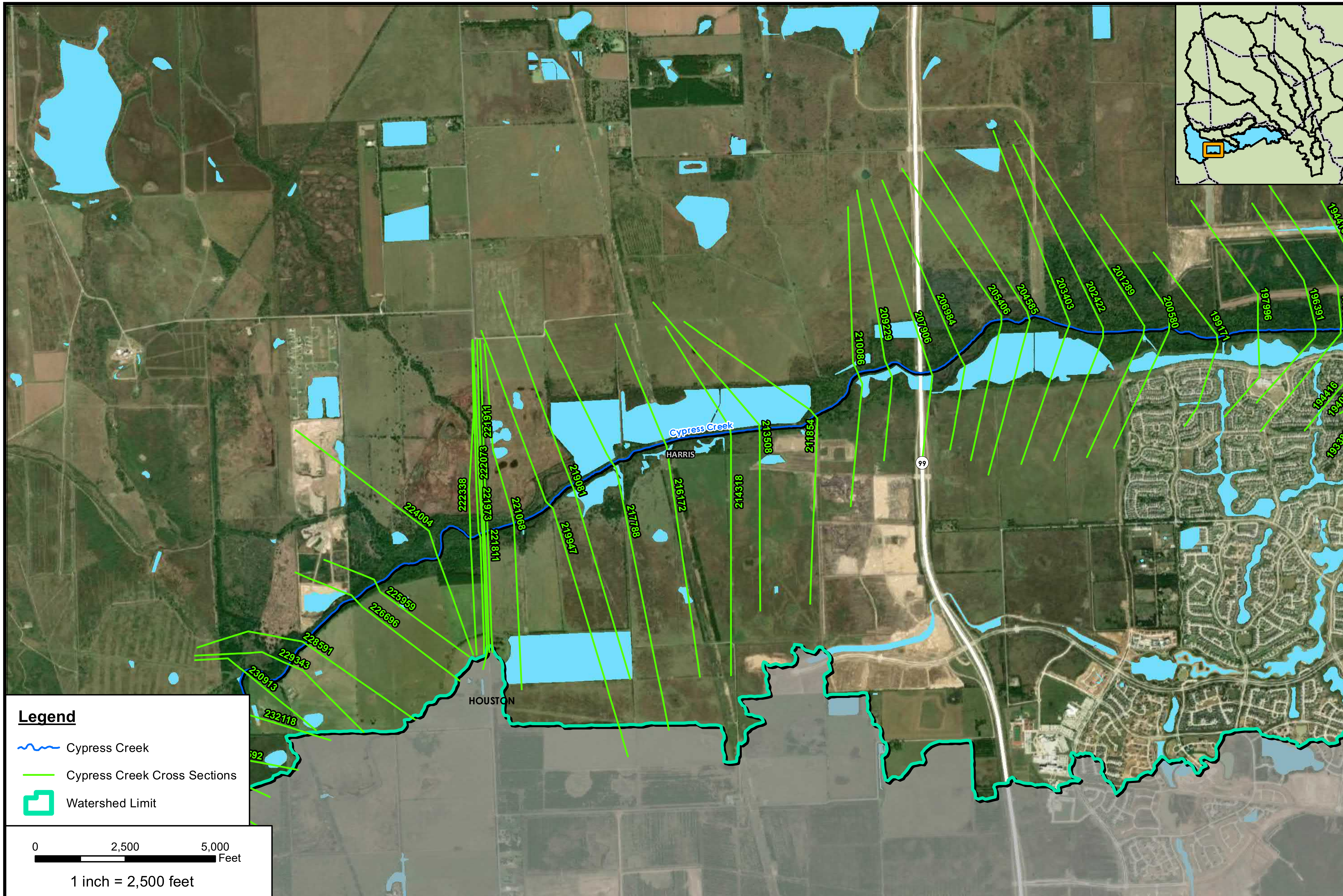
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | CYPRESS CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - A4



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | CYPRESS CREEK

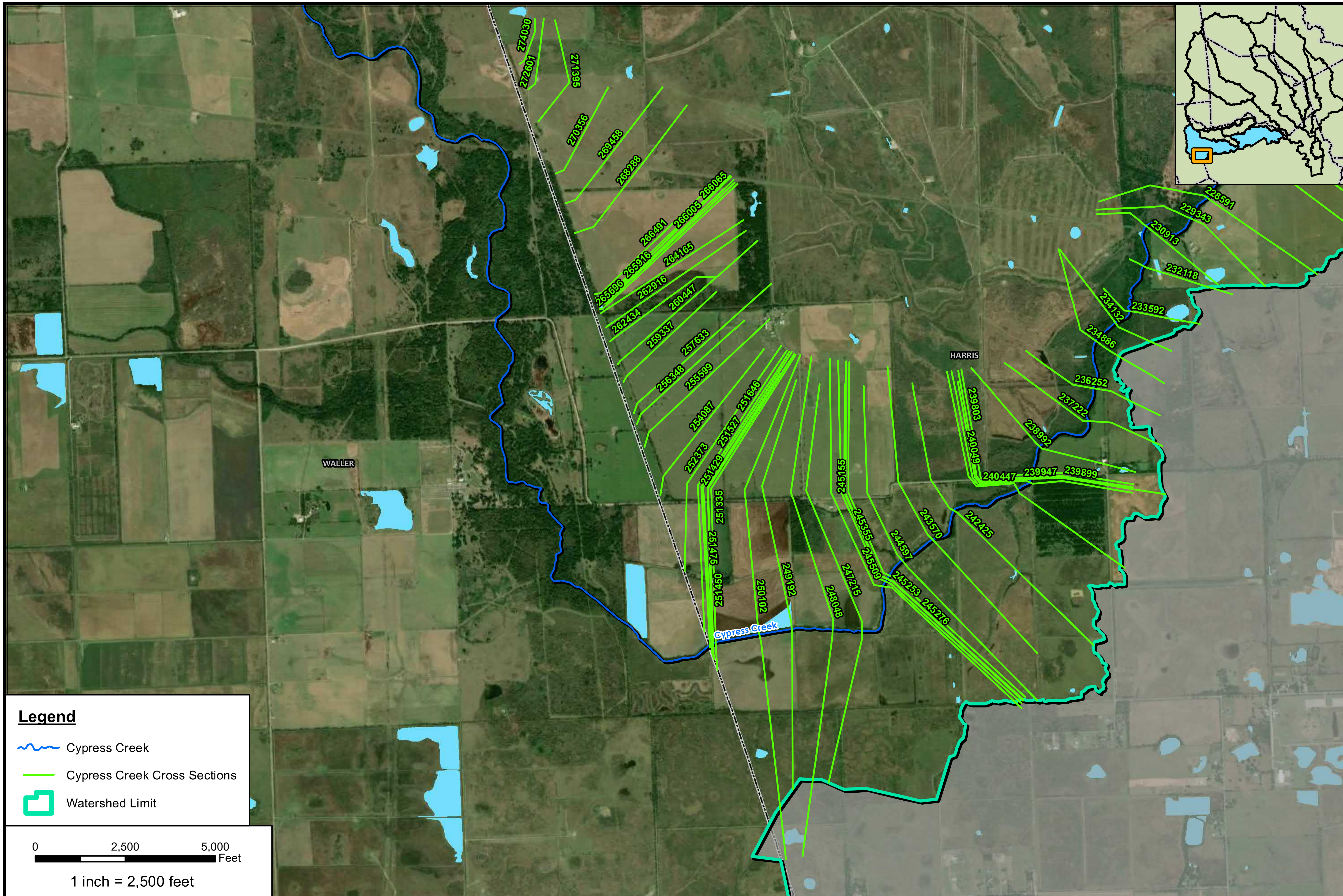
PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - A5



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

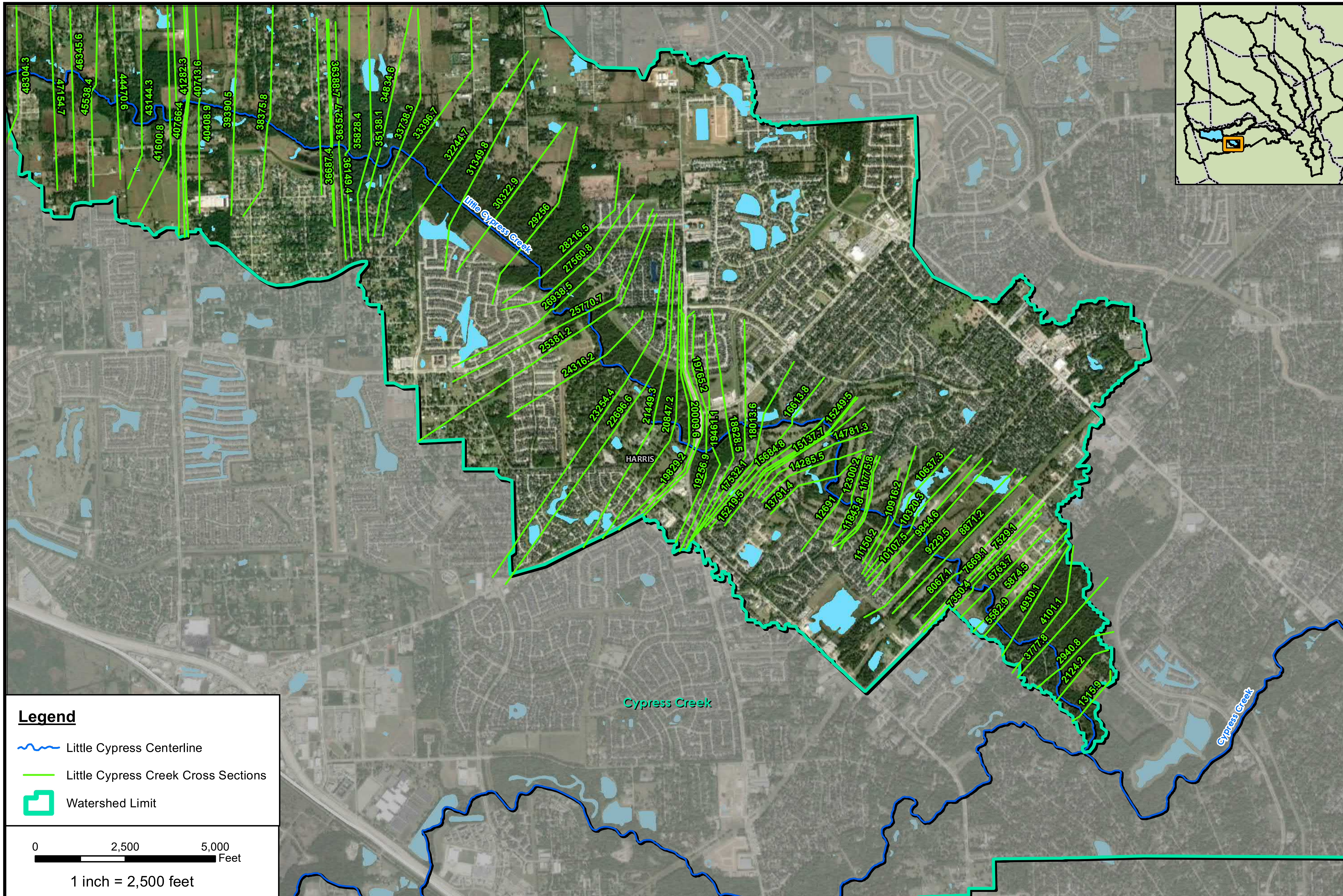
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | CYPRESS CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - A6



Legend

- Little Cypress Centerline
- Little Cypress Creek Cross Sections
- Watershed Limit

0 | 2,500 | 5,000 Feet

1 inch = 2,500 feet

PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

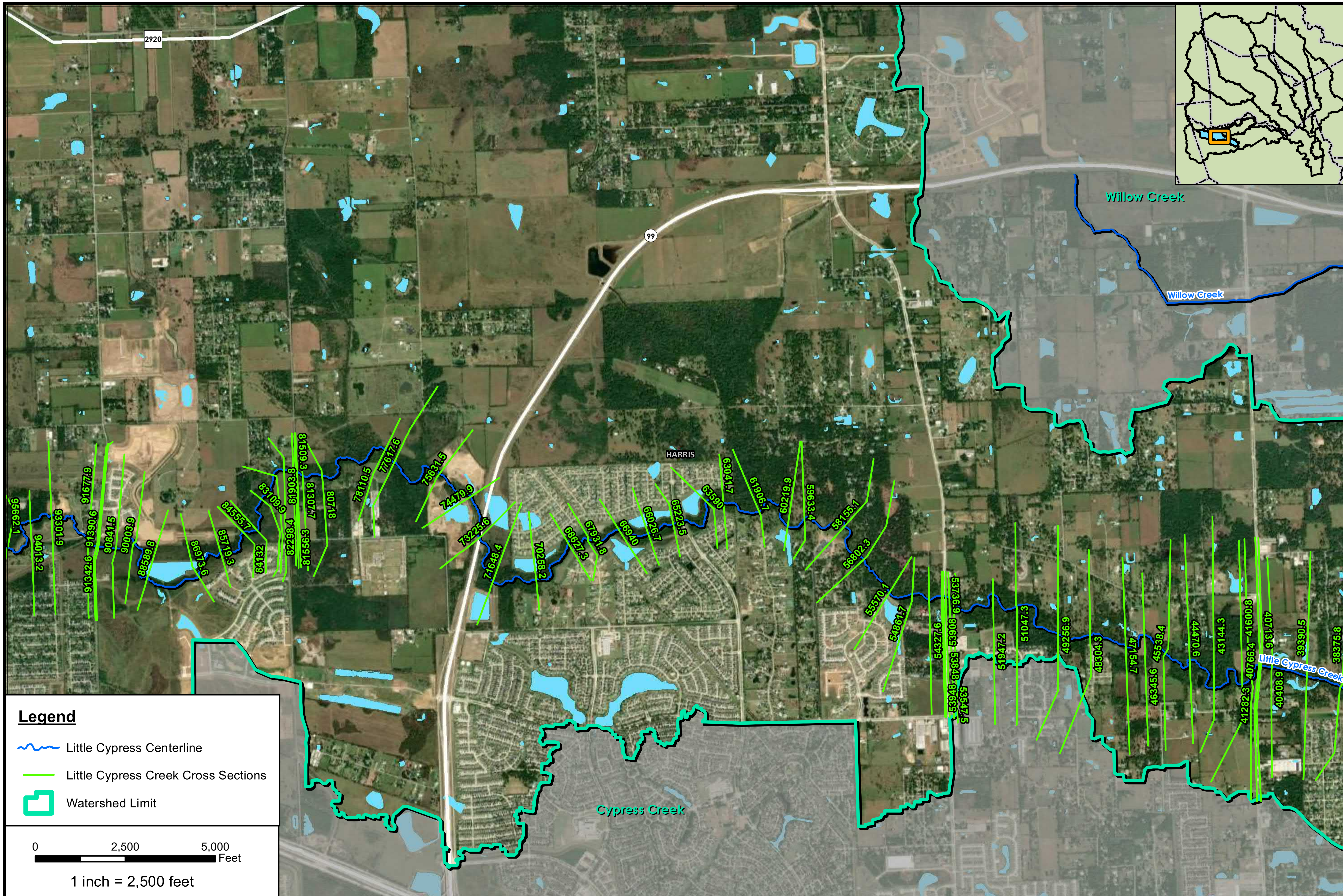
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | LITTLE CYPRESS CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - B1



PROJECT AVO

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DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FtUS

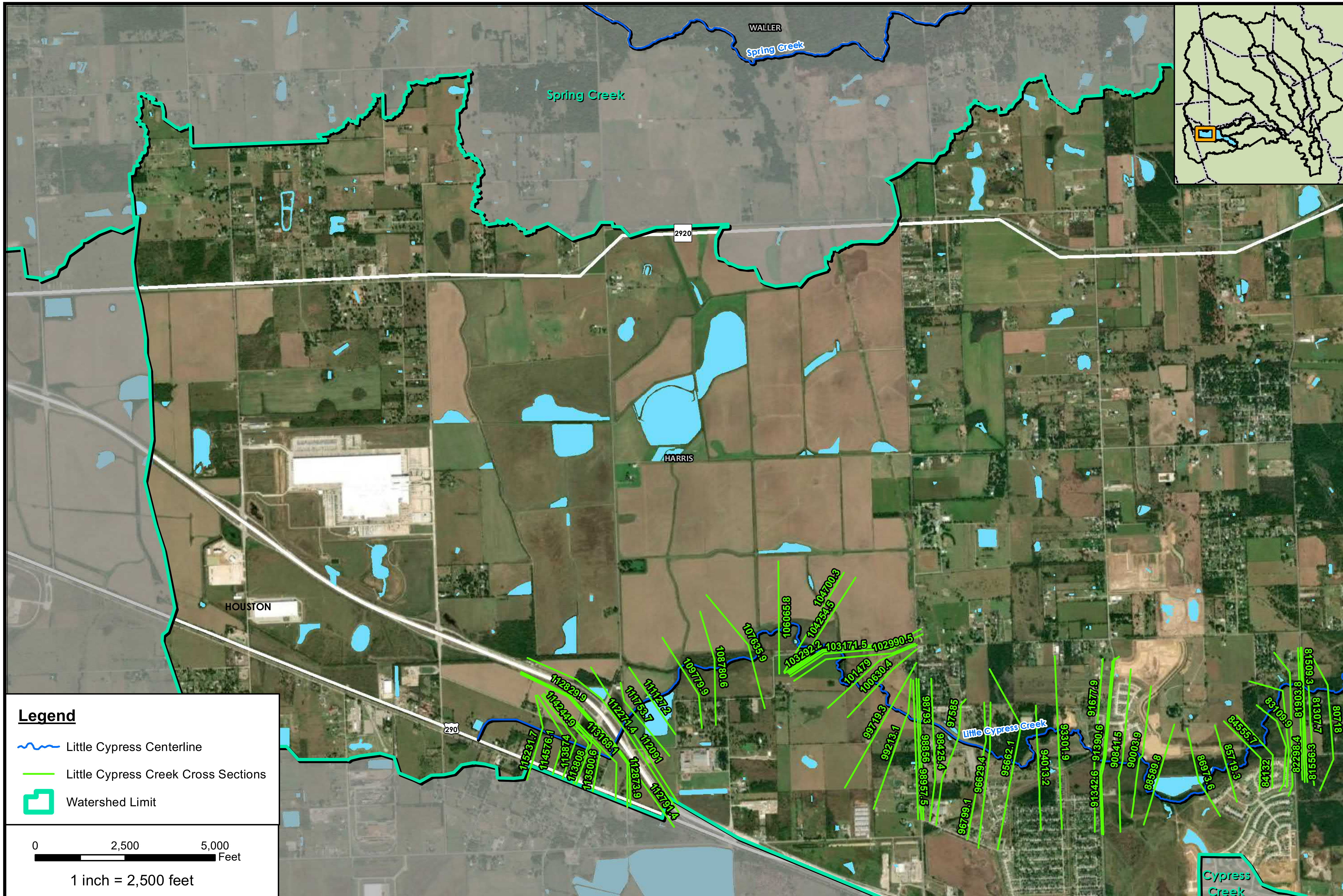
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | LITTLE CYPRESS CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - B2



PROJECT AVO

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DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

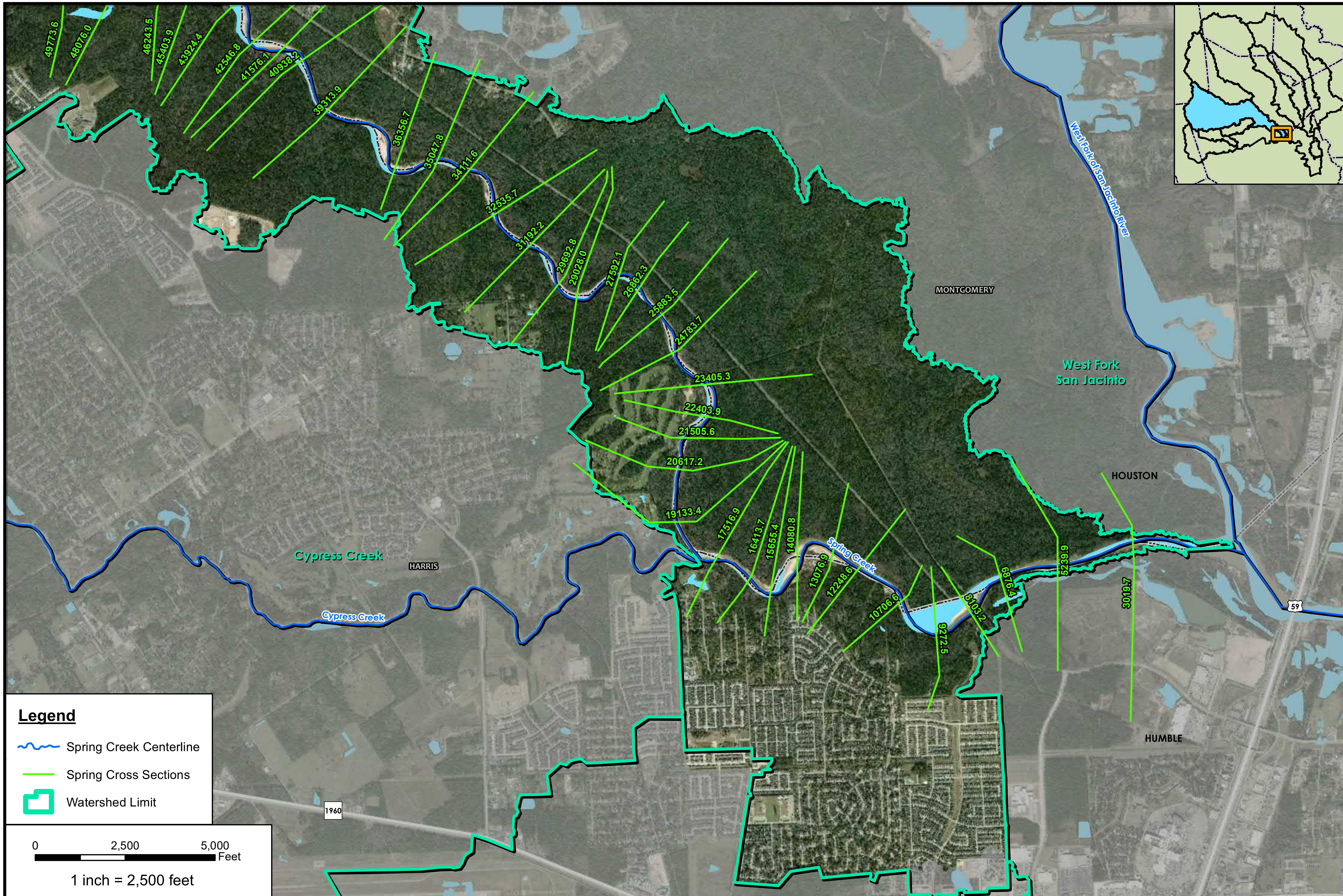
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | LITTLE CYPRESS CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - B3



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

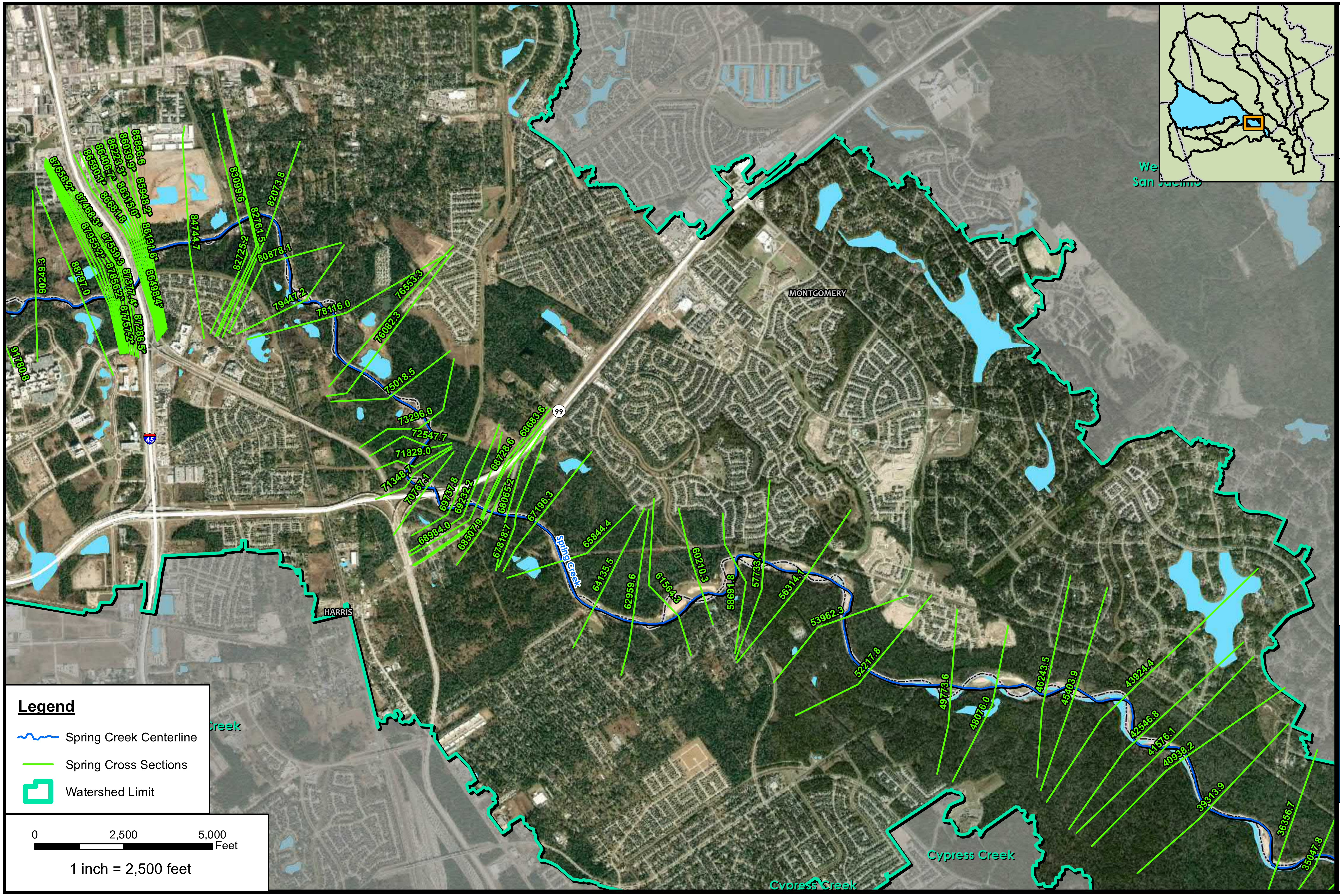
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | SPRING CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - C1



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | SPRING CREEK

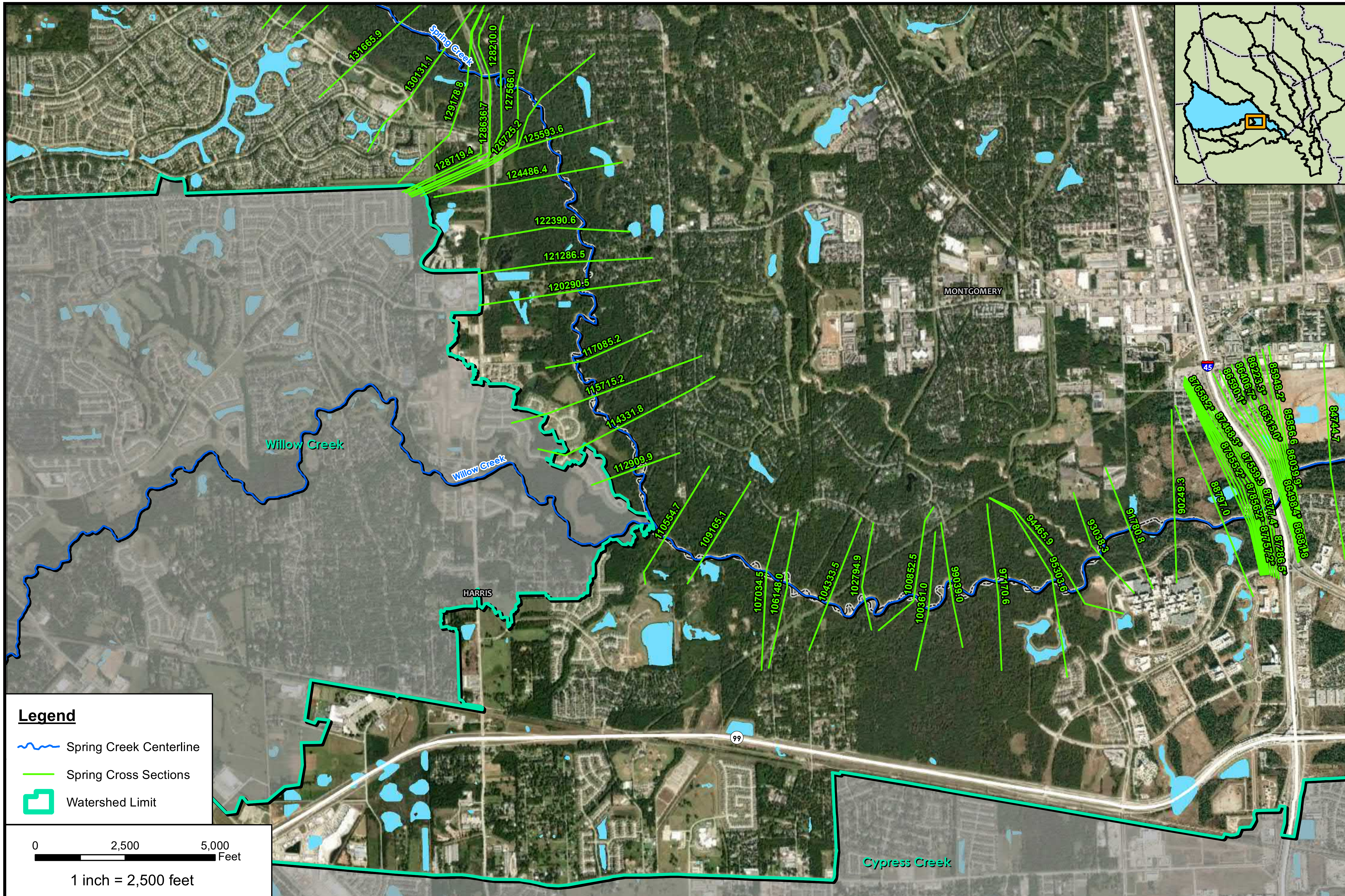
PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FtUS

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - C2



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

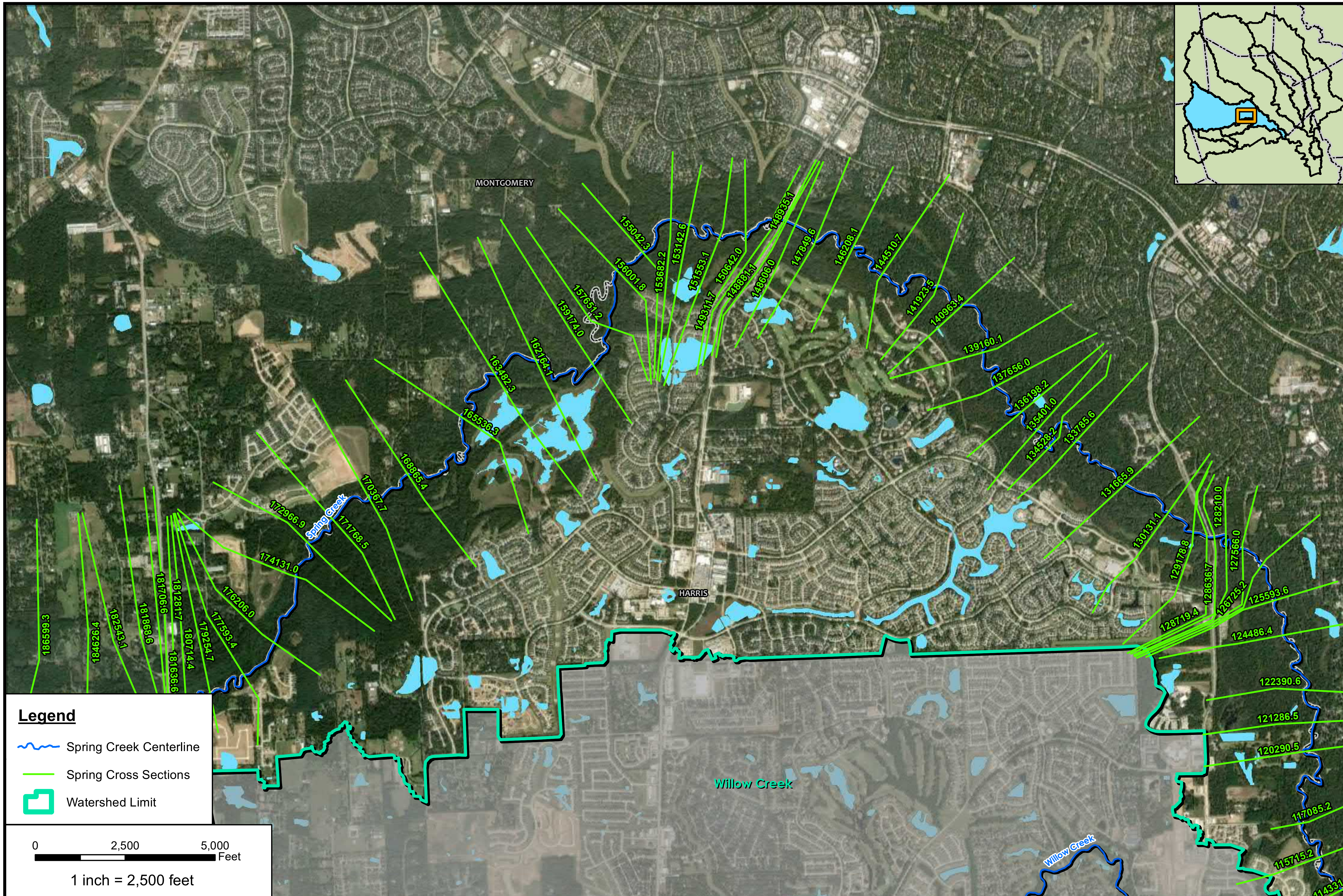
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | SPRING CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - C3



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FtUS

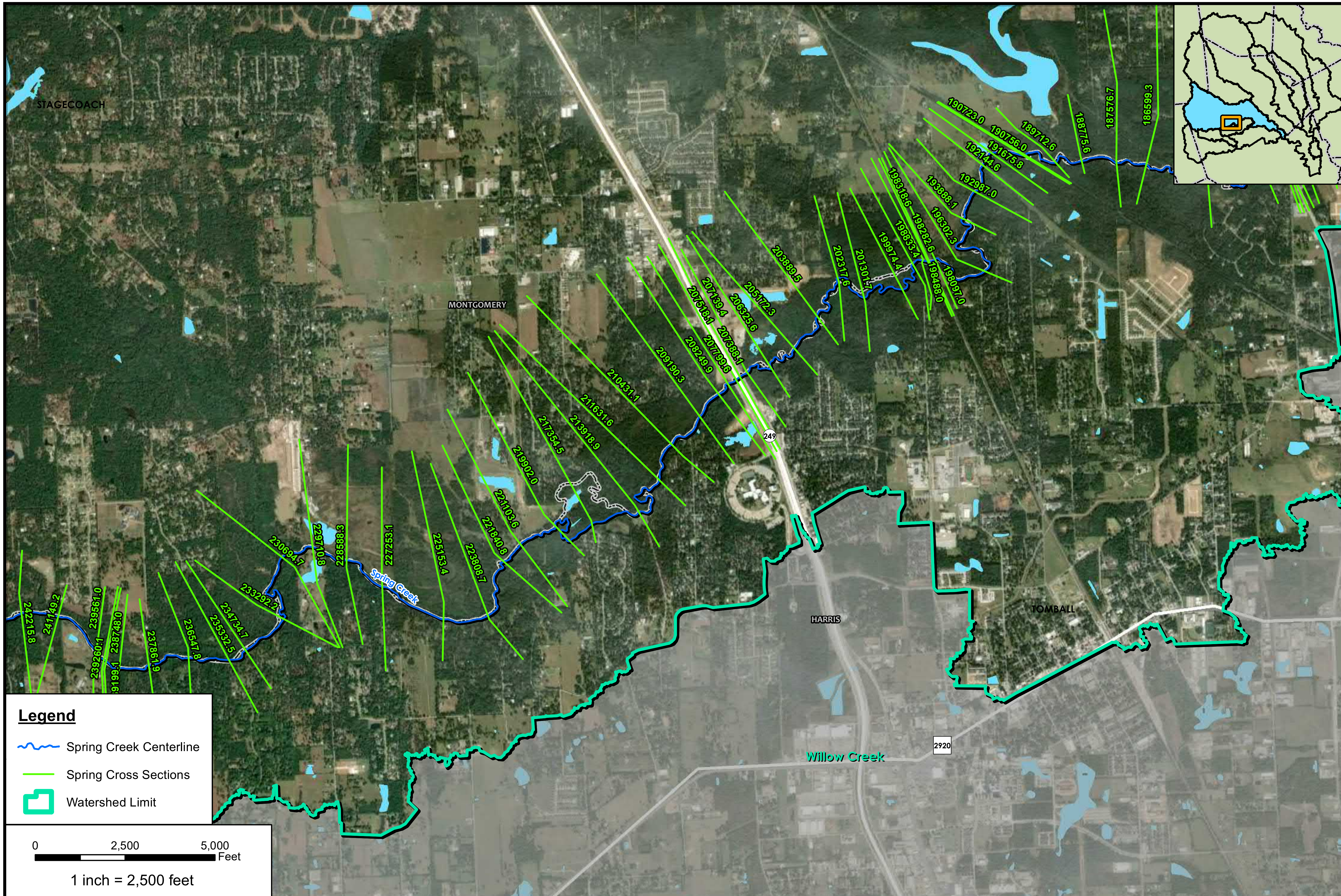
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | SPRING CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - C4



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | SPRING CREEK

PROJECT AVO 33465

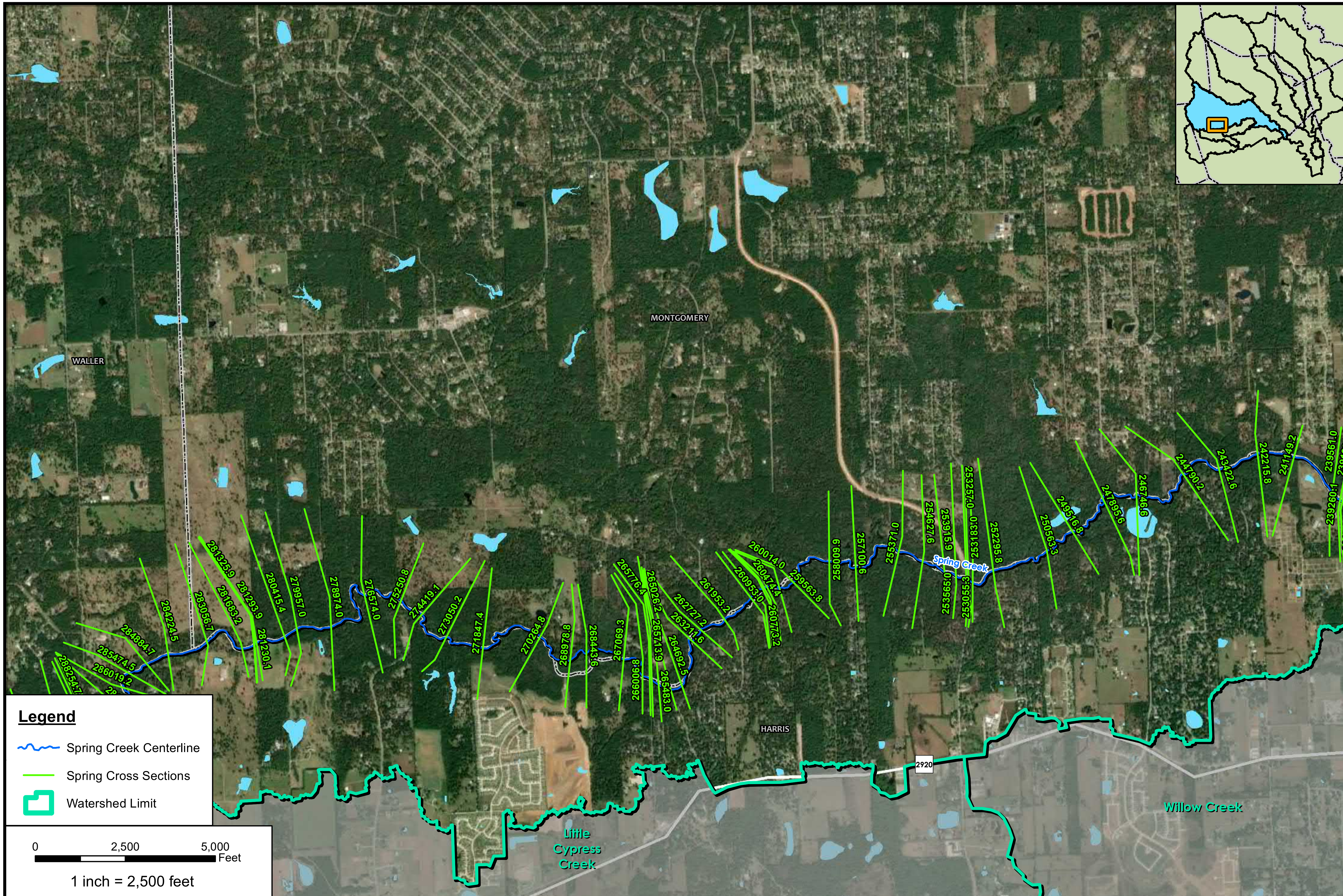
DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

N S E W

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - C5



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DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

N W E S

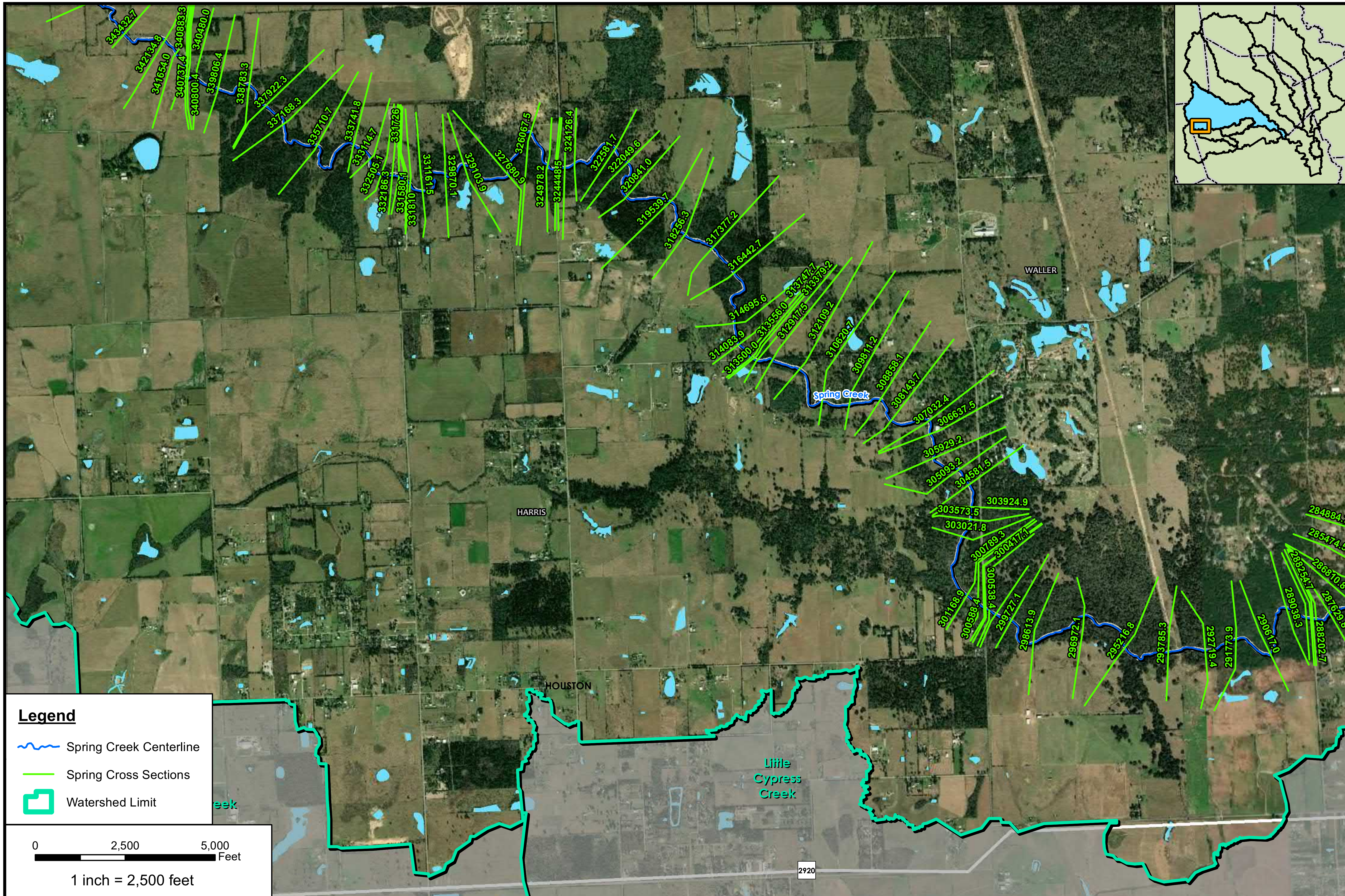
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | SPRING CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - C6



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

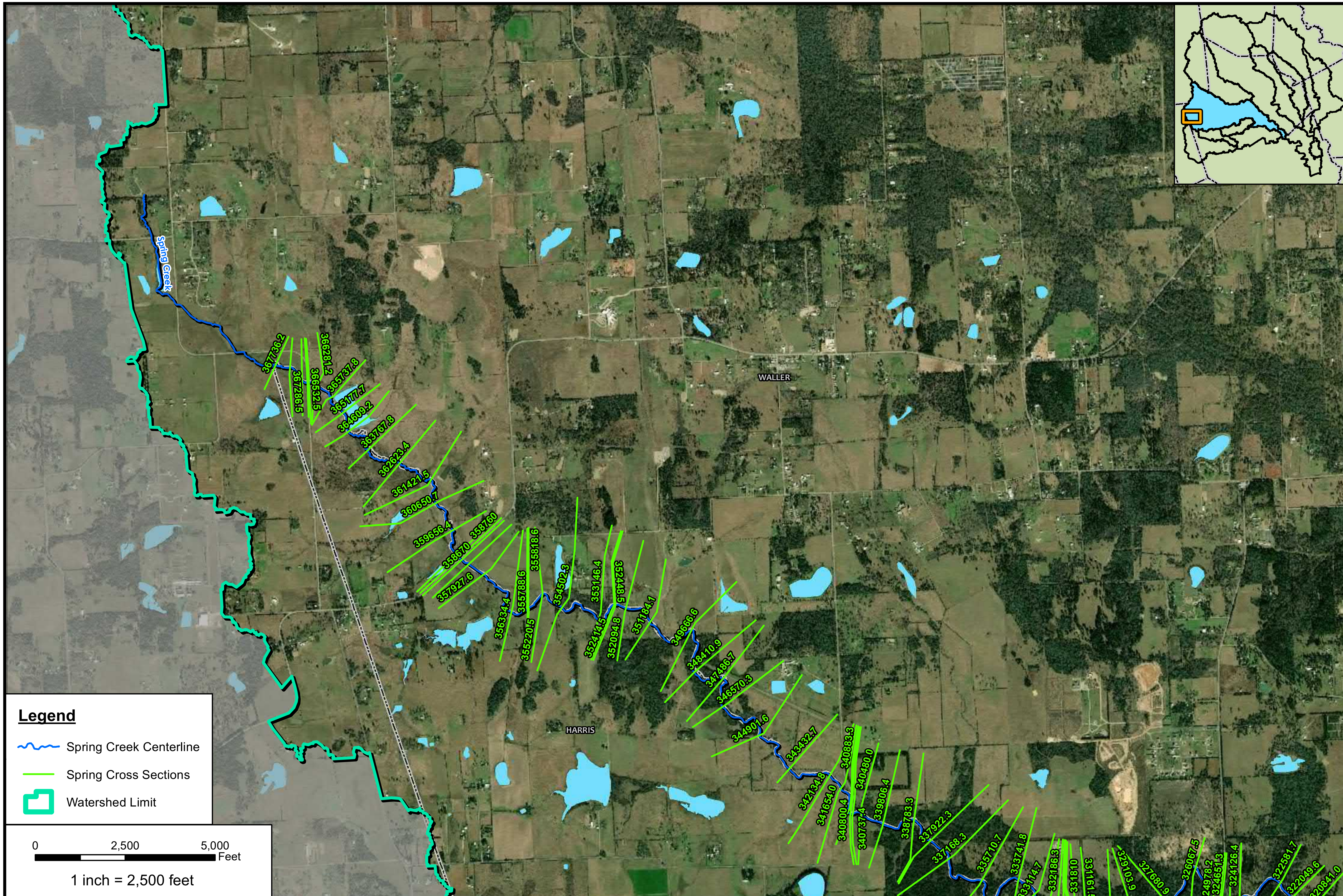
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | SPRING CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - C7



Legend

- Spring Creek Centerline
- Spring Cross Sections
- Watershed Limit

0 2,500 5,000 Feet

1 inch = 2,500 feet

PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

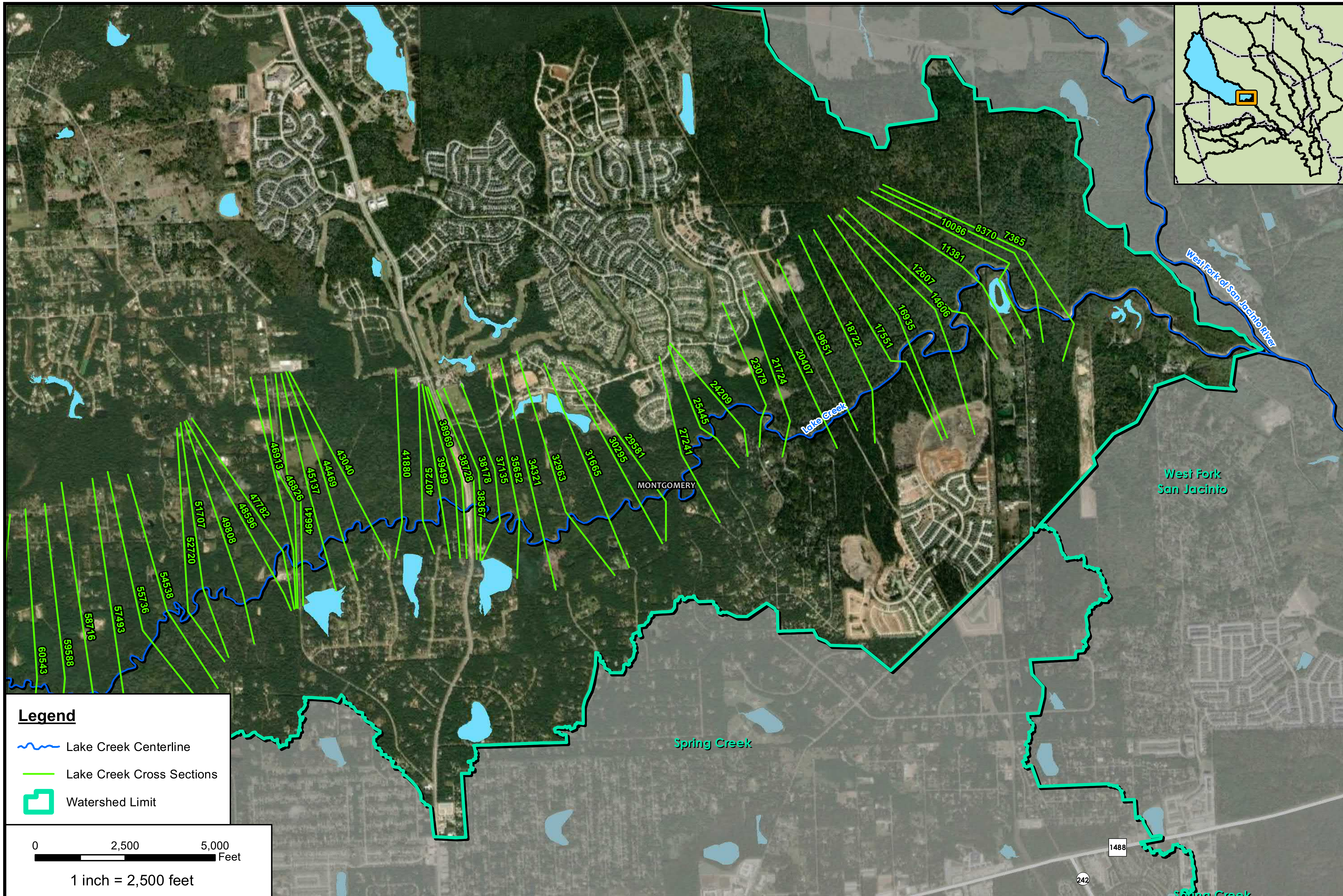
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | SPRING CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - C8



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | LAKE CREEK

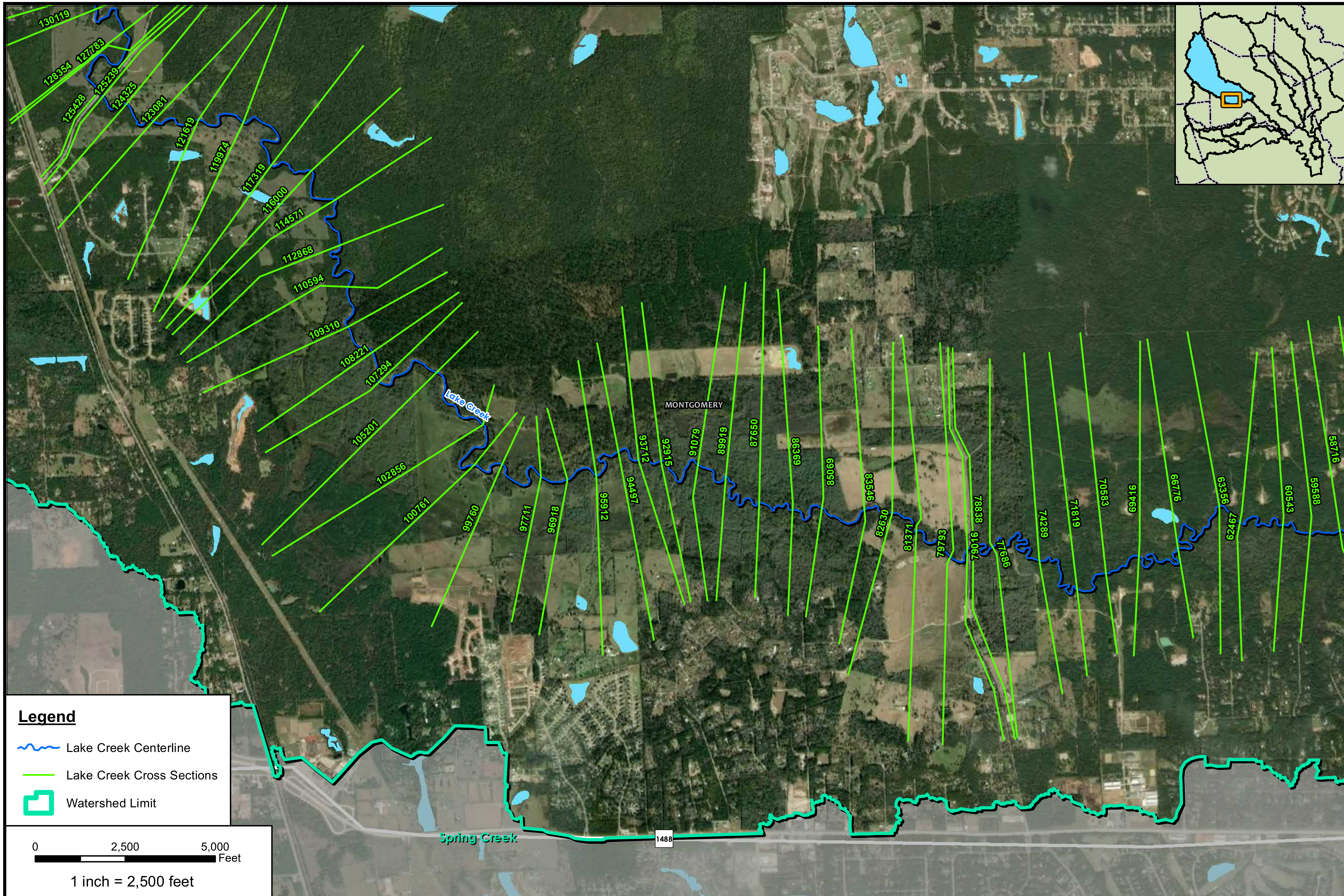
PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - D1



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

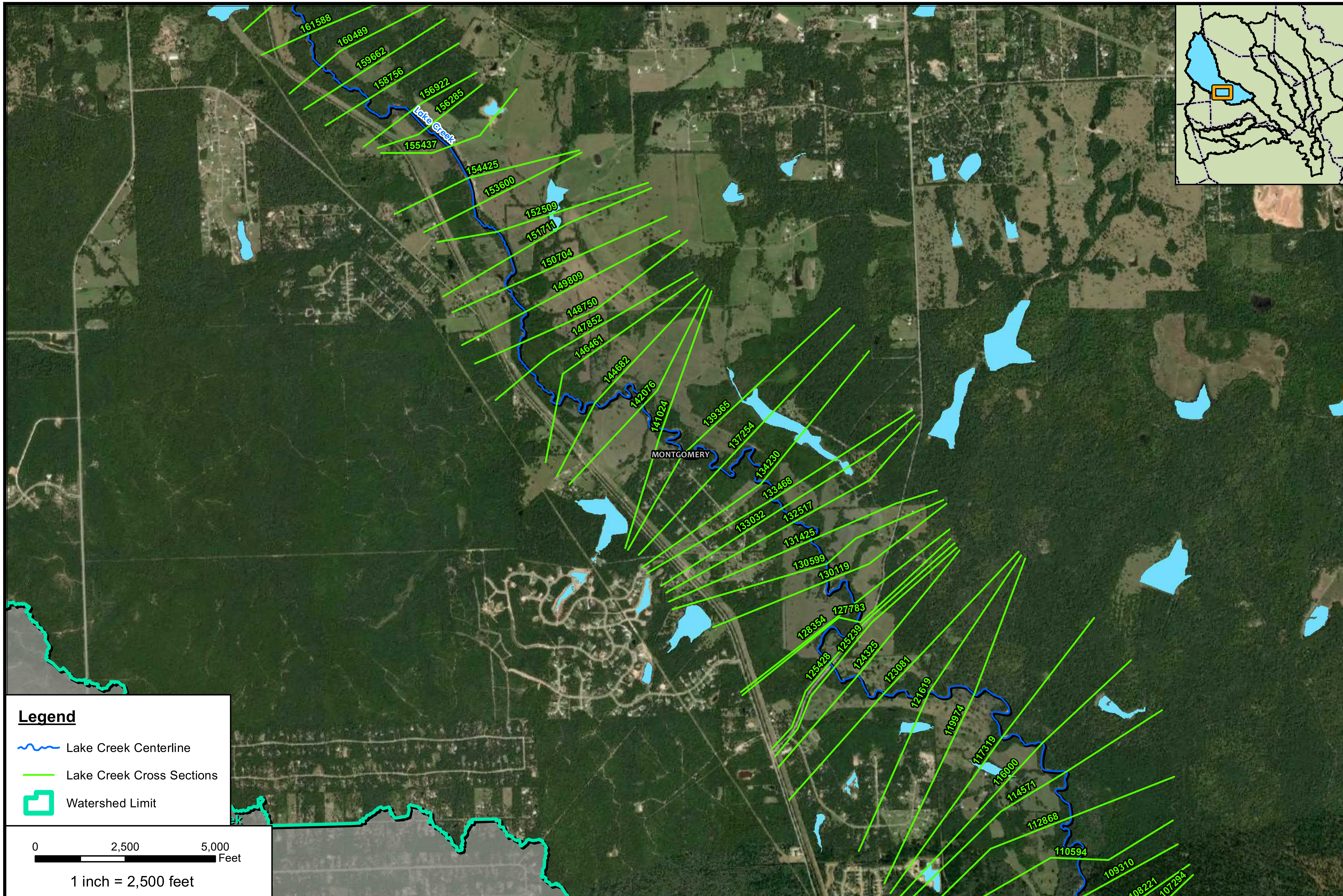
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | LAKE CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - D2



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

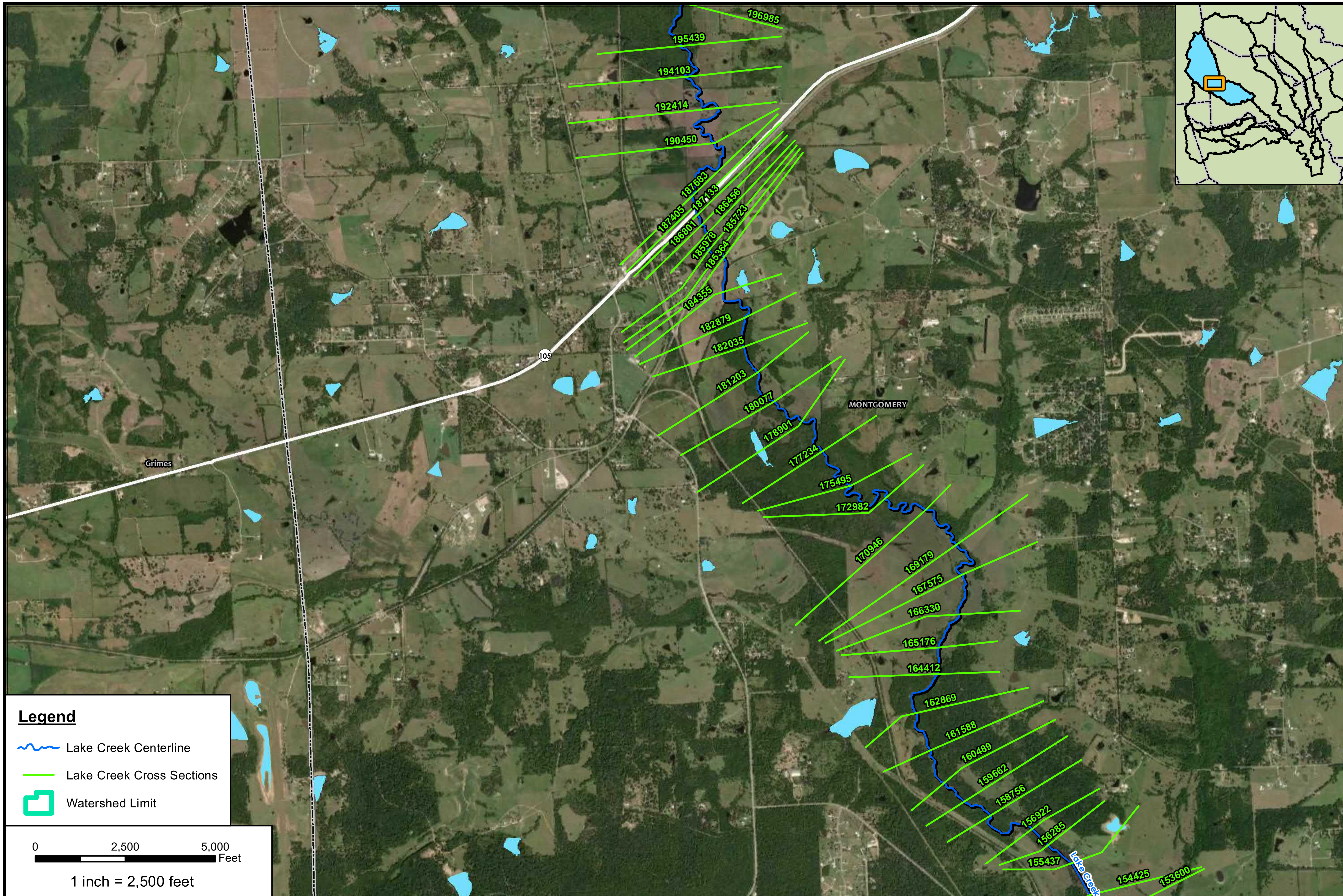
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | LAKE CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - D3



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

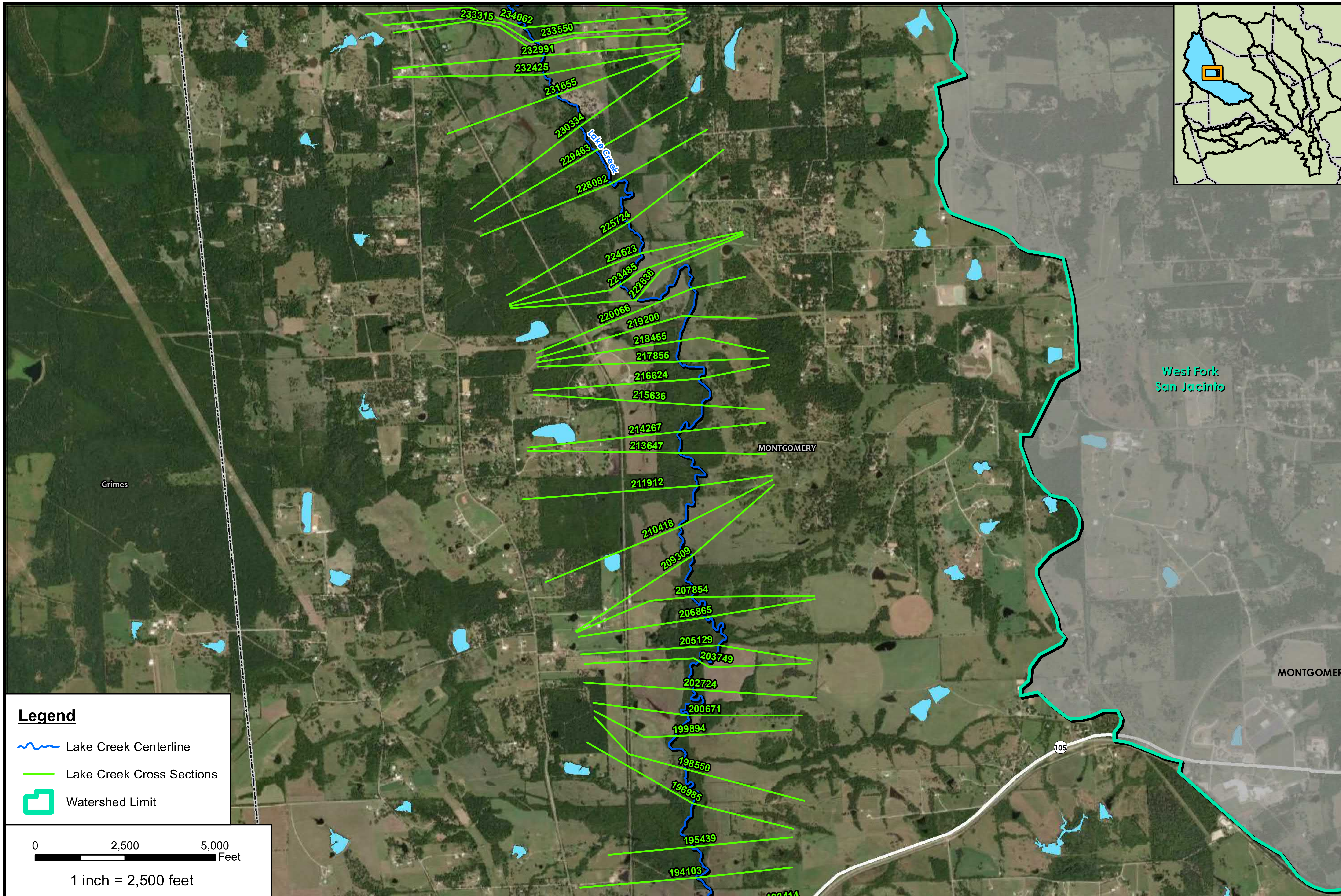
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | LAKE CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - D4



PROJECT AVO 33465

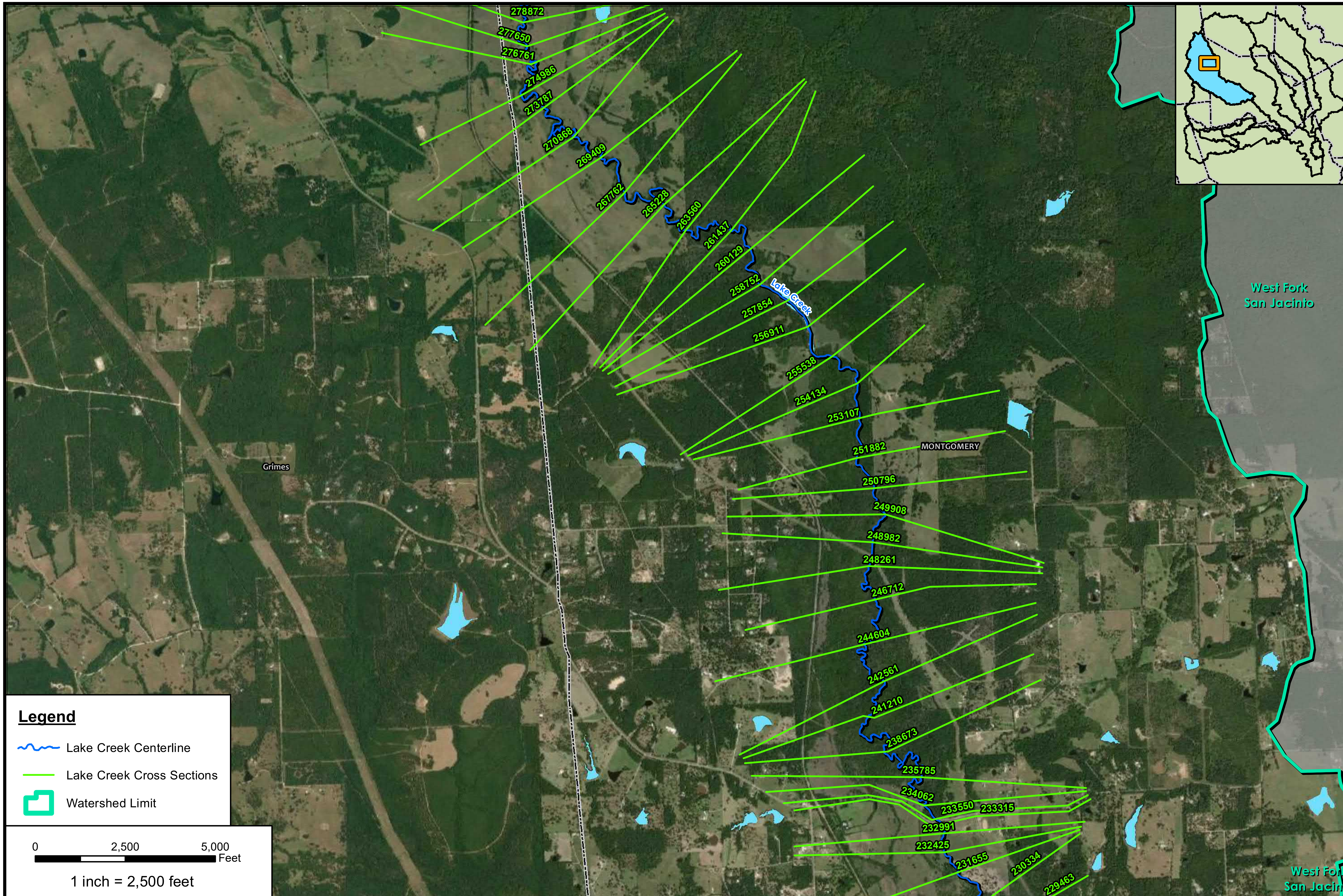
DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

HARRIS COUNTY FLOOD CONTROL DISTRICT
San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | LAKE CREEK

SAN JACINTO
REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit
C8 - D5



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

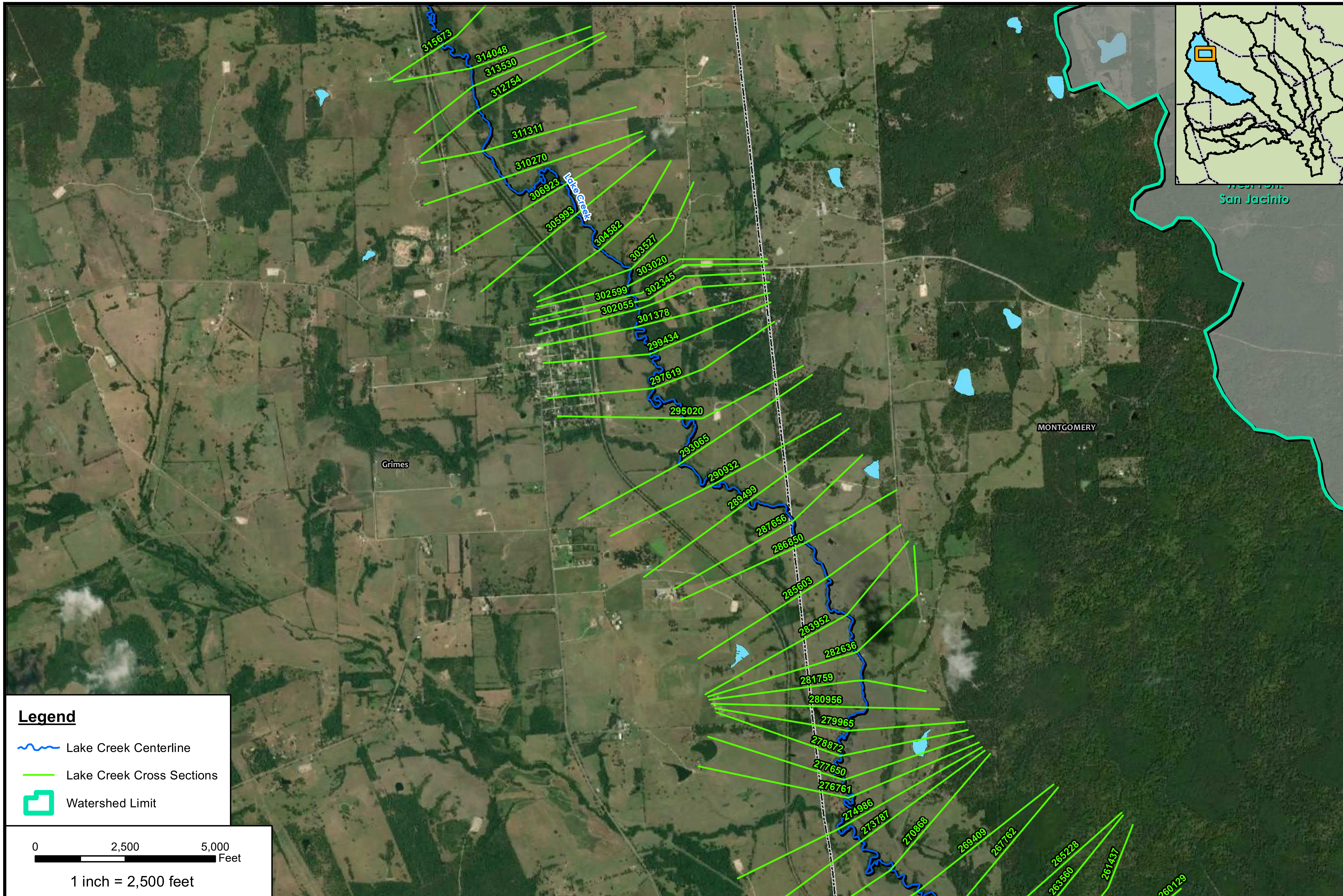
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | LAKE CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - D6



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

N W E S

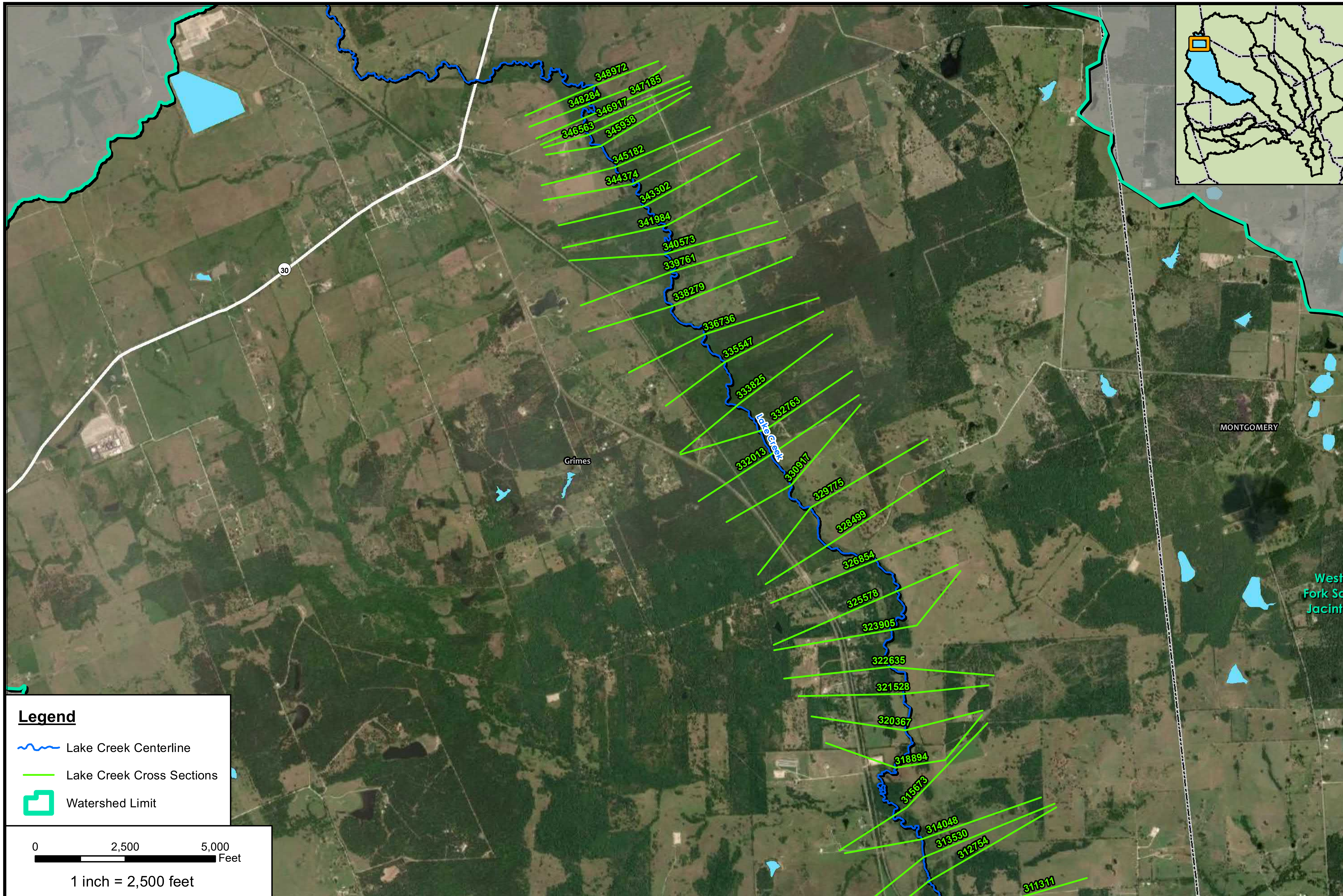
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | LAKE CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - D7



PROJECT AVO 33465

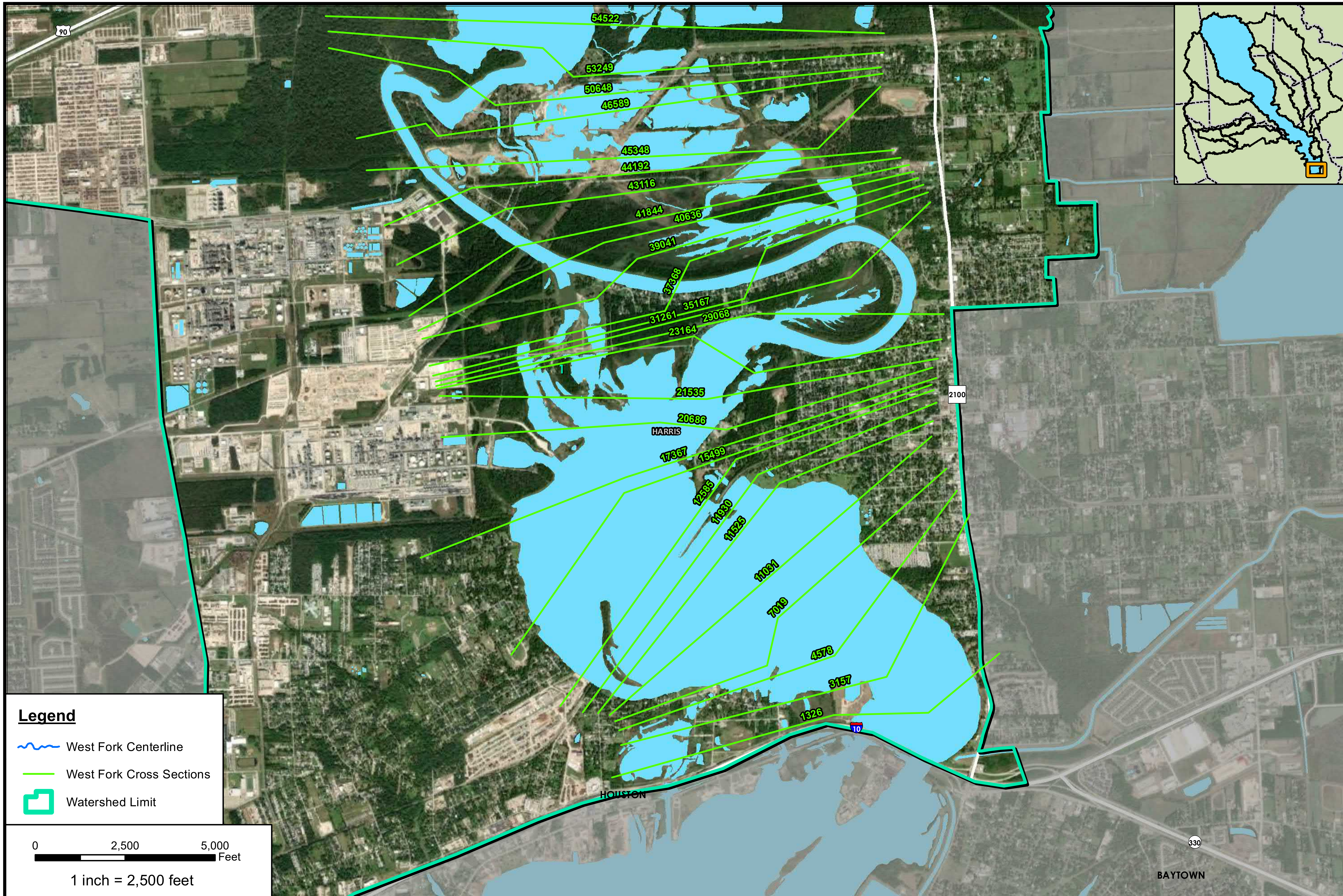
DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

HARRIS COUNTY FLOOD CONTROL DISTRICT
San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | LAKE CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit
C8 - D8



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

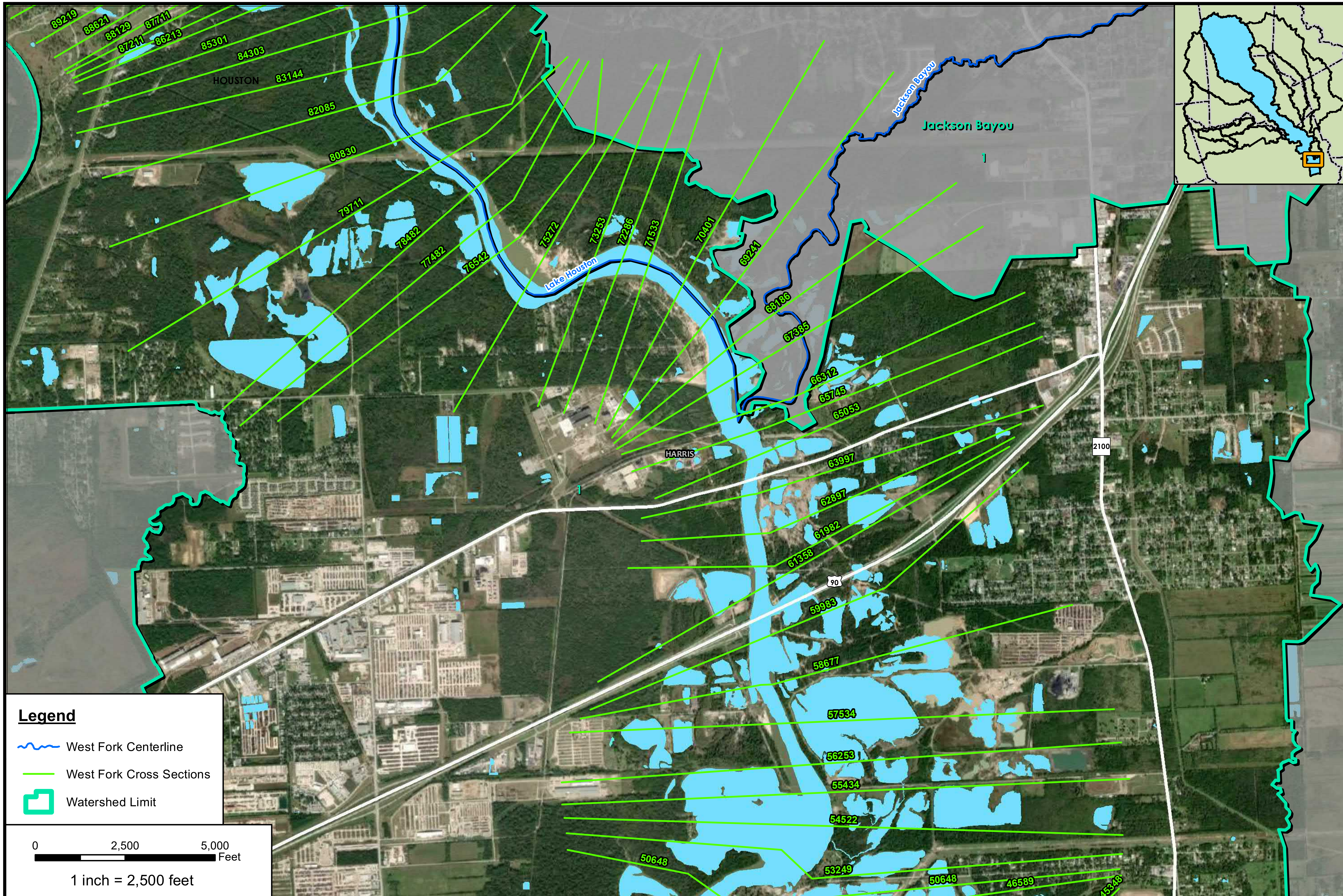
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | WEST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - E1



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | WEST FORK SAN JACINTO

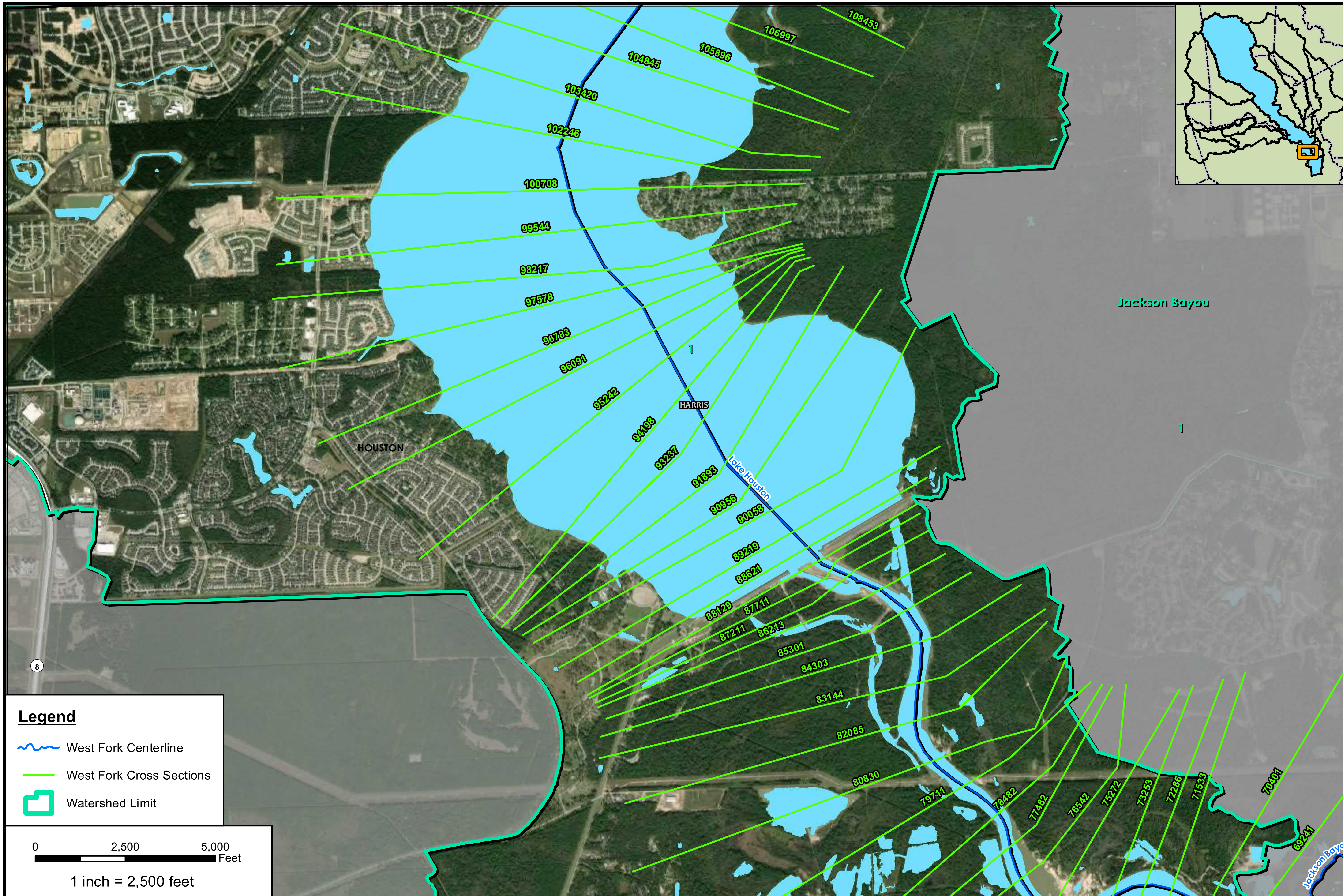
PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FtUS

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - E2



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

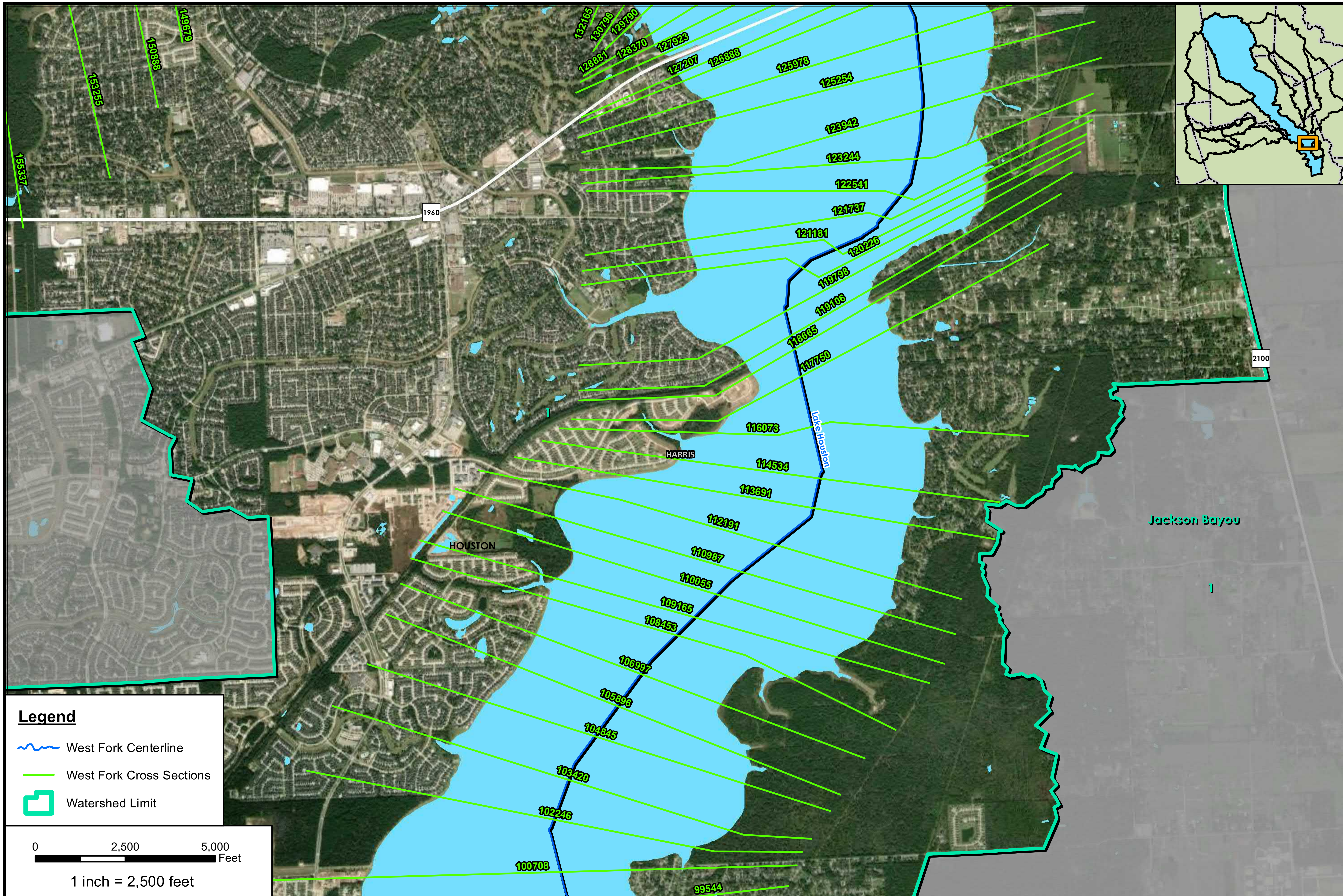
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | WEST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - E3



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

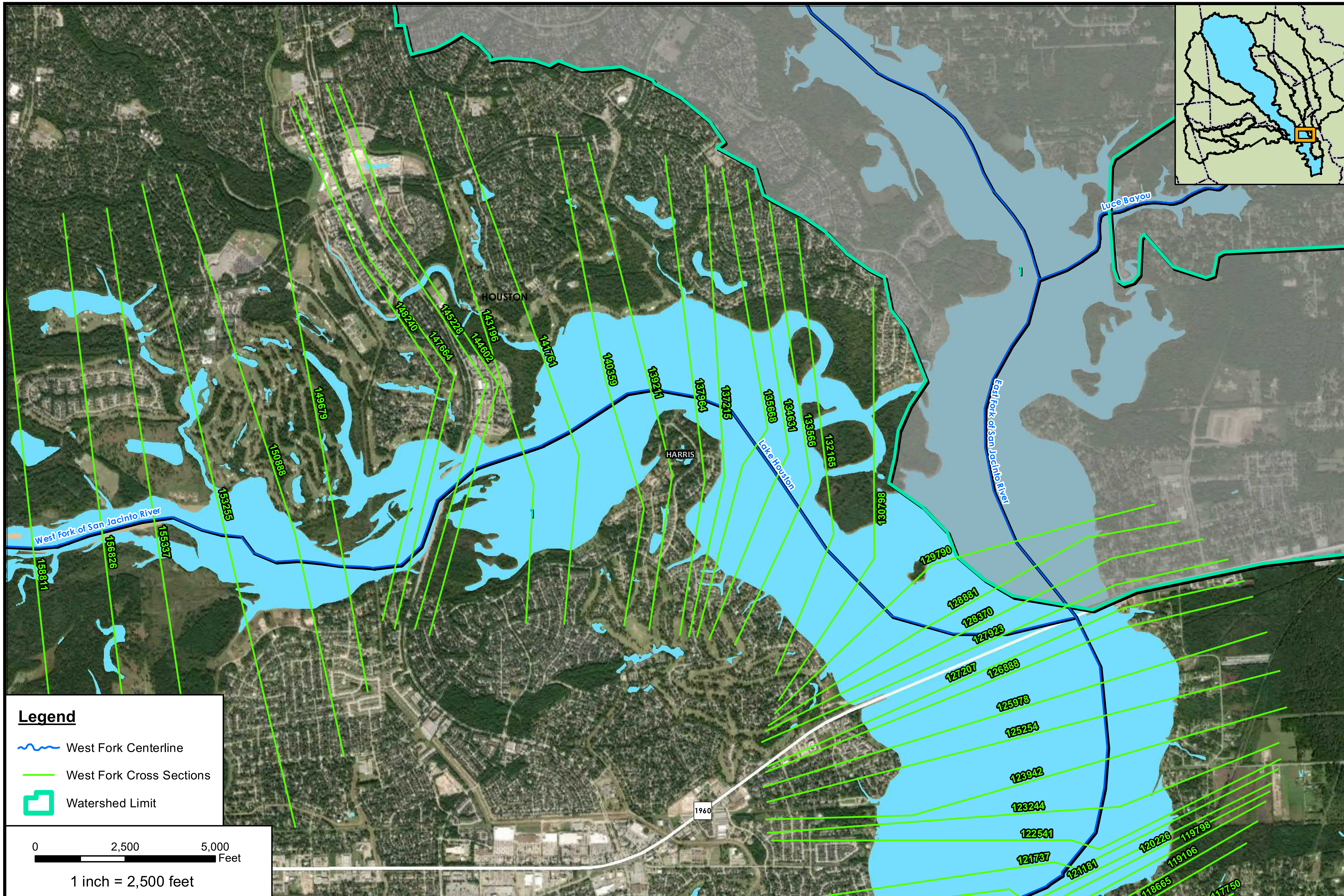
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | WEST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - E4



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

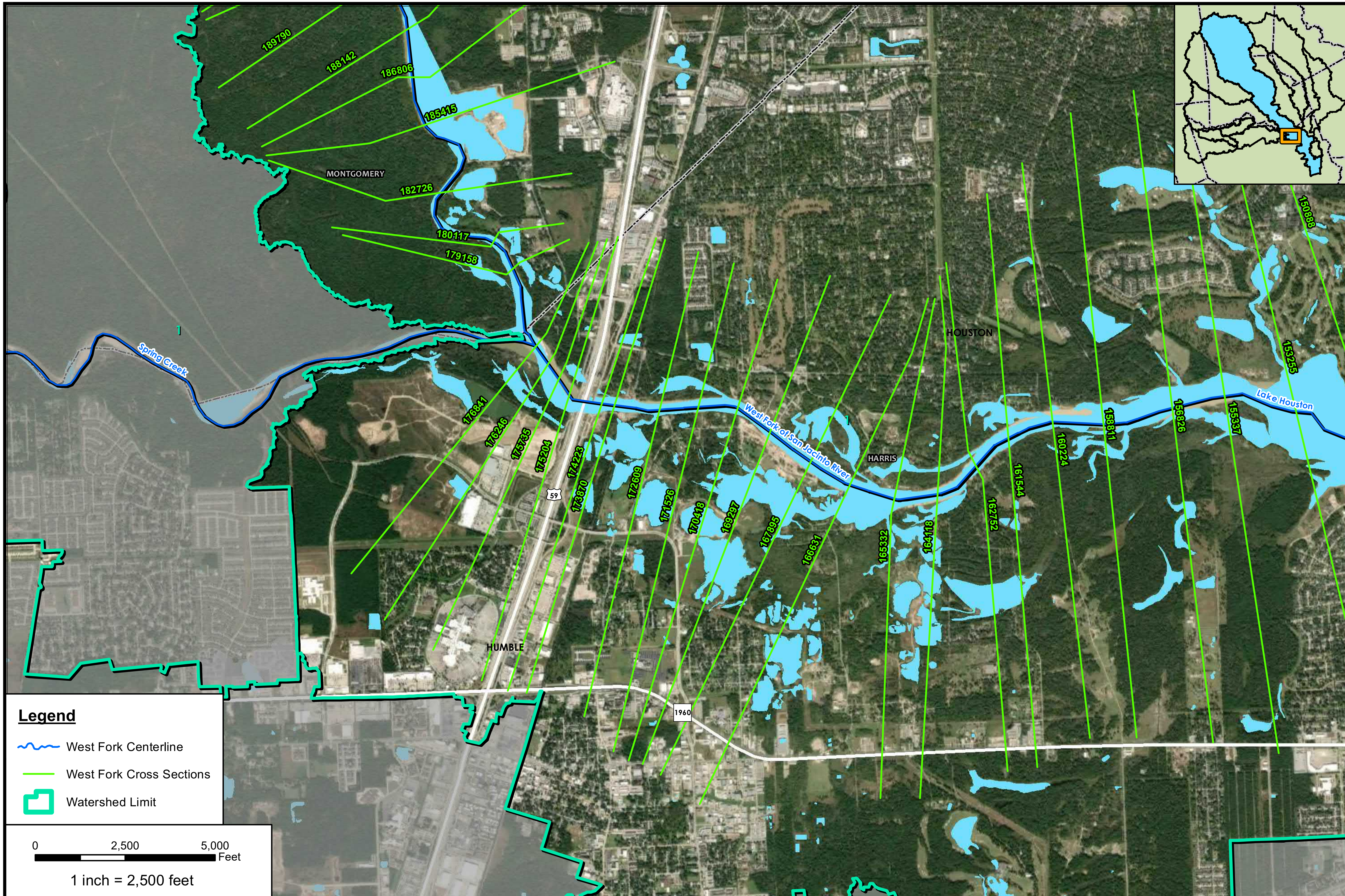
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | WEST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - E5



PROJECT AVO

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DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

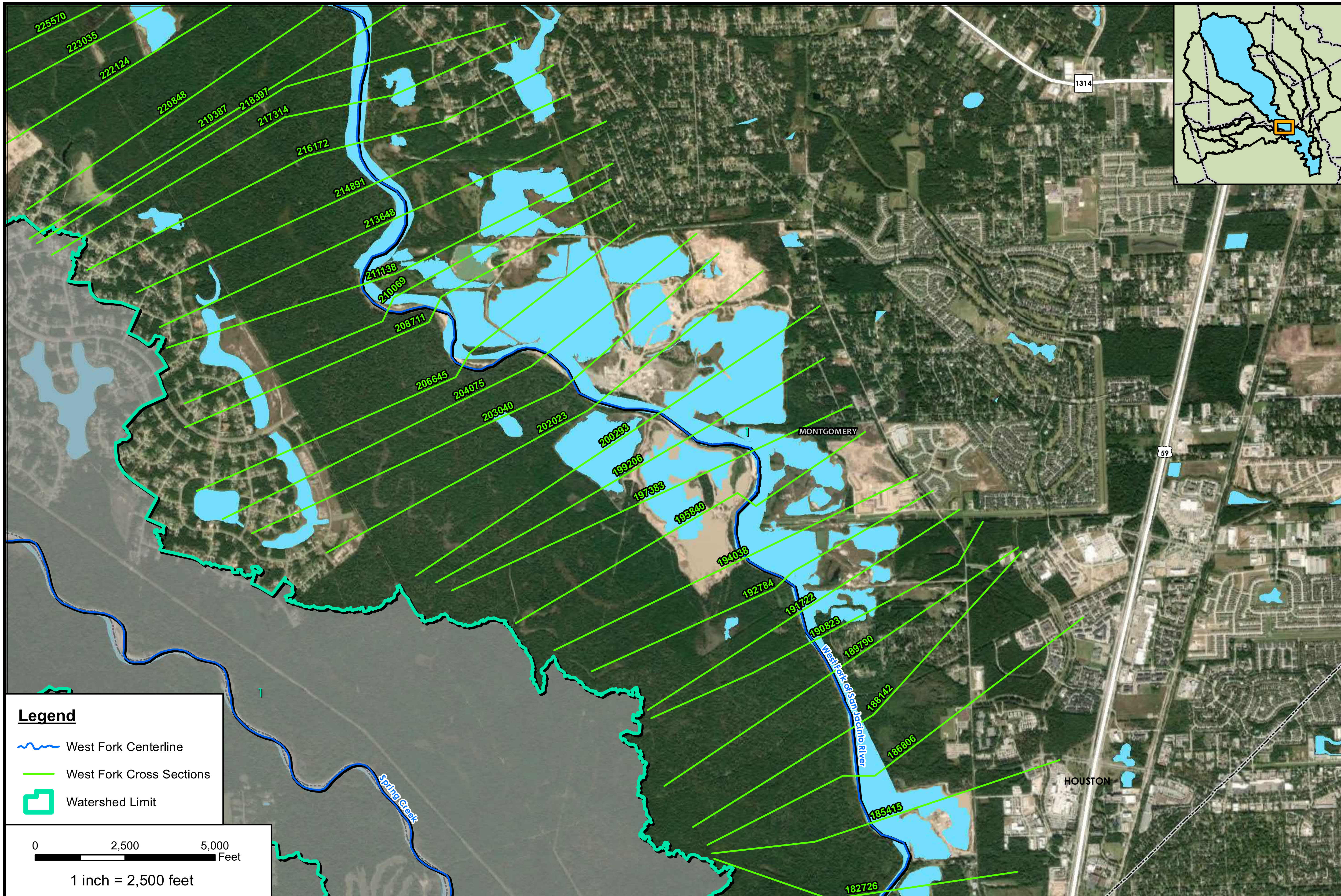
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | WEST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit
C8 - E6



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

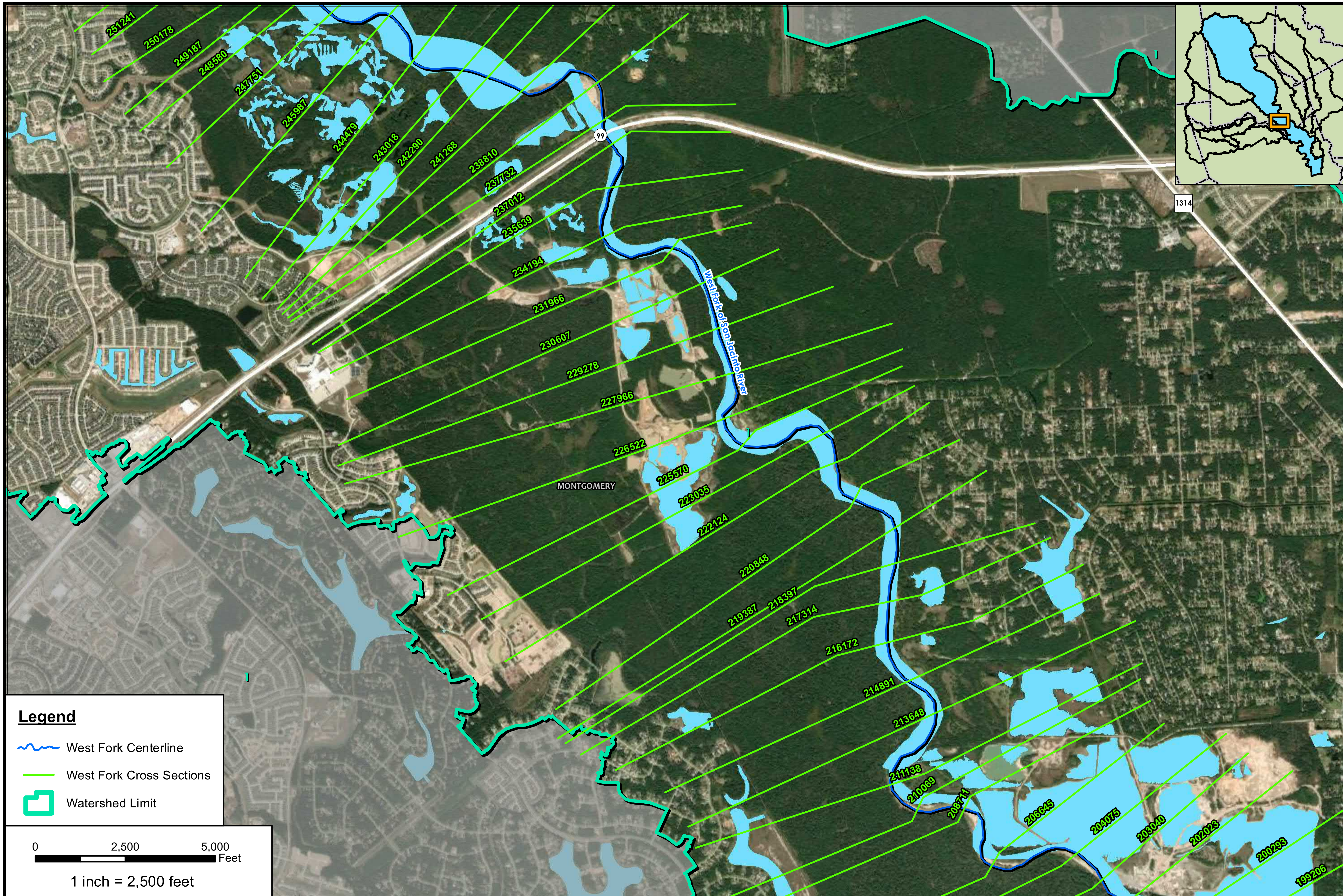
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | WEST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - E7



PROJECT AVO 33465

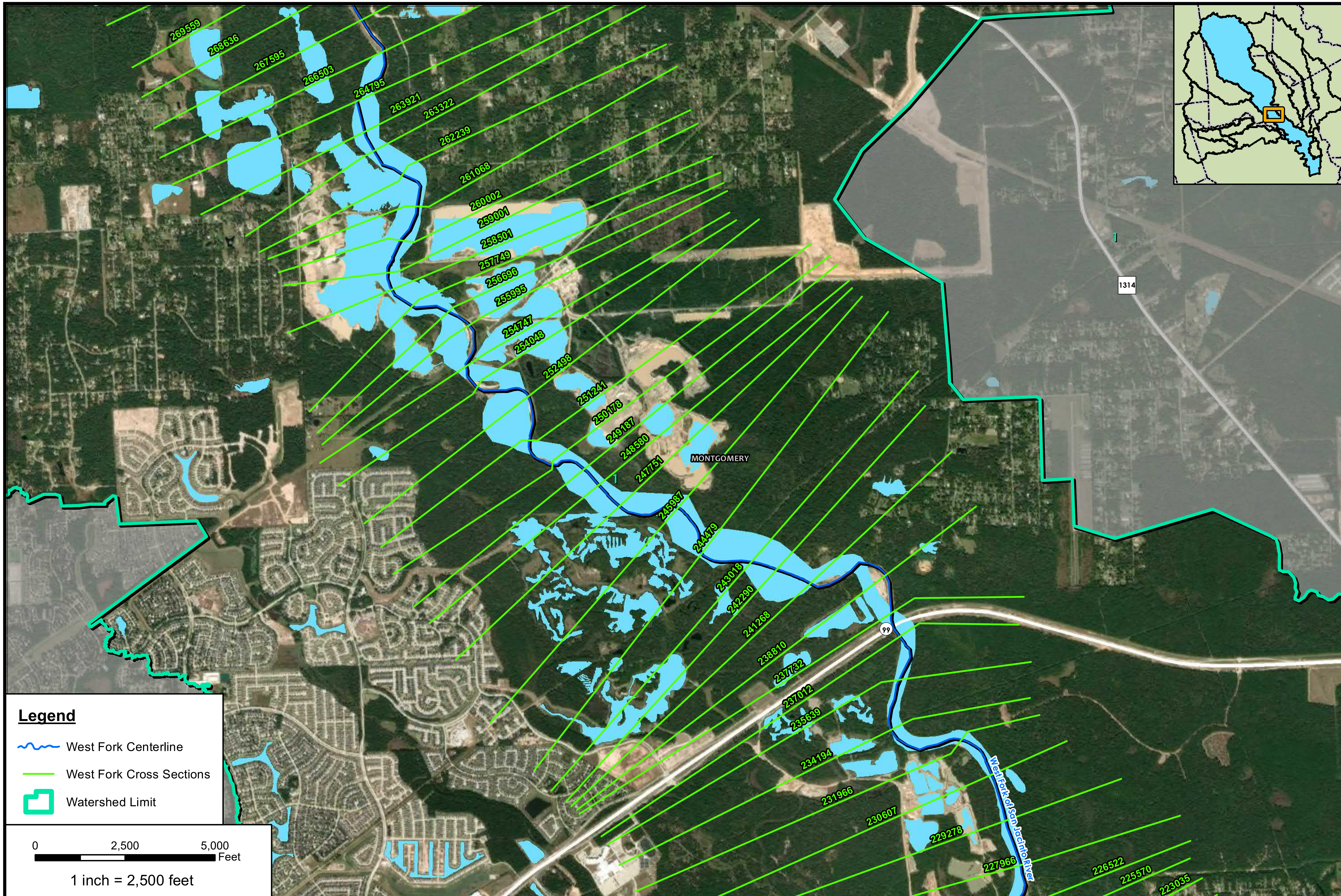
DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

HARRIS COUNTY FLOOD CONTROL DISTRICT
San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | WEST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - E8



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NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FtUS

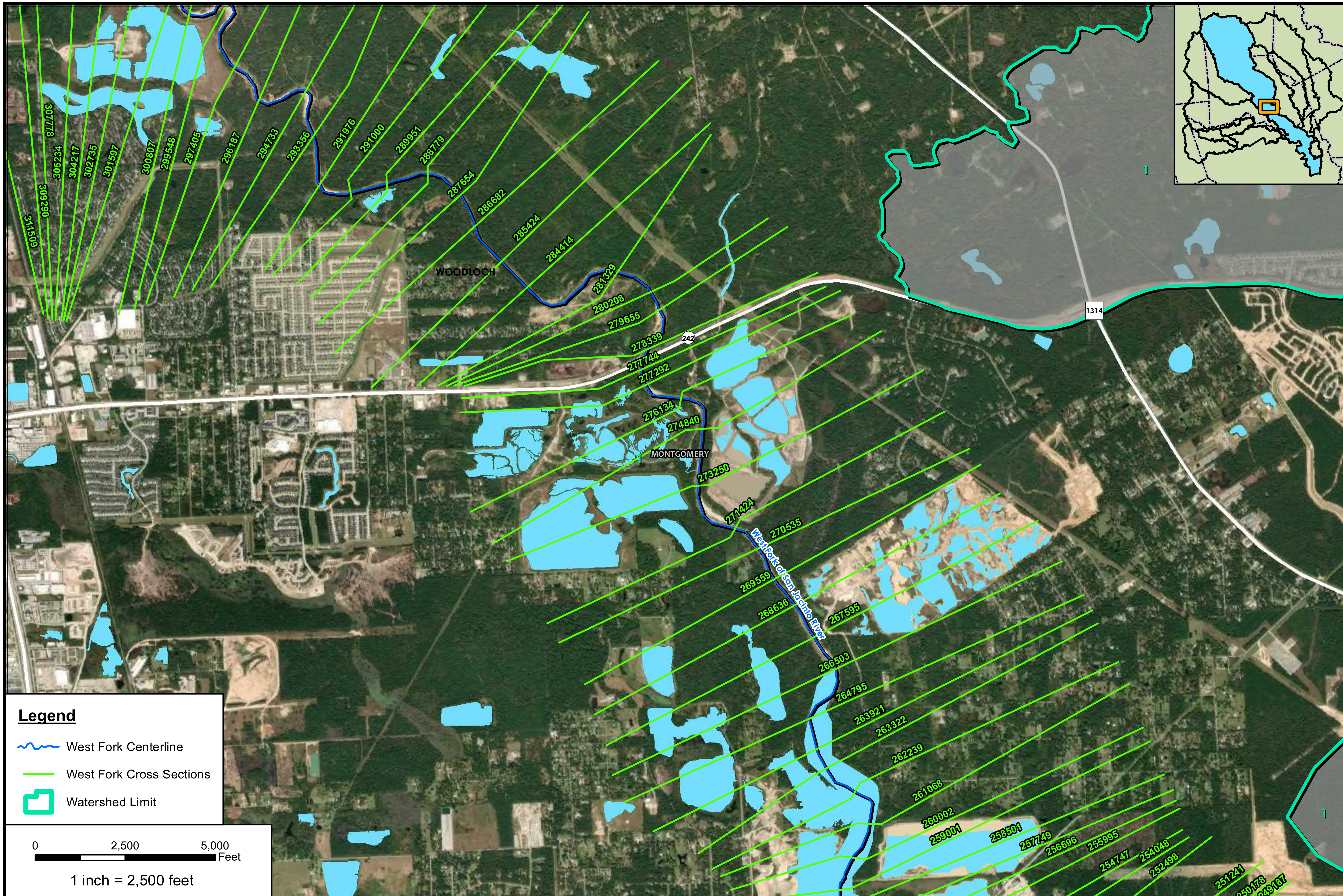
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | WEST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - E9



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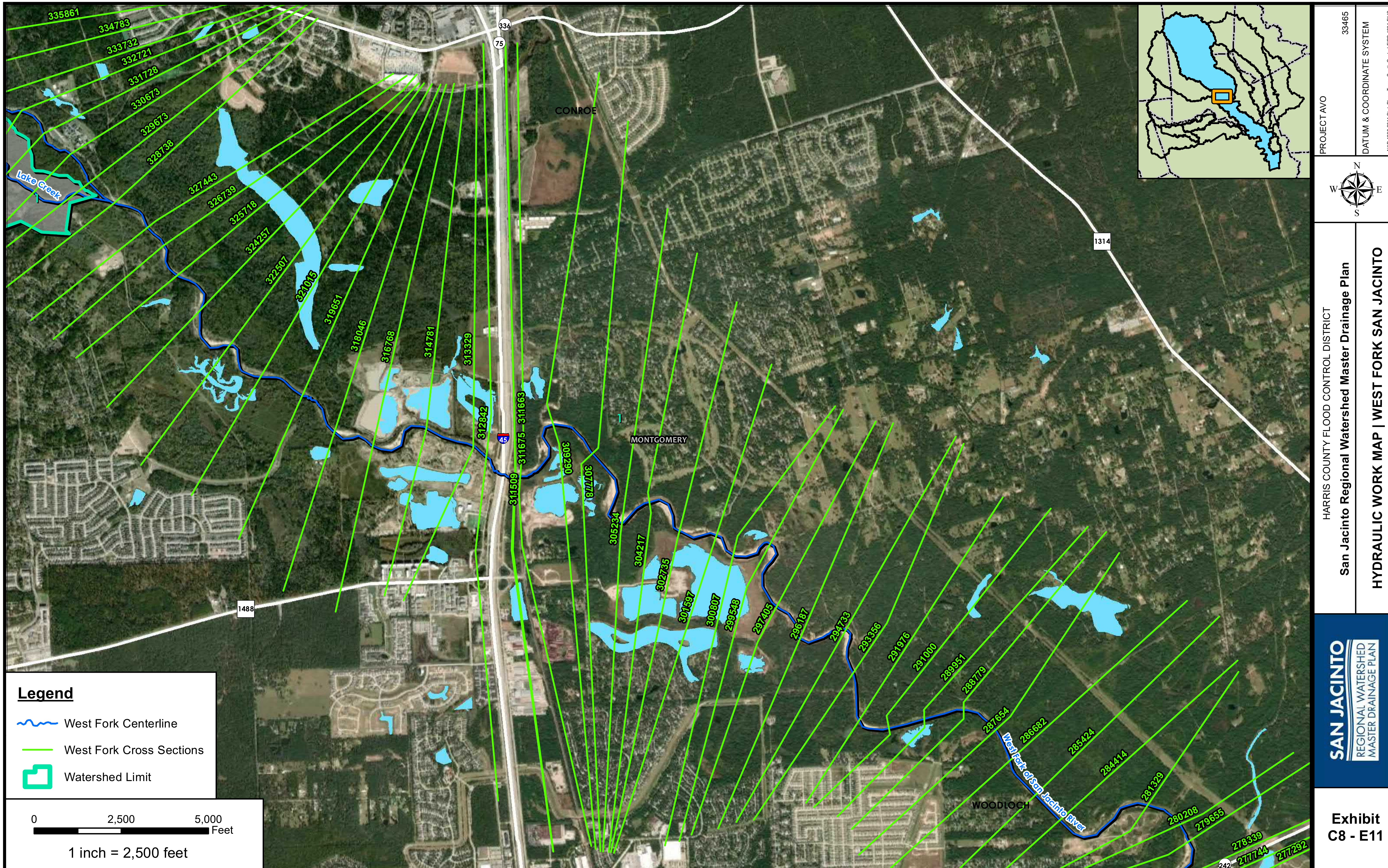
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

HARRIS COUNTY FLOOD CONTROL DISTRICT
San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | WEST FORK SAN JACINTO

SAN JACINTO
REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - E10



HARRIS COUNTY FLOOD CONTROL DISTRICT
San Jacinto Regional Watershed Master Drainage Plan
HYDRAULIC WORK MAP | WEST FORK SAN JACINTO
PROJECT AVO 33465
DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN
Exhibit C8 - E11
Legend
West Fork Centerline
West Fork Cross Sections
Watershed Limit
0 2,500 5,000 Feet
1 inch = 2,500 feet
CONROE
MONTGOMERY
WOODLOCH
Lake Creek
West Fork of San Jacinto River
336
75
45
1314
1488
242
335861
334783
333732
332721
331728
330673
329673
328738
327443
326739
325718
324257
322507
321015
319651
318046
316768
314781
313329
312842
311675
311663
311509
309290
307718
305234
304217
302735
301597
300807
299548
297405
296187
294733
293356
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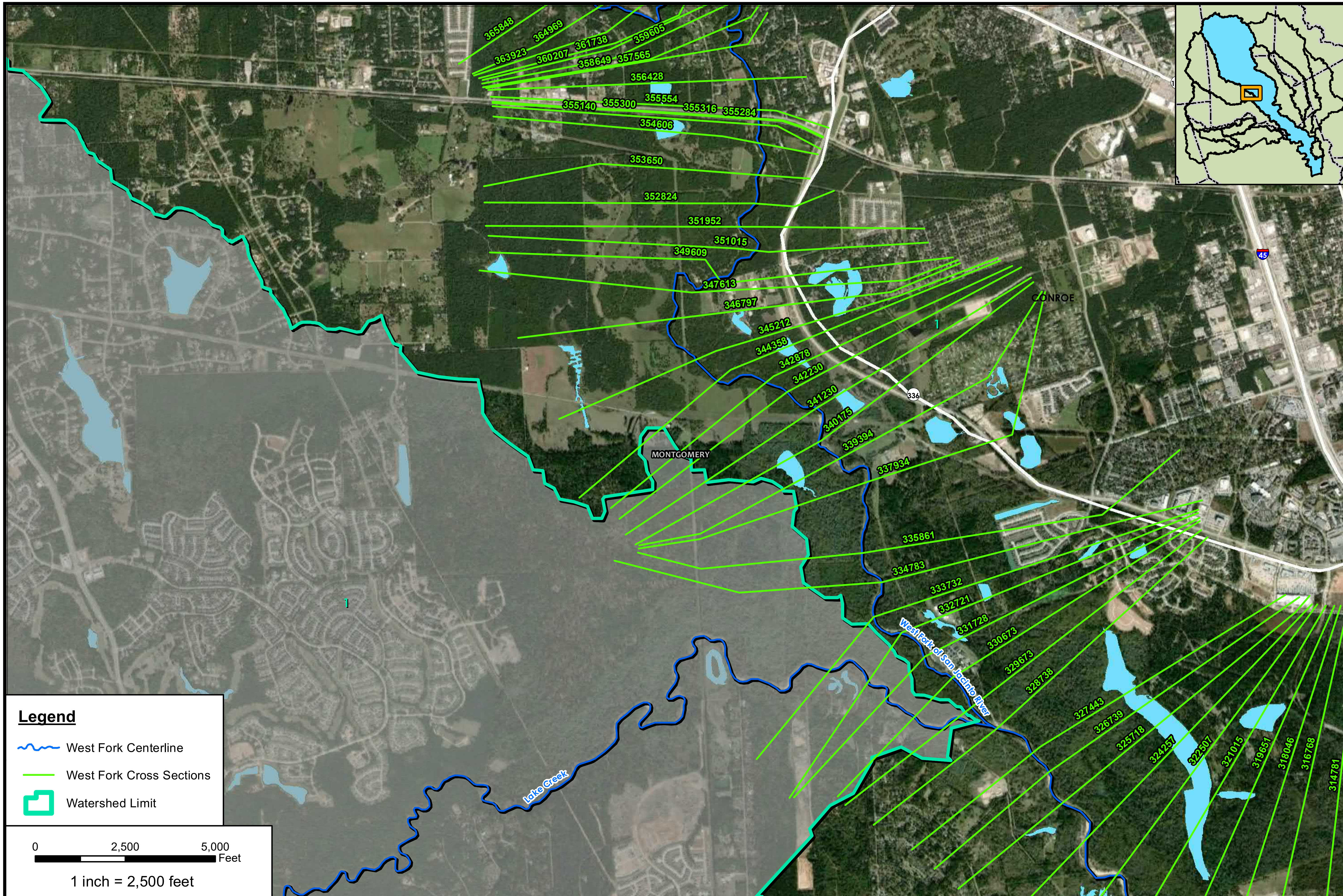


PROJECT AVO

33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

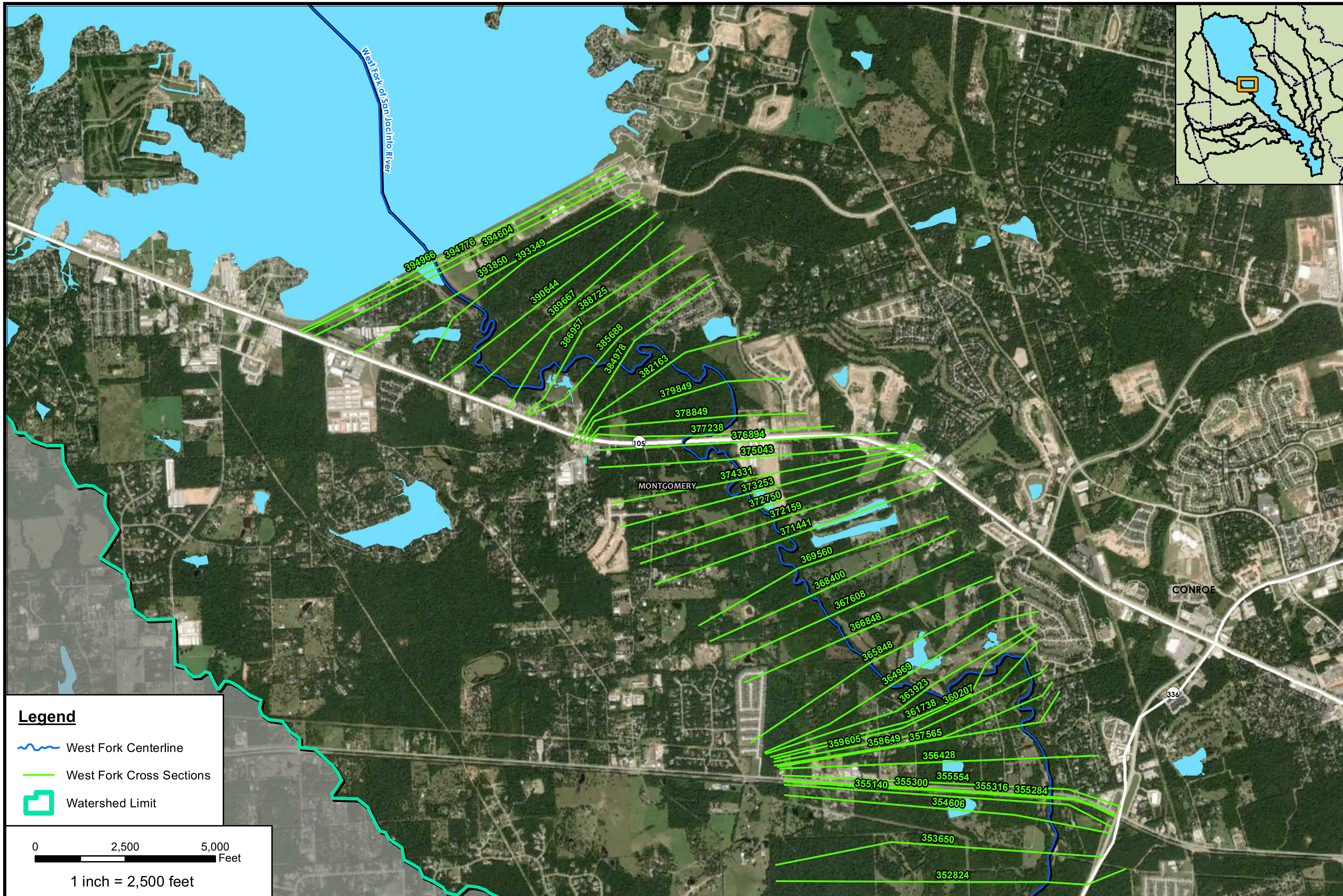
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | WEST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - E12



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | WEST FORK SAN JACINTO

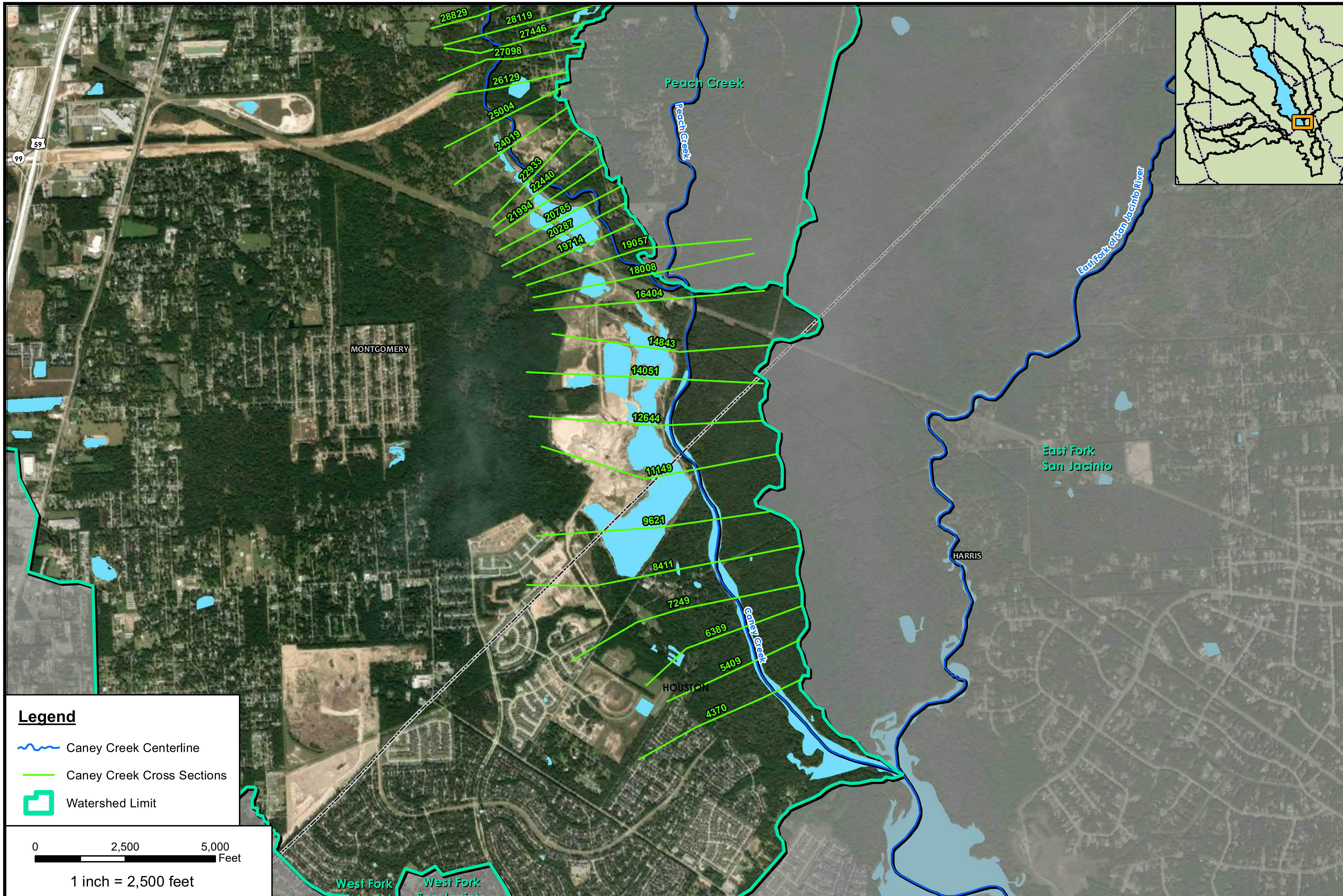
PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - E13



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | CANEY CREEK

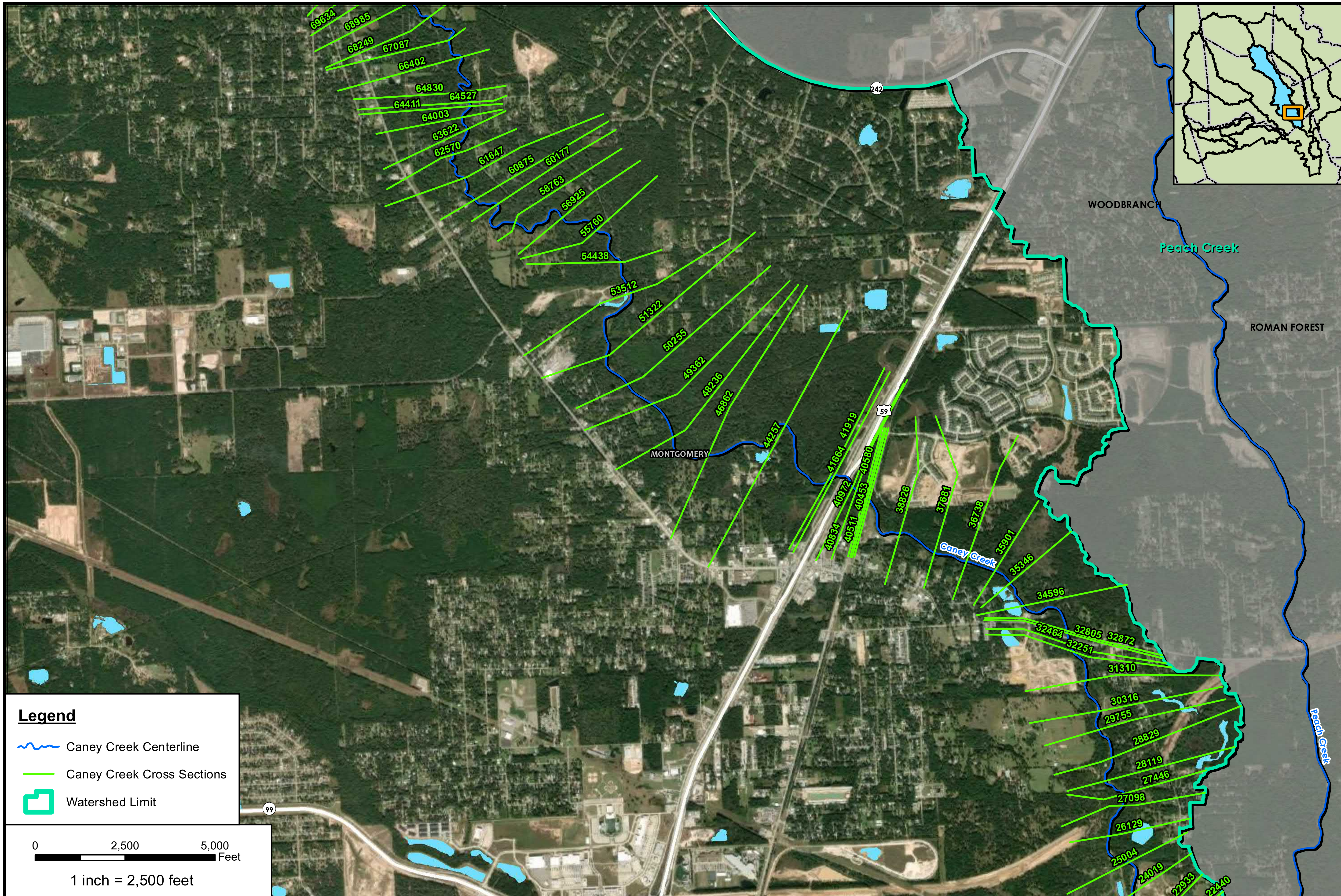
PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - F1



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

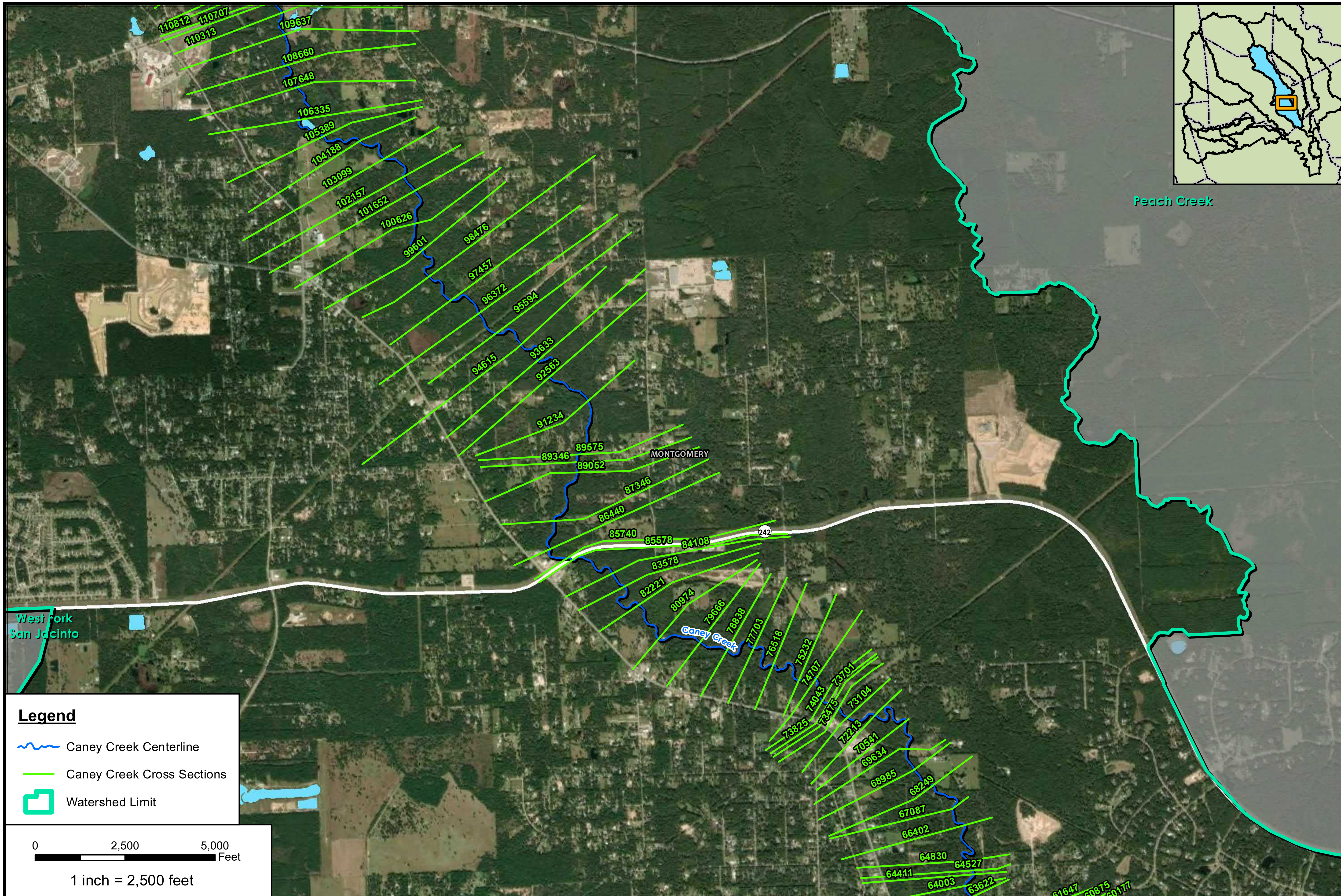
HYDRAULIC WORK MAP | CANEY CREEK

PROJECT AVO 33465

DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

SAN JACINTO
REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - F2



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

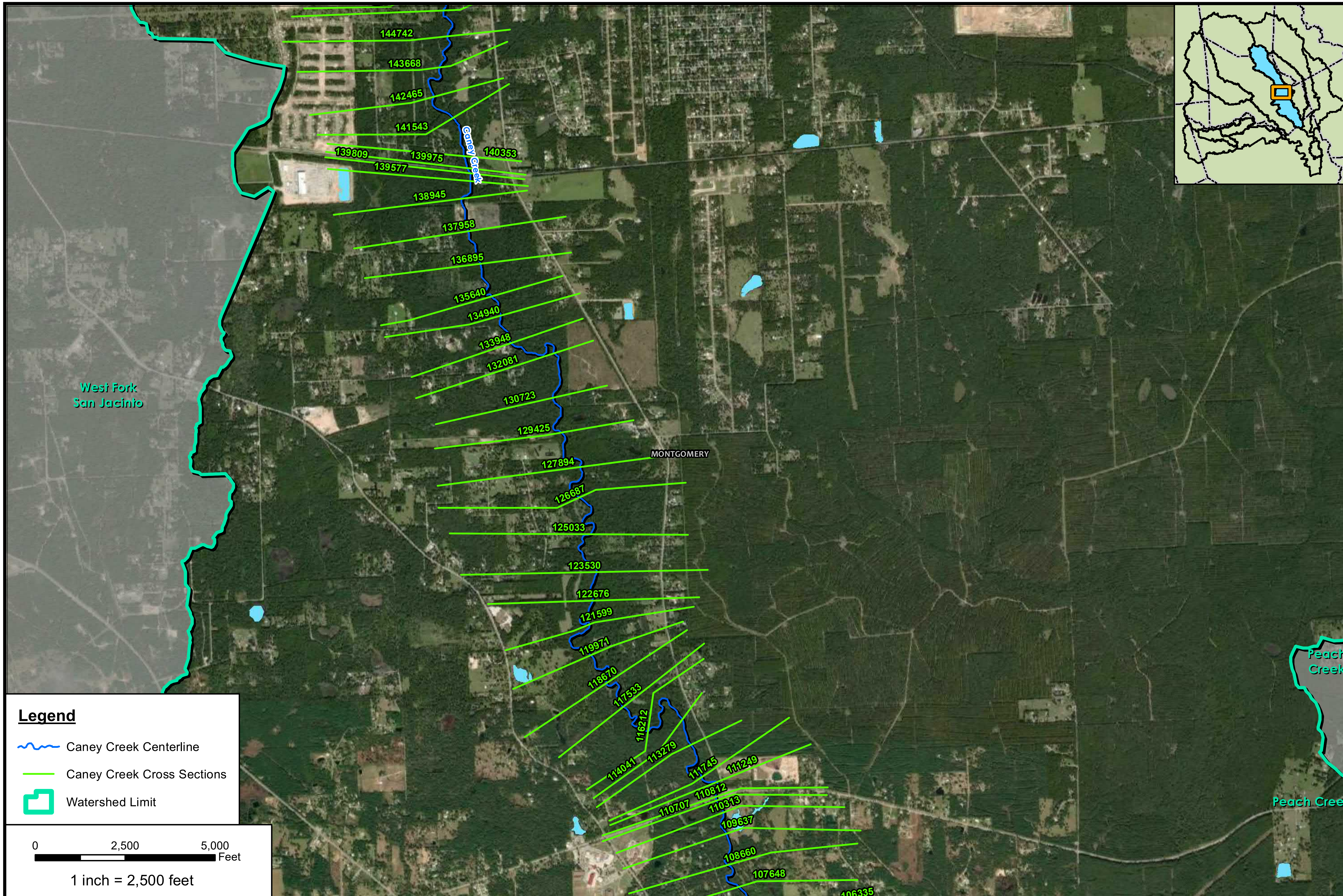
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | CANEY CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - F3



PROJECT AVO 33465

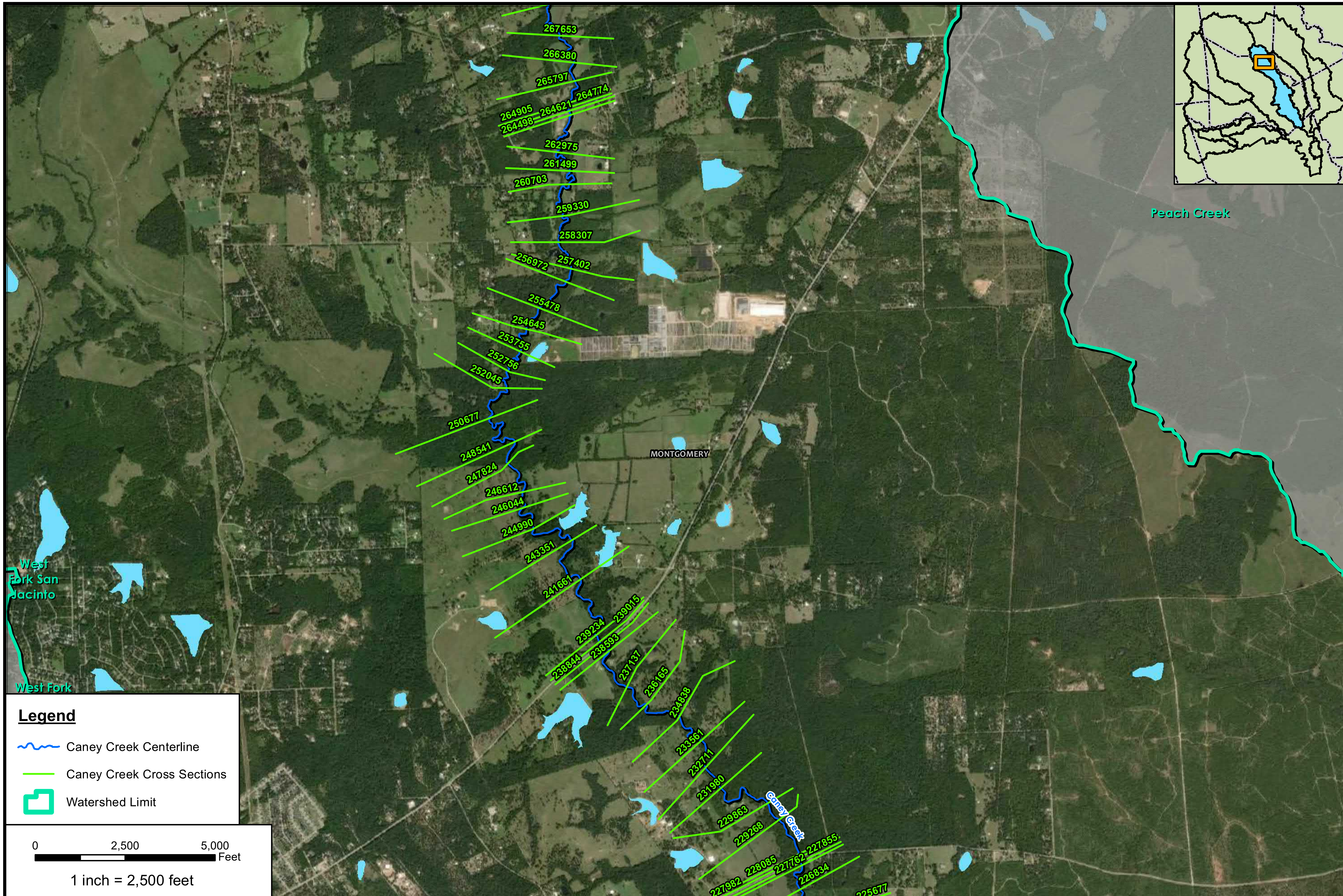
DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FtUS

HARRIS COUNTY FLOOD CONTROL DISTRICT
San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | CANEY CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit
C8 - F4



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

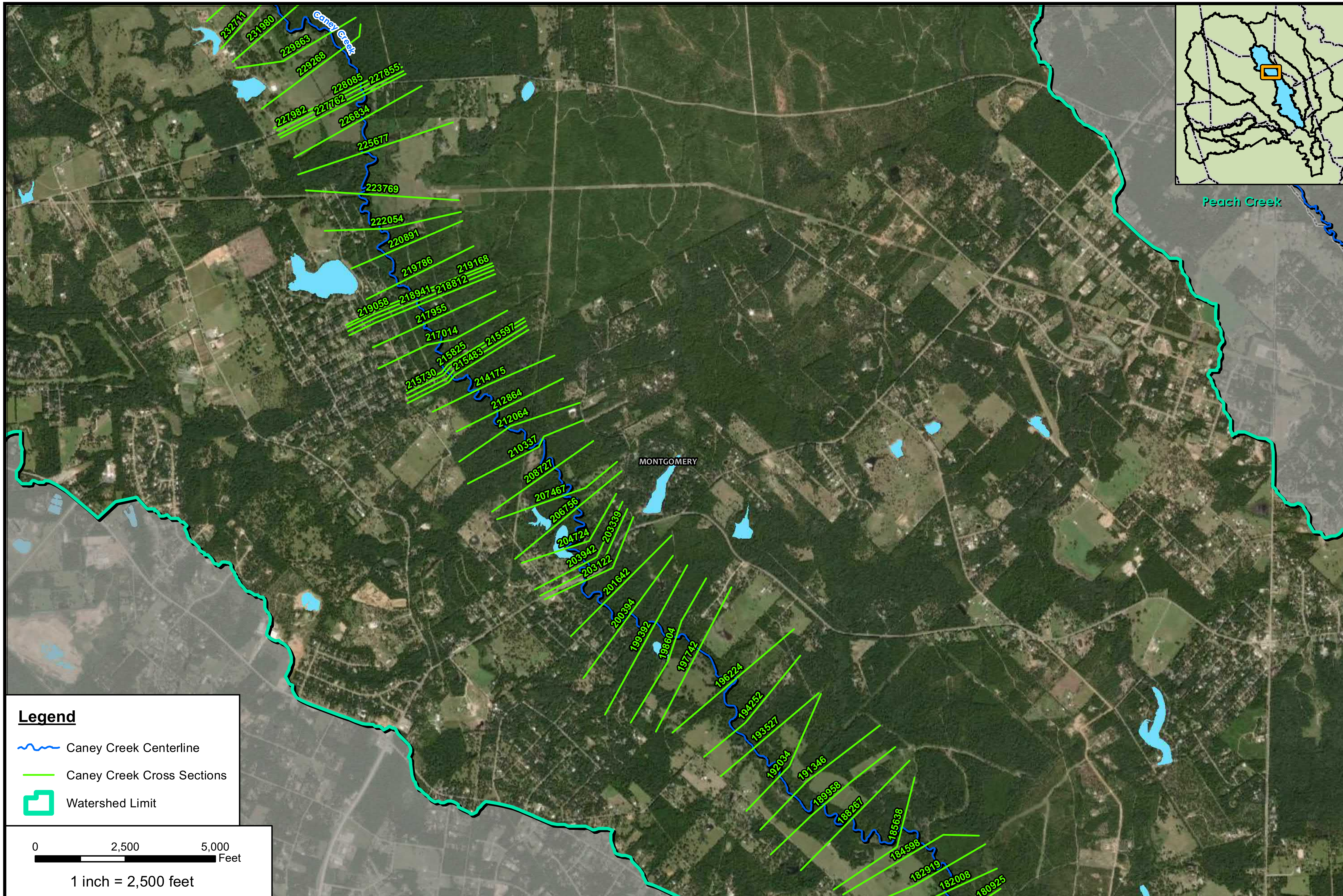
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | CANEY CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - F5



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

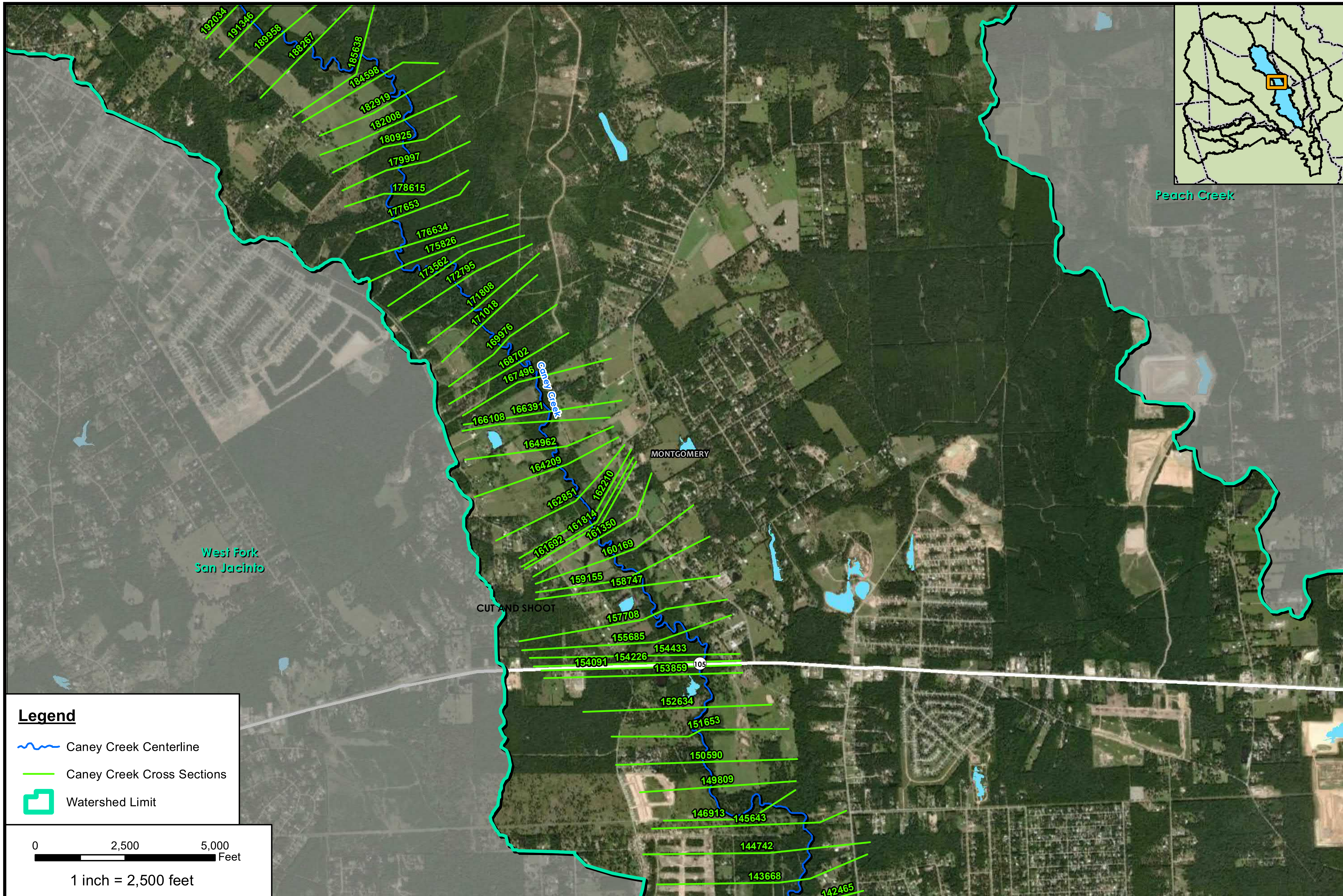
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | CANEY CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - F6



PROJECT AVO

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DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

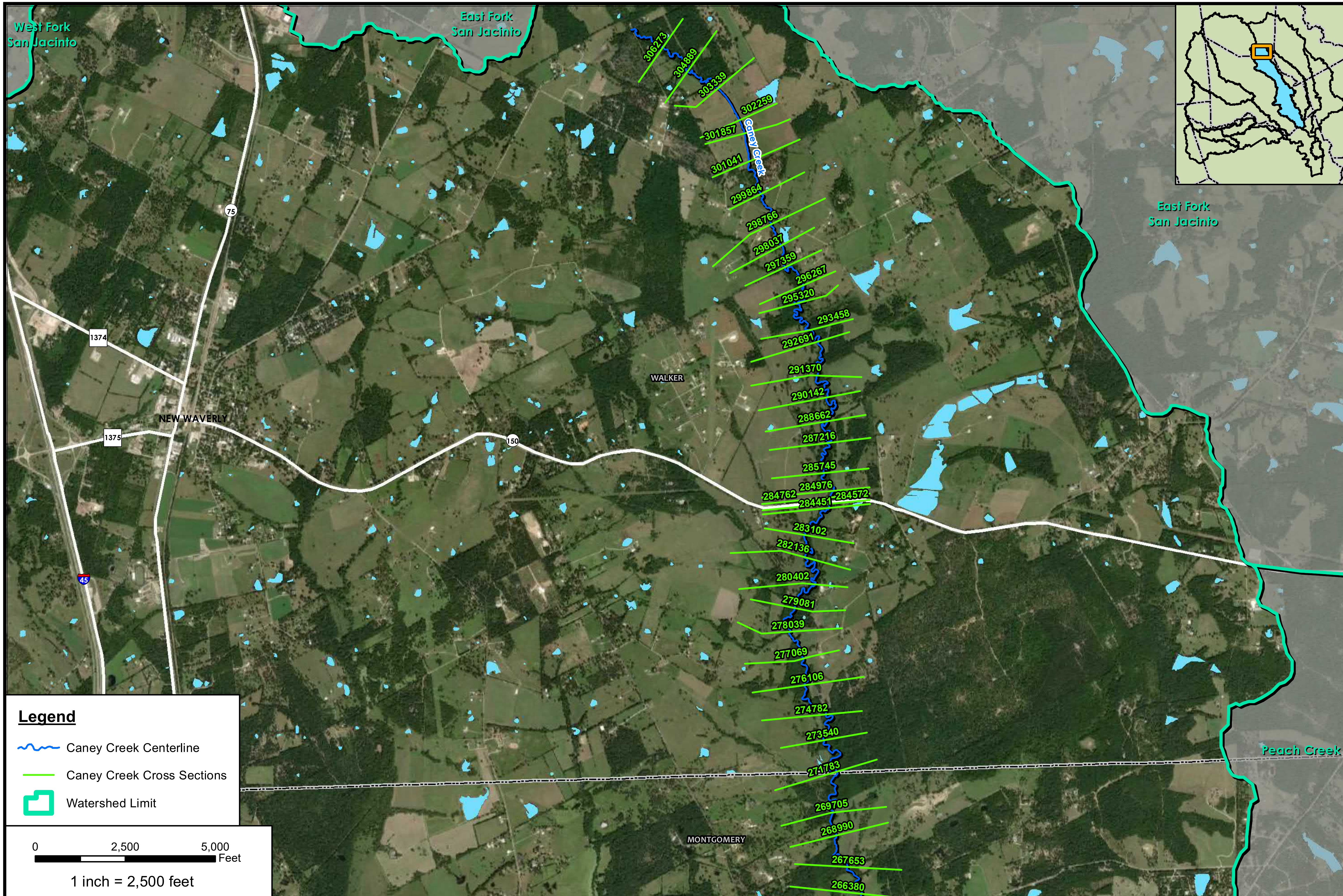
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | CANEY CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - F7



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

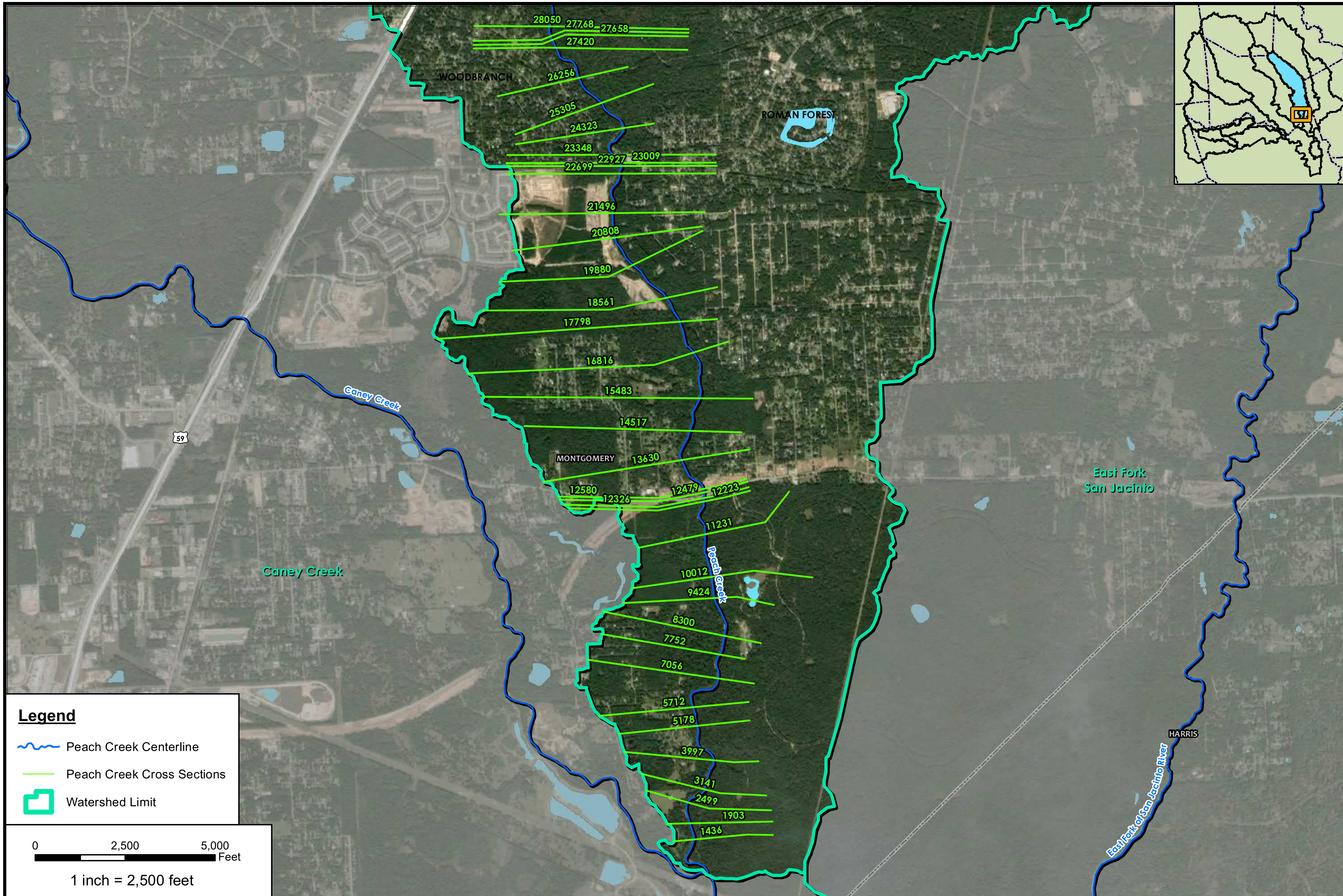
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | CANEY CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - F8



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

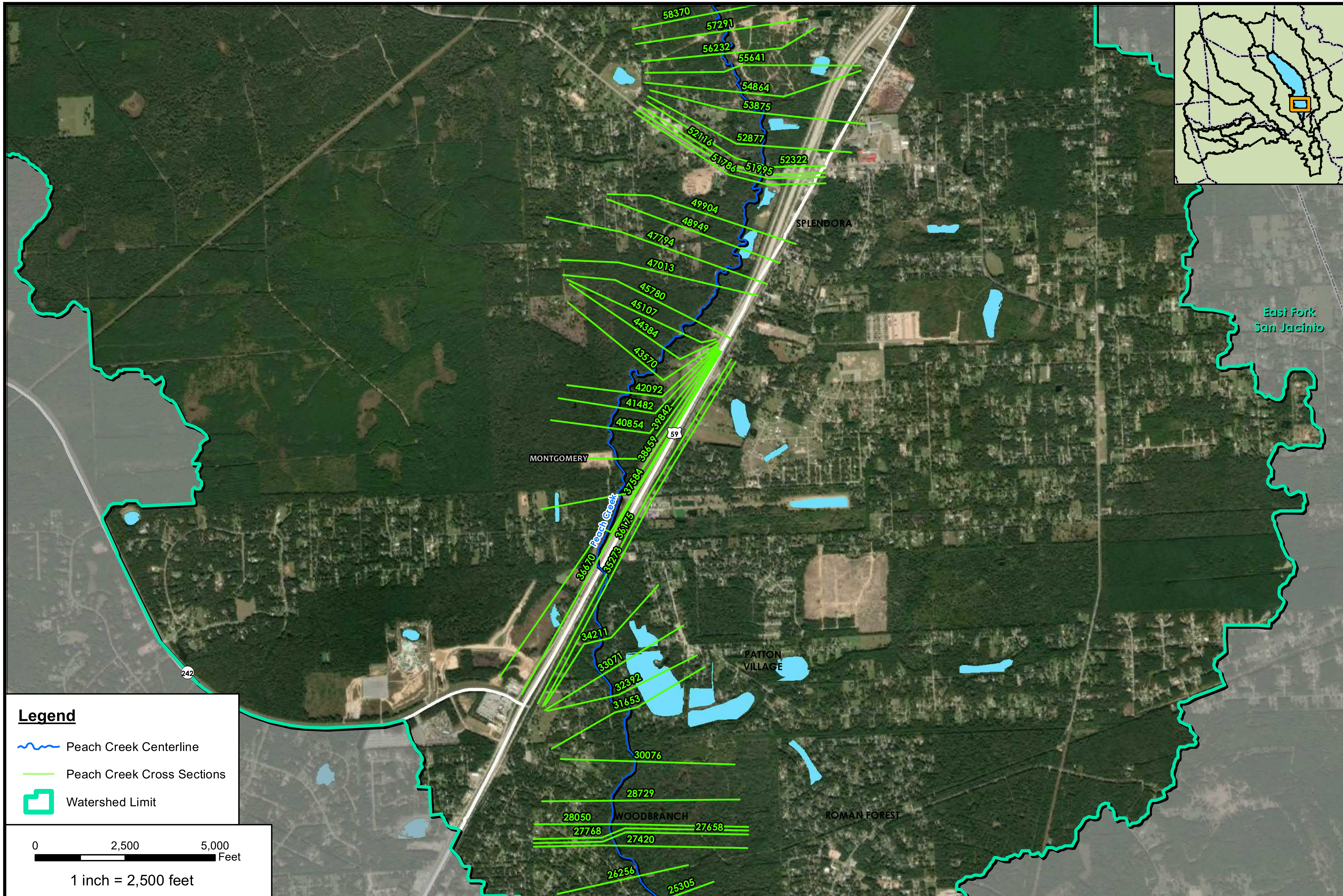
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | PEACH CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - G1



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FtUS

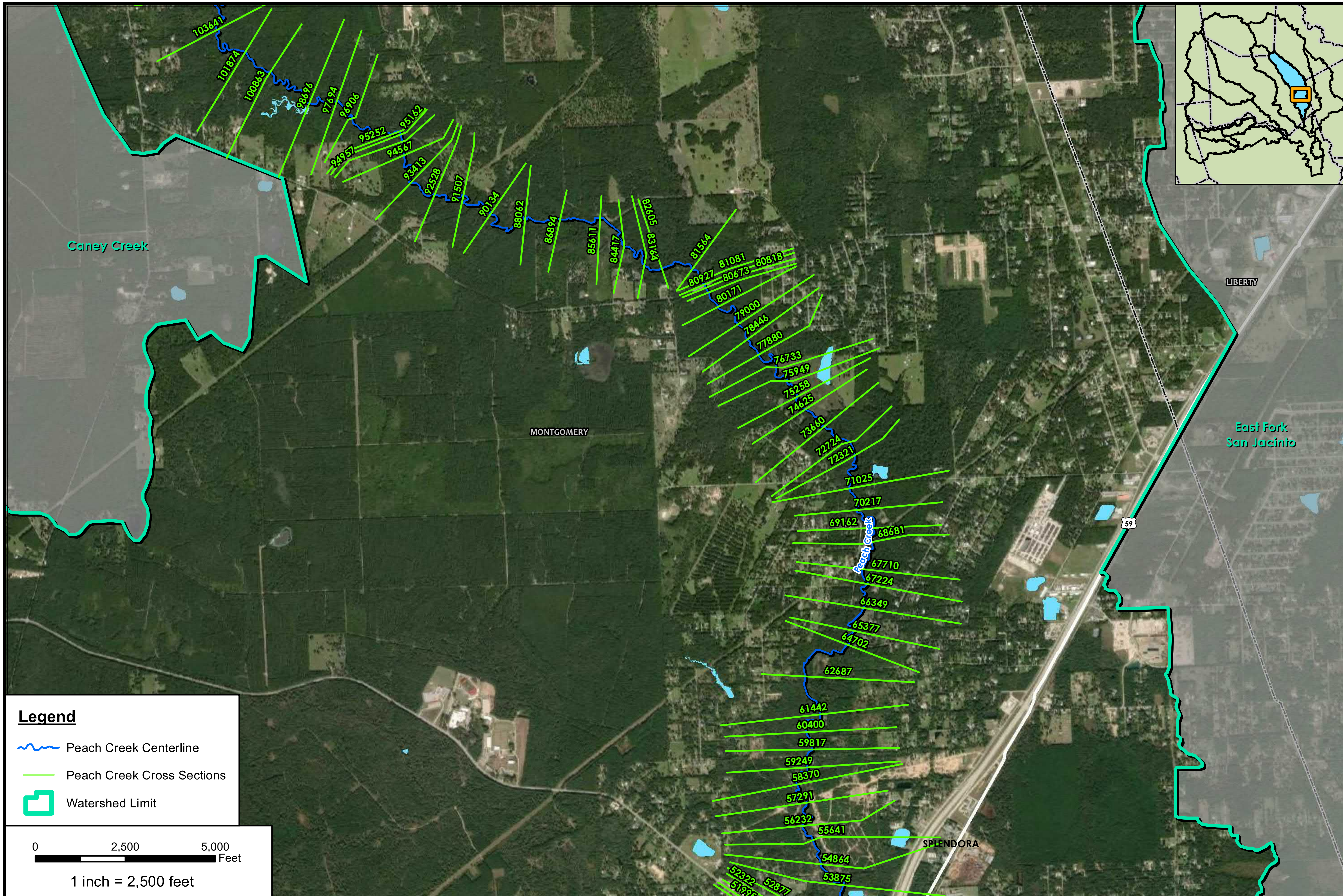
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | PEACH CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - G2



PROJECT AVO 33465

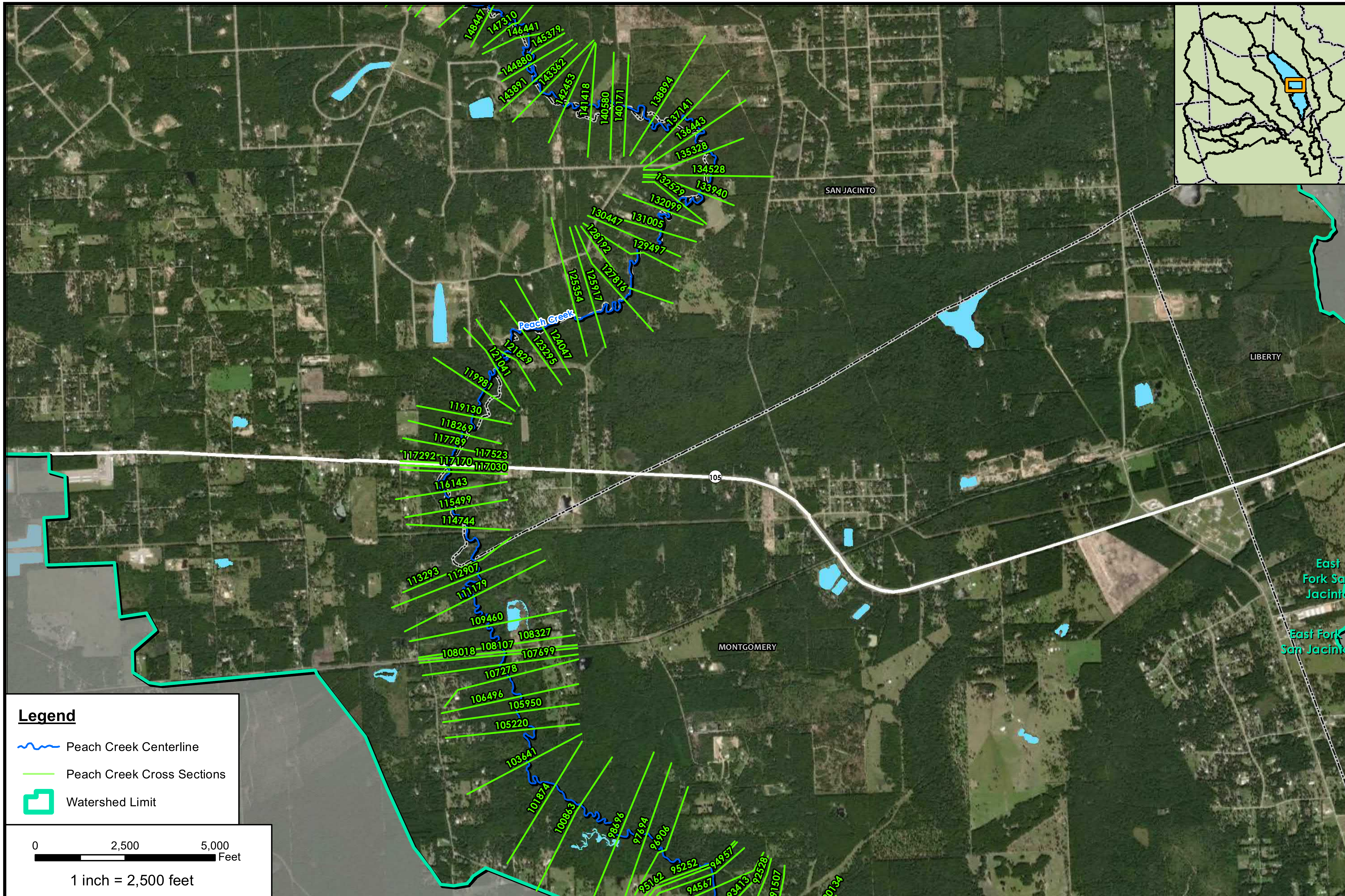
DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

HARRIS COUNTY FLOOD CONTROL DISTRICT
San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | PEACH CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - G3



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

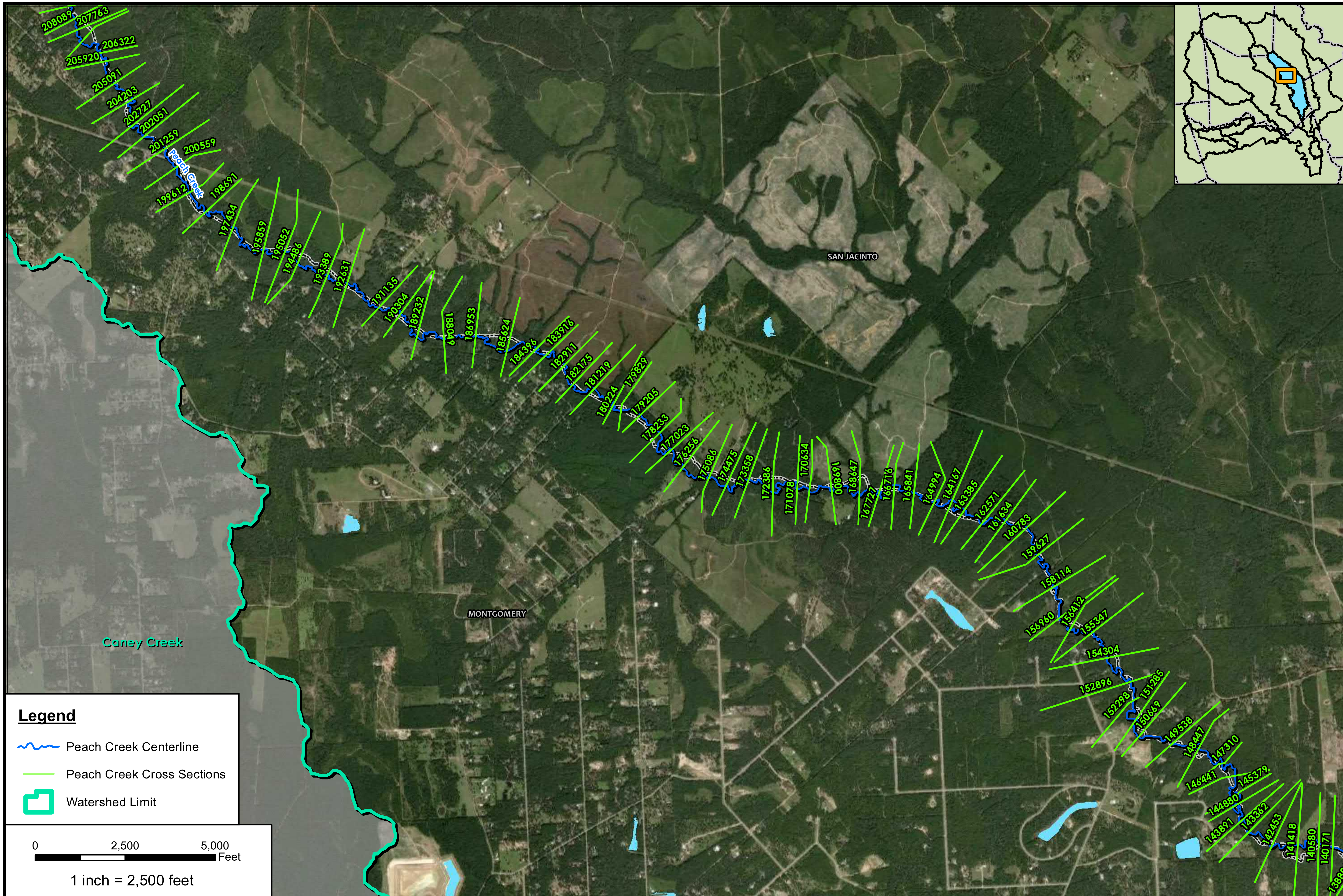
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | PEACH CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - G4



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FtUS

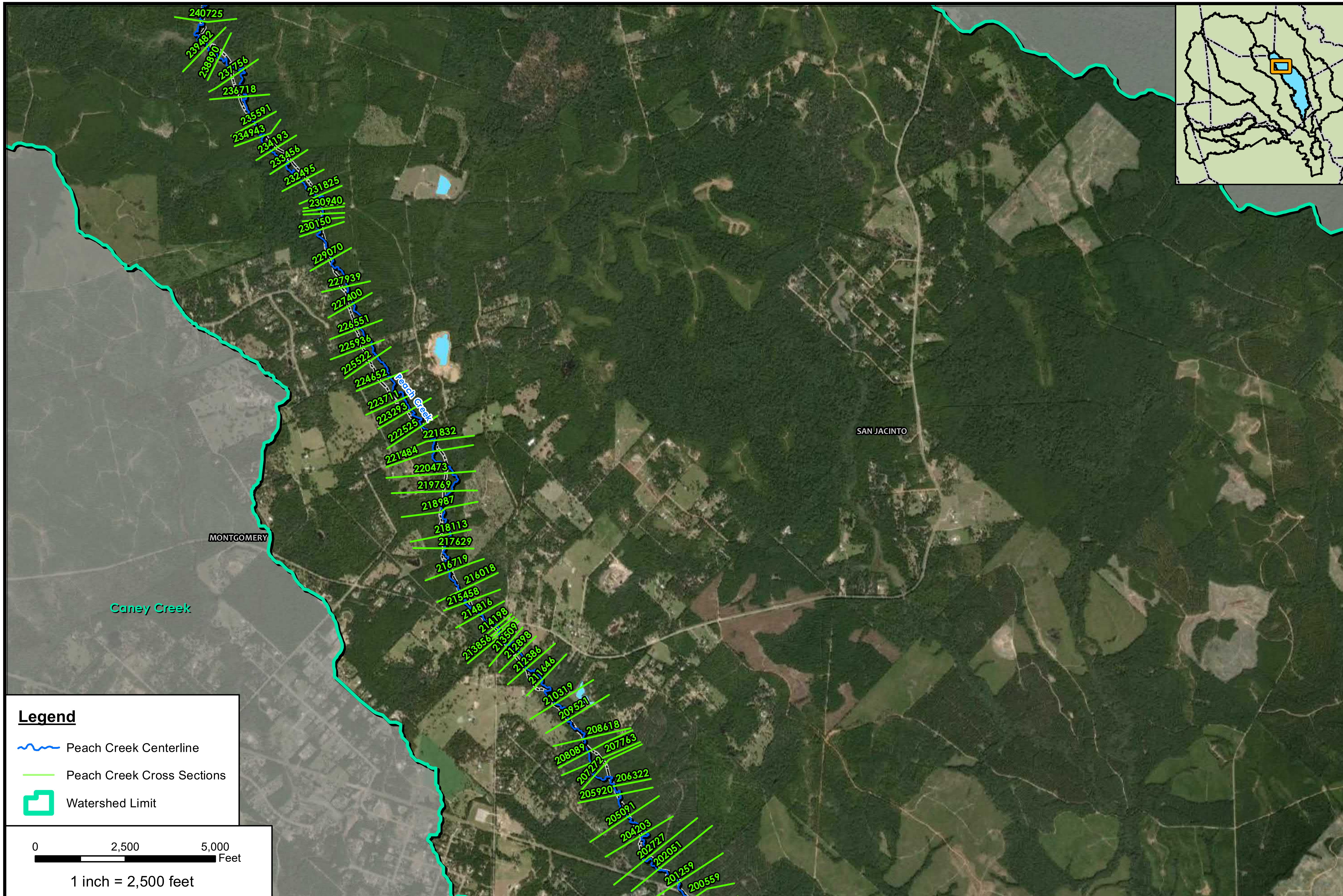
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | PEACH CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - G5



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

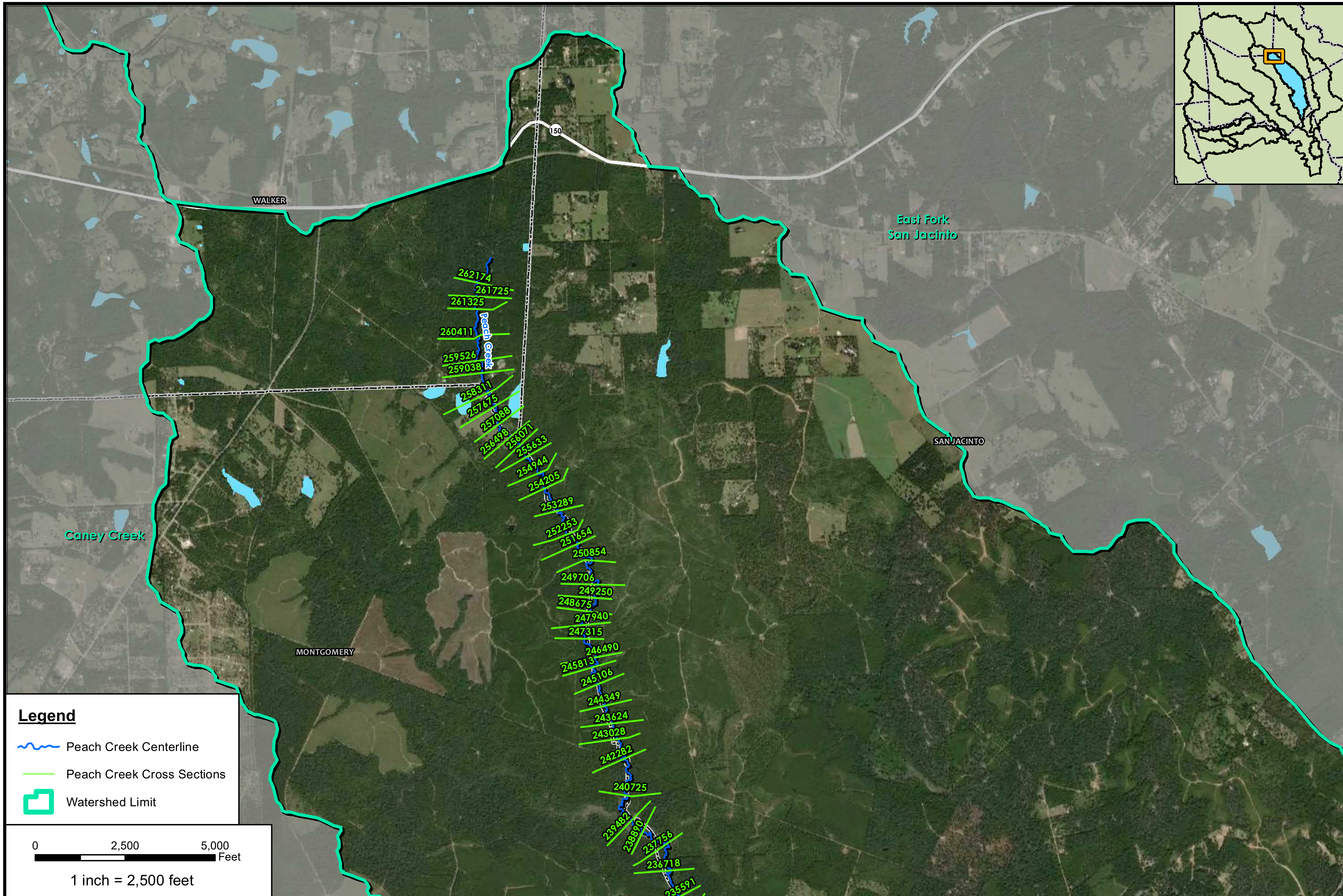
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | PEACH CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - G6



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FtUS

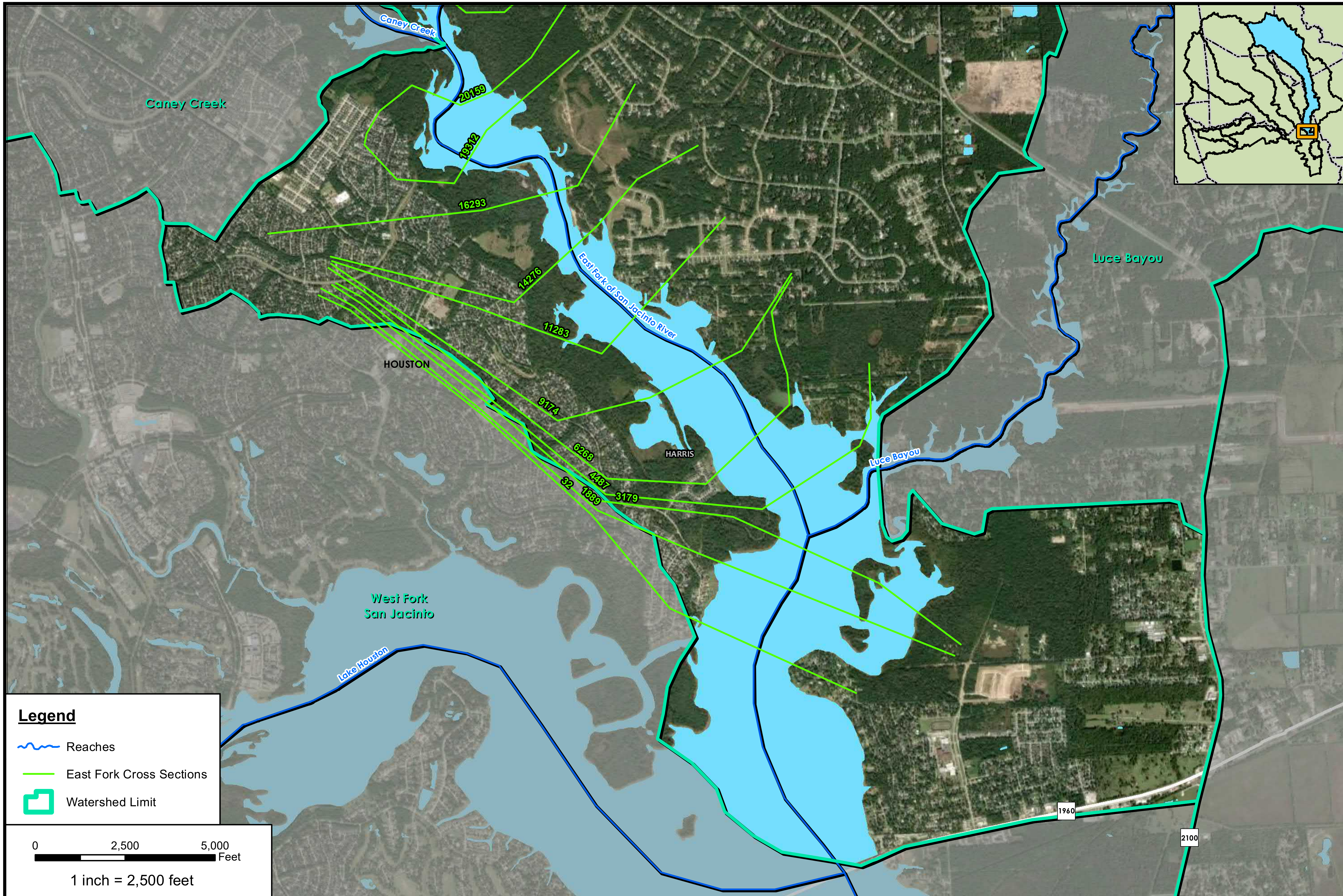
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | PEACH CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - G7



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

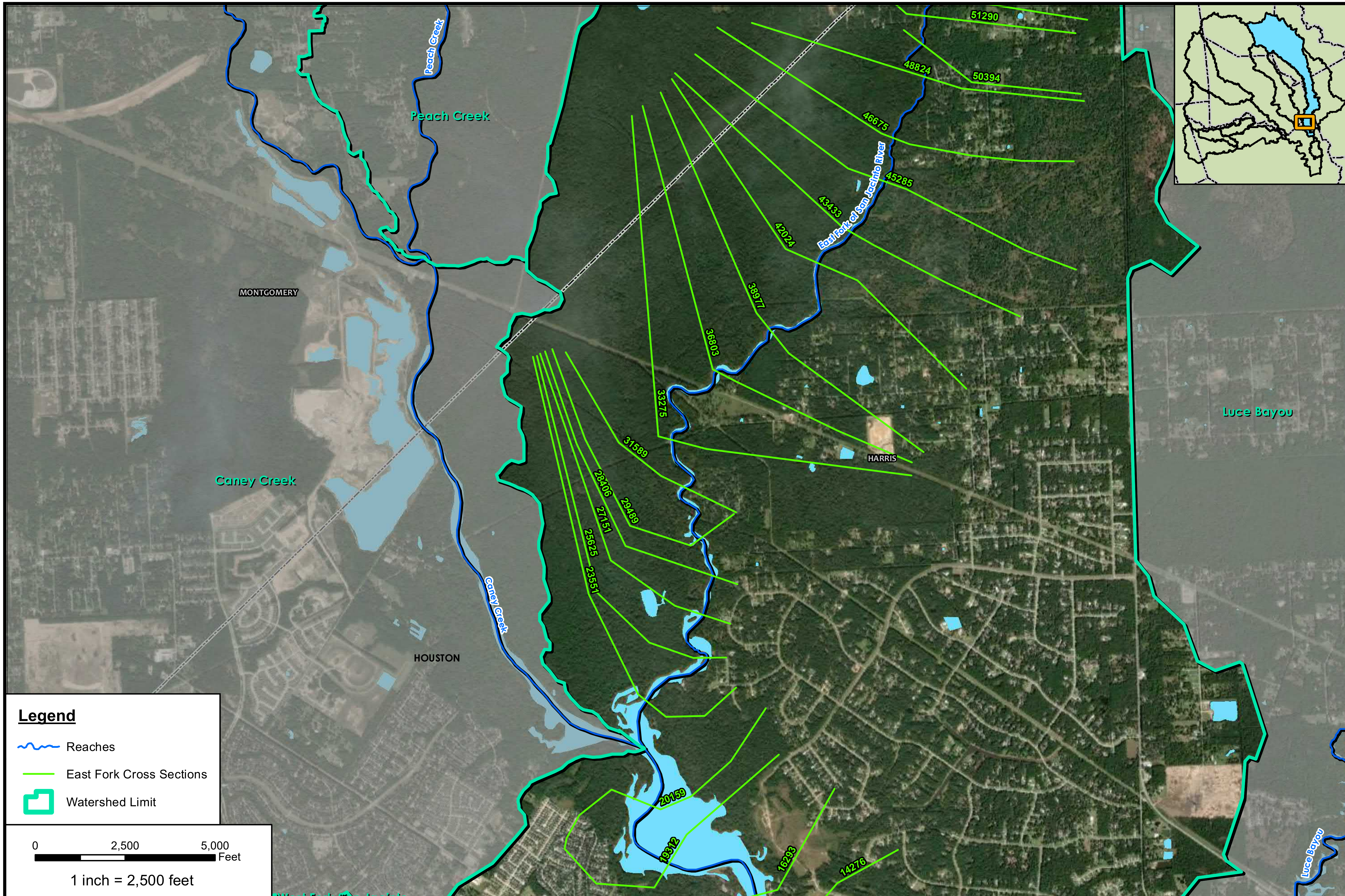
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | EAST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - H1



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

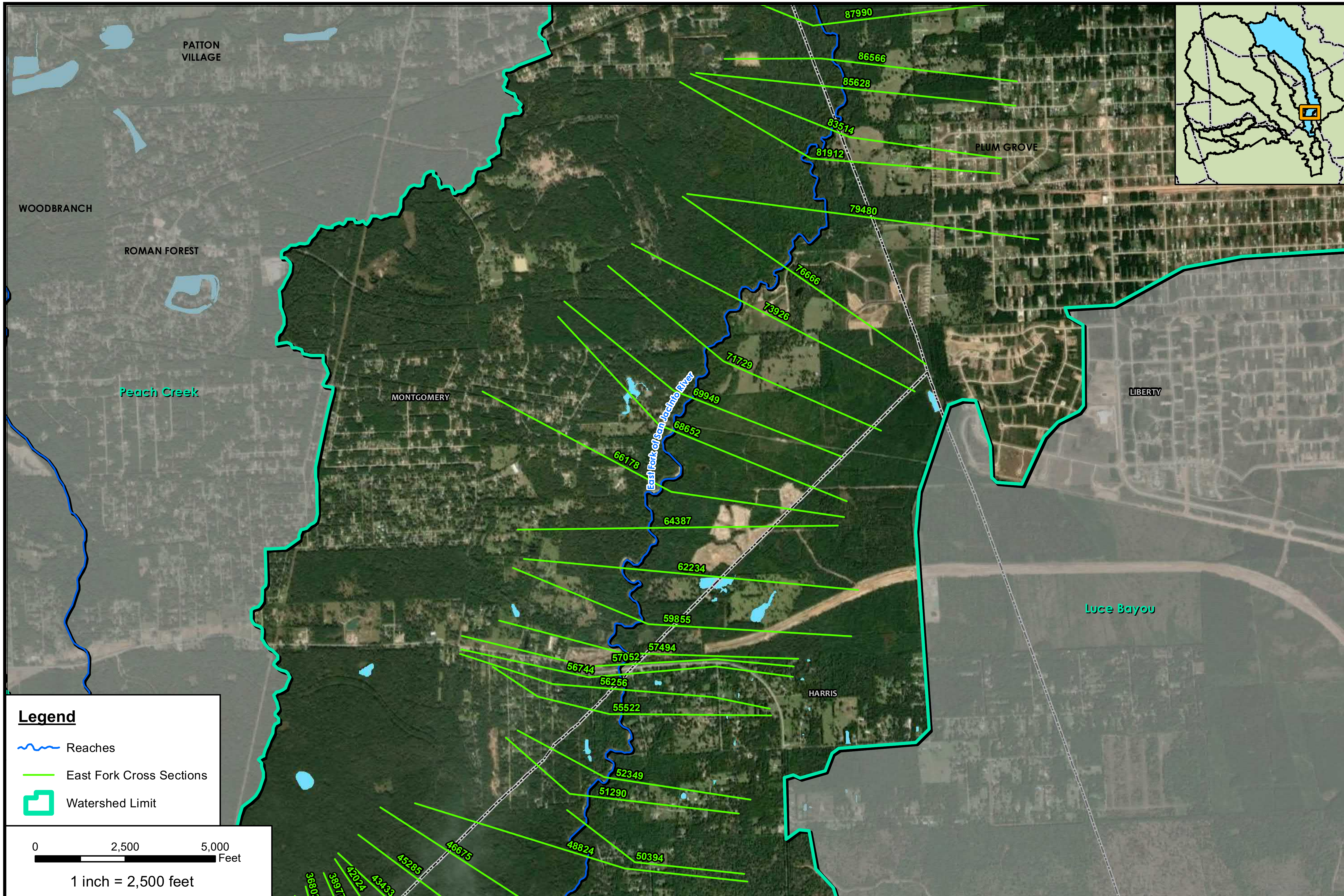
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | EAST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - H2



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

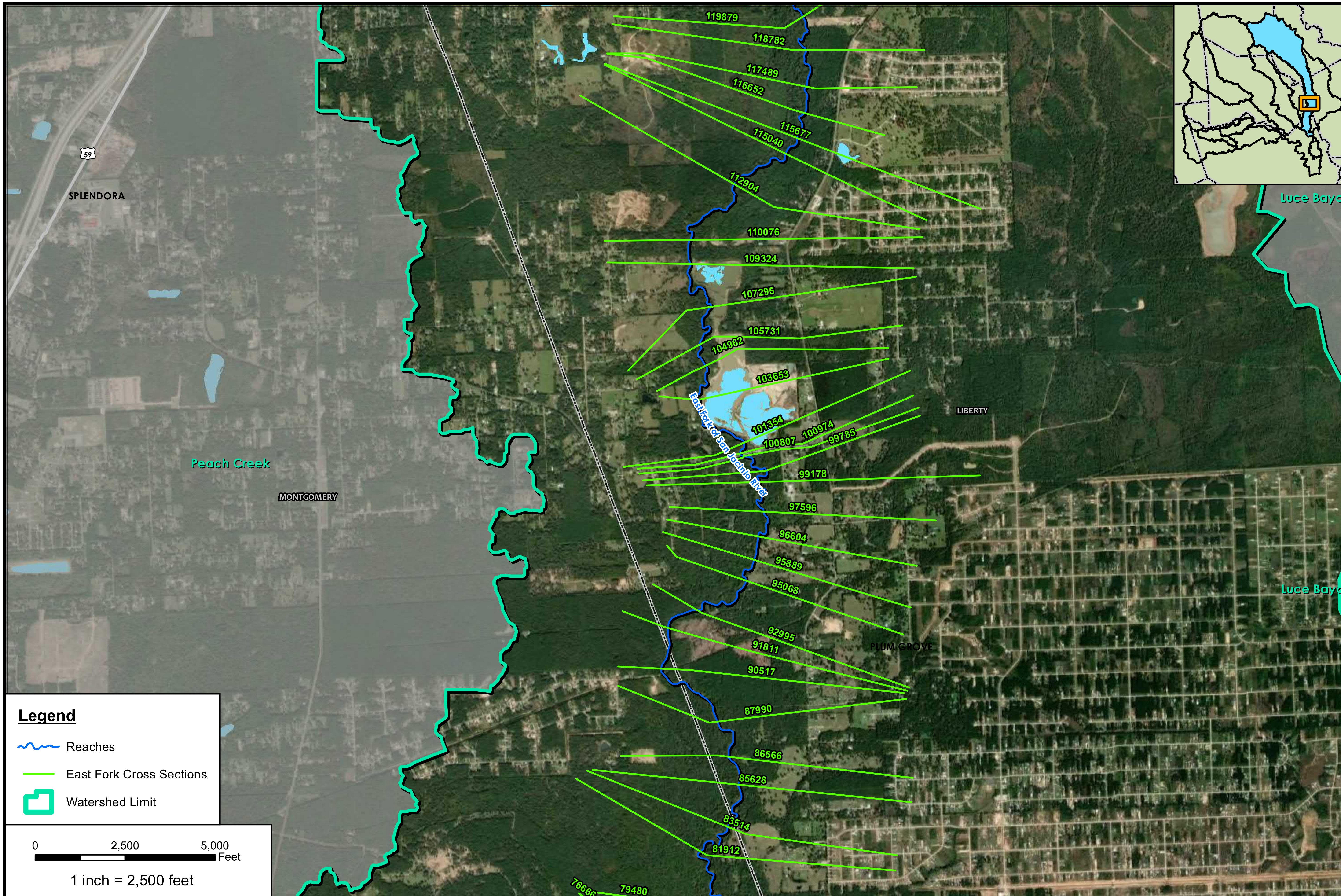
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | EAST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - H3



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

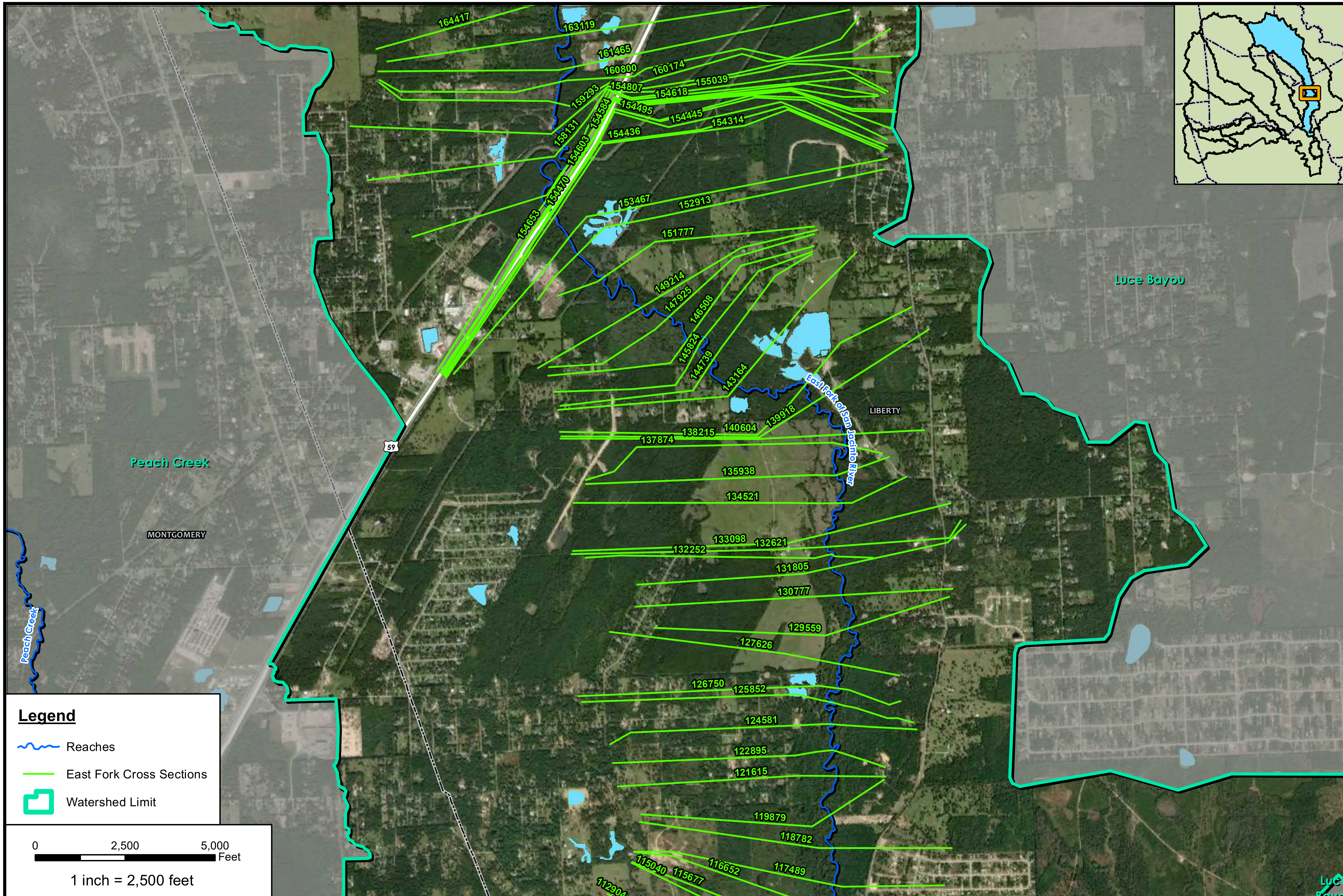
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | EAST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - H4



PROJECT AVO 33465

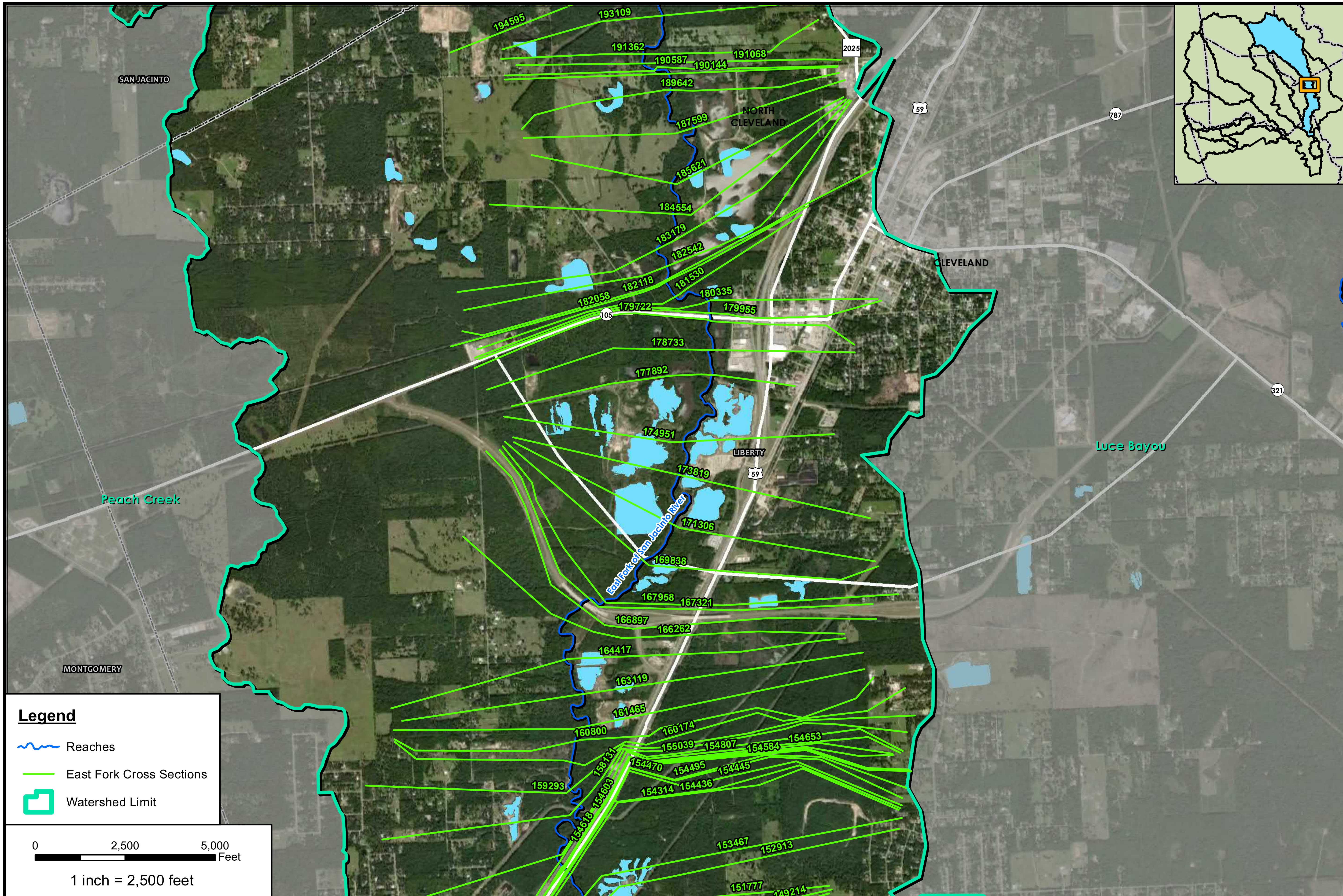
DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

HARRIS COUNTY FLOOD CONTROL DISTRICT
San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | EAST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - H5



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | EAST FORK SAN JACINTO

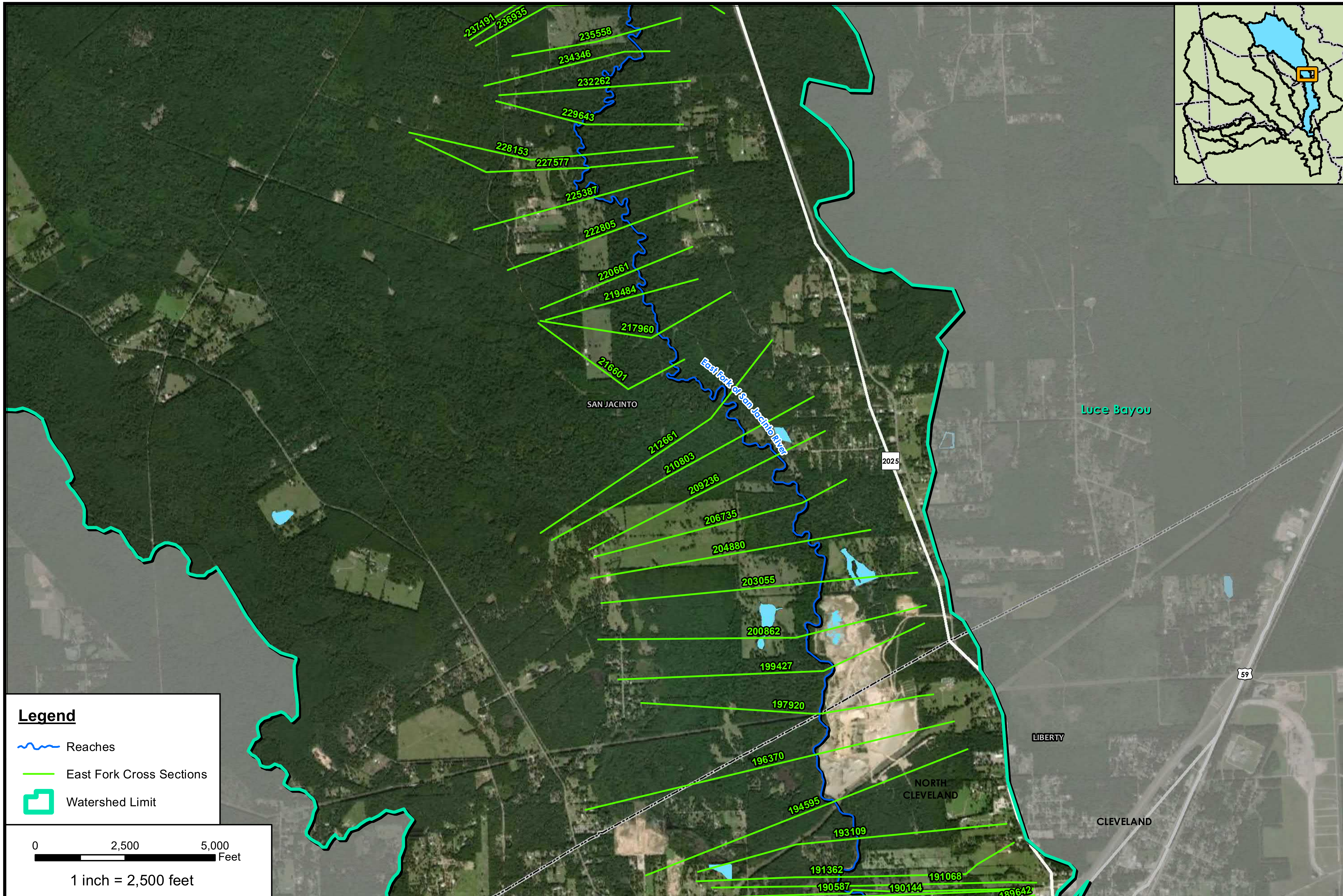
PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - H6



PROJECT AVO 33465

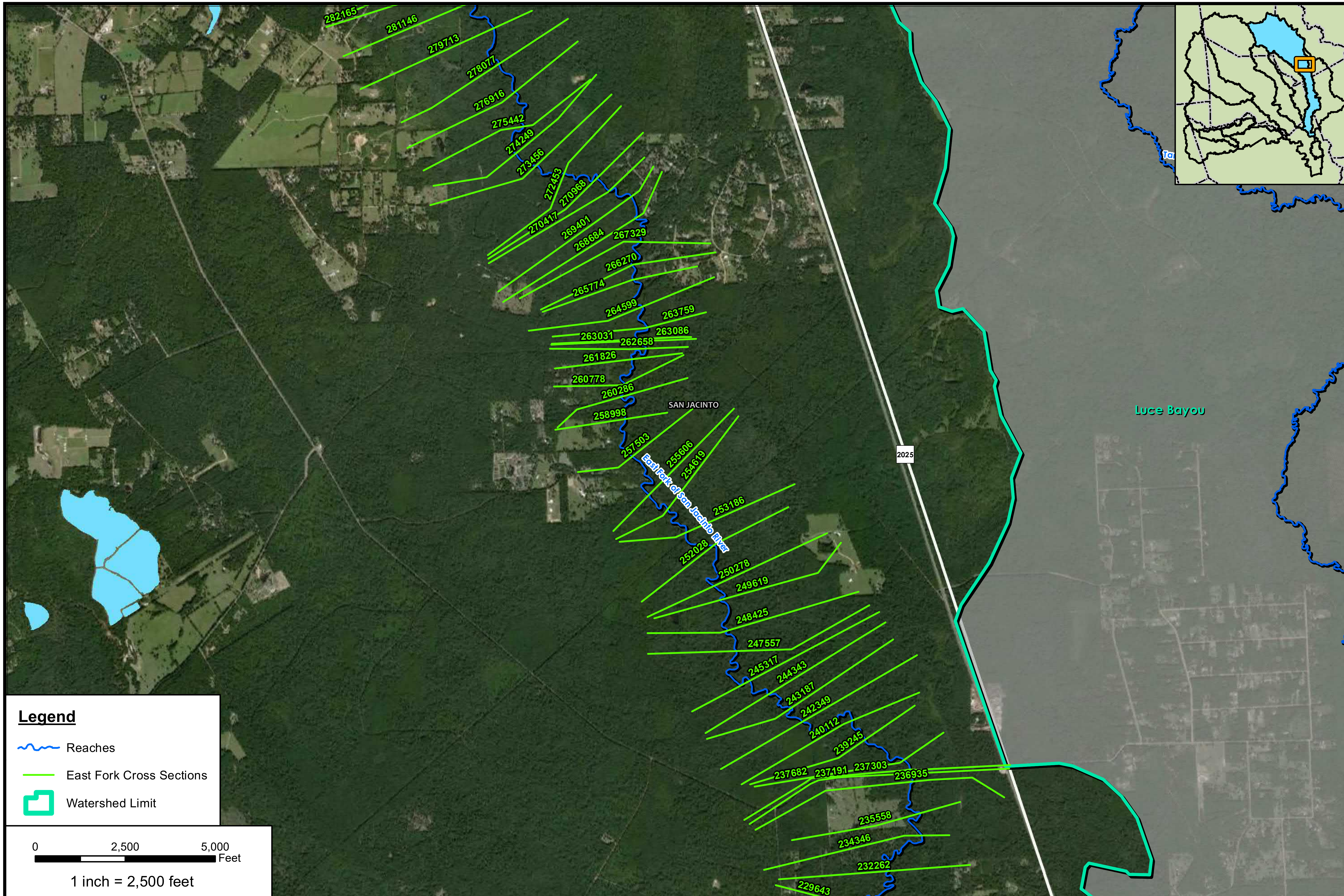
DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

HARRIS COUNTY FLOOD CONTROL DISTRICT
San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | EAST FORK SAN JACINTO

SAN JACINTO
REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit
C8 - H7



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FtUS

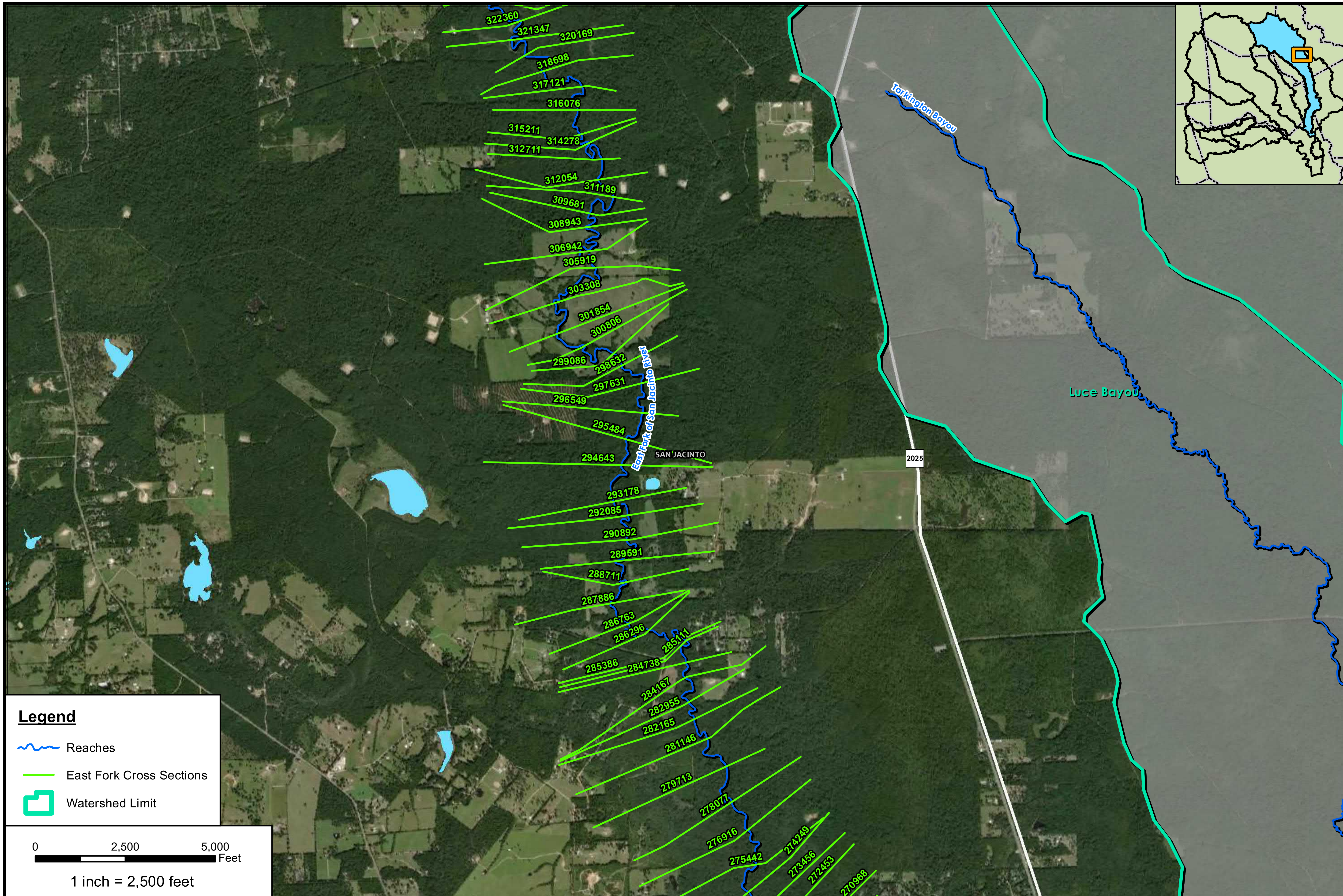
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | EAST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - H8



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

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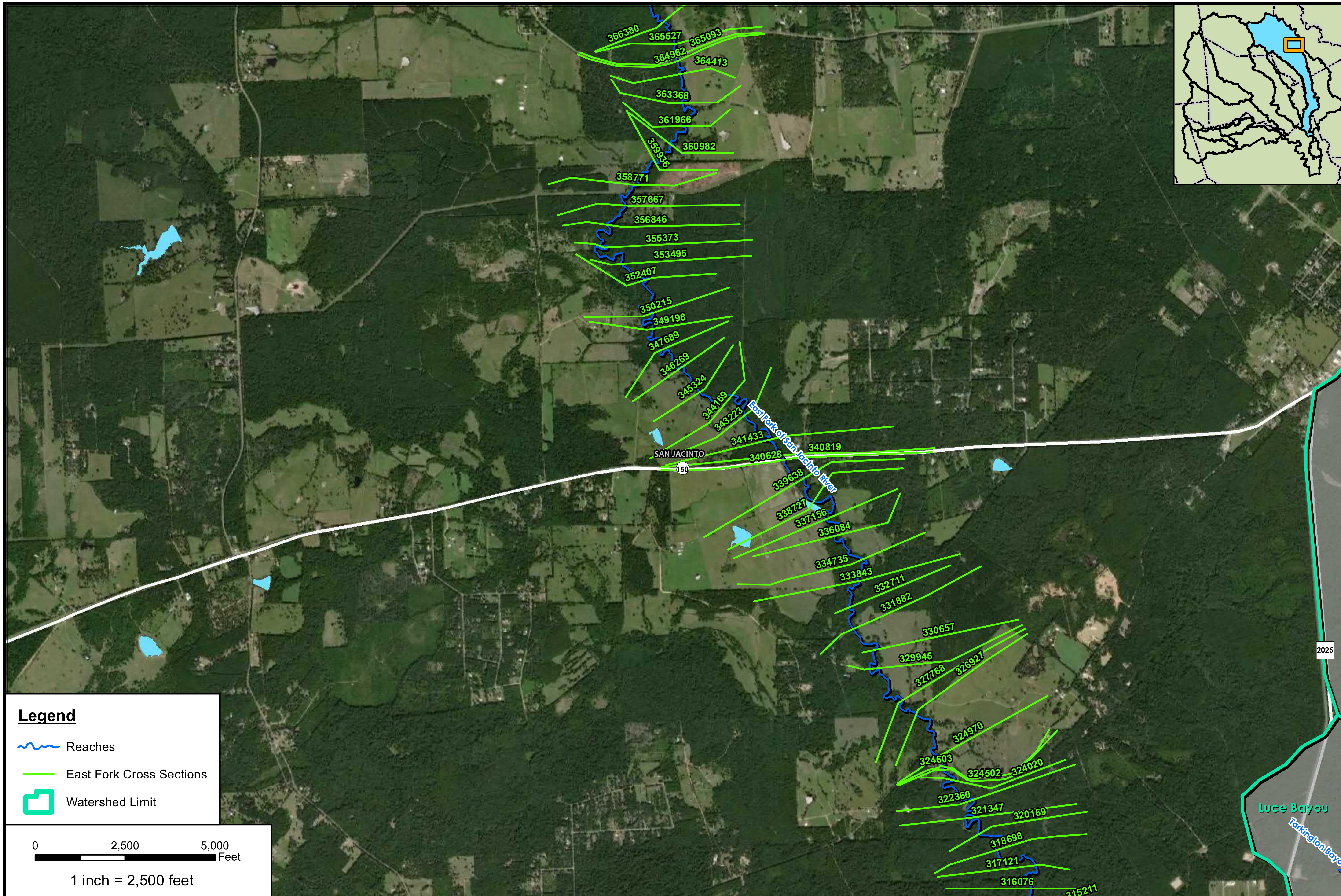
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | EAST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - H9



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

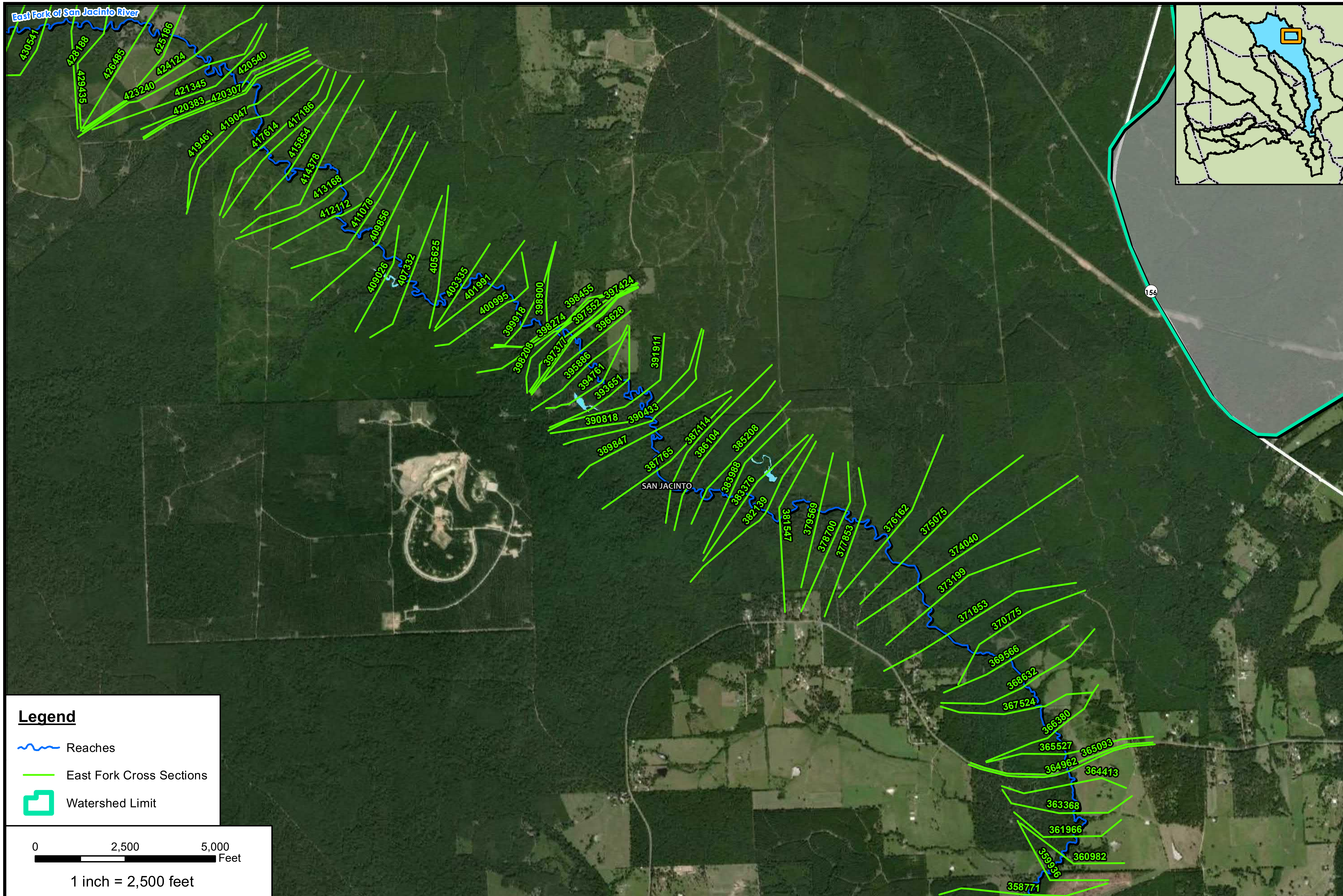
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | EAST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - H10



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

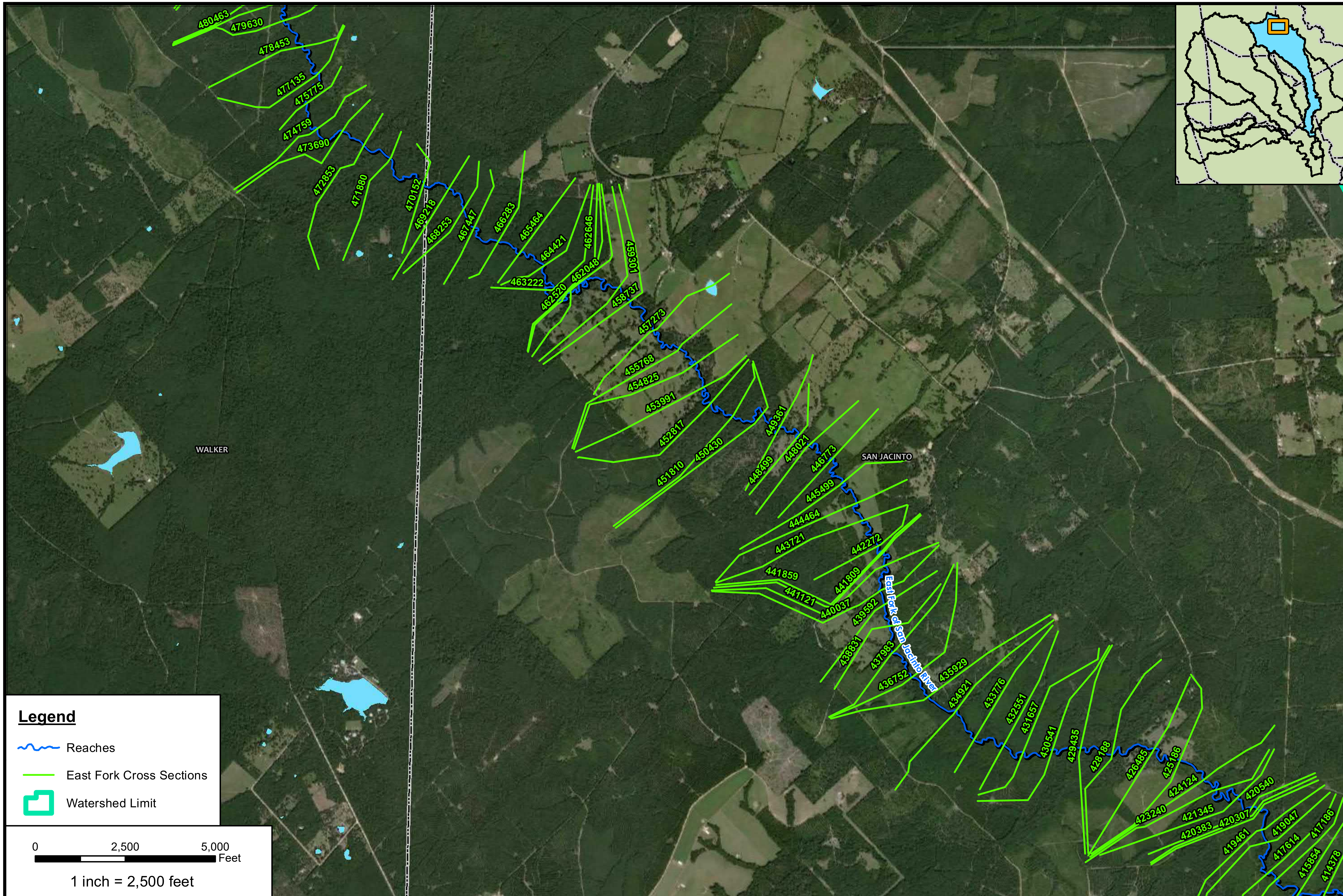
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FtUS

HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | EAST FORK SAN JACINTO

Exhibit C8 - H11



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM
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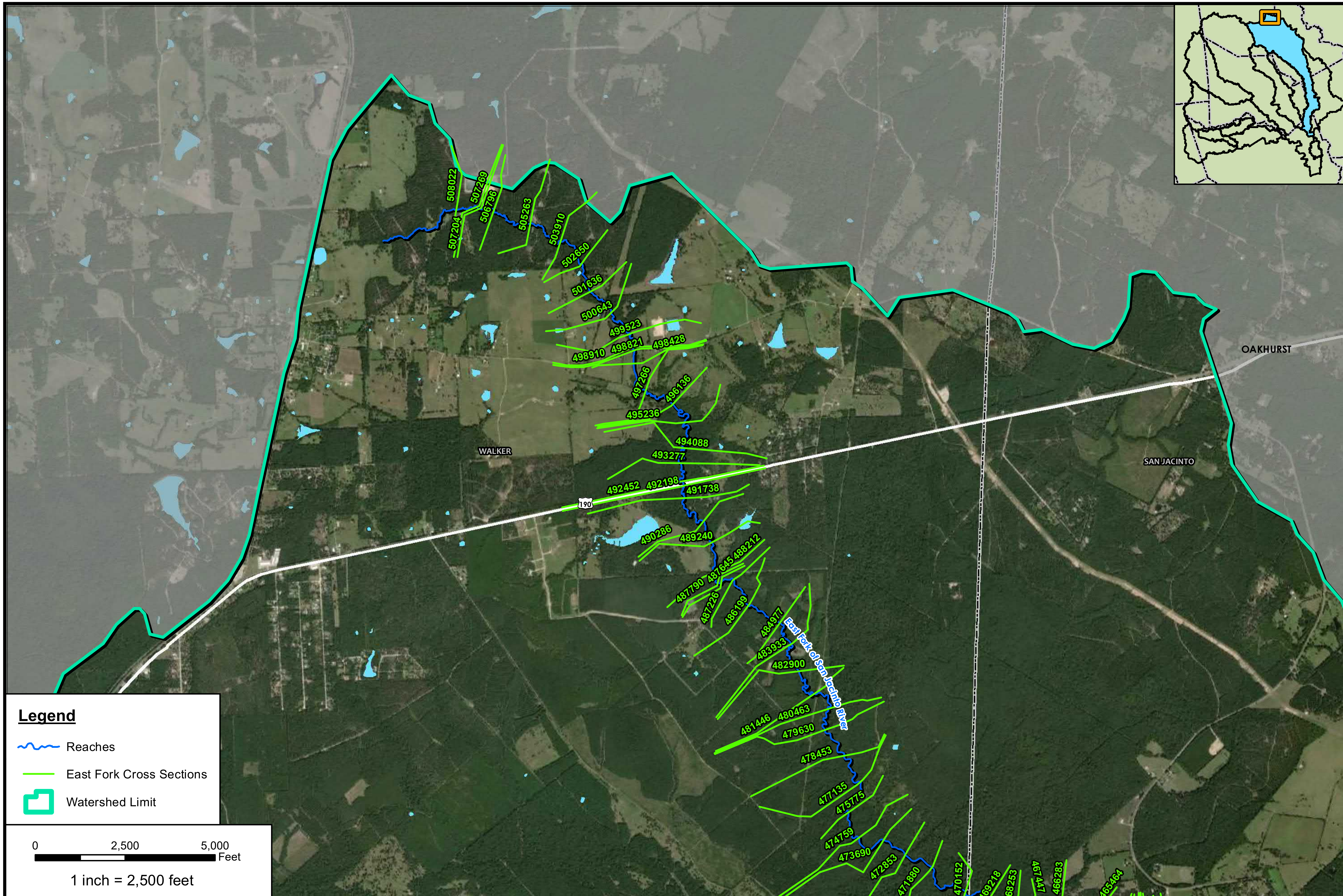
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | EAST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - H12



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

PROJECT AVO 33465

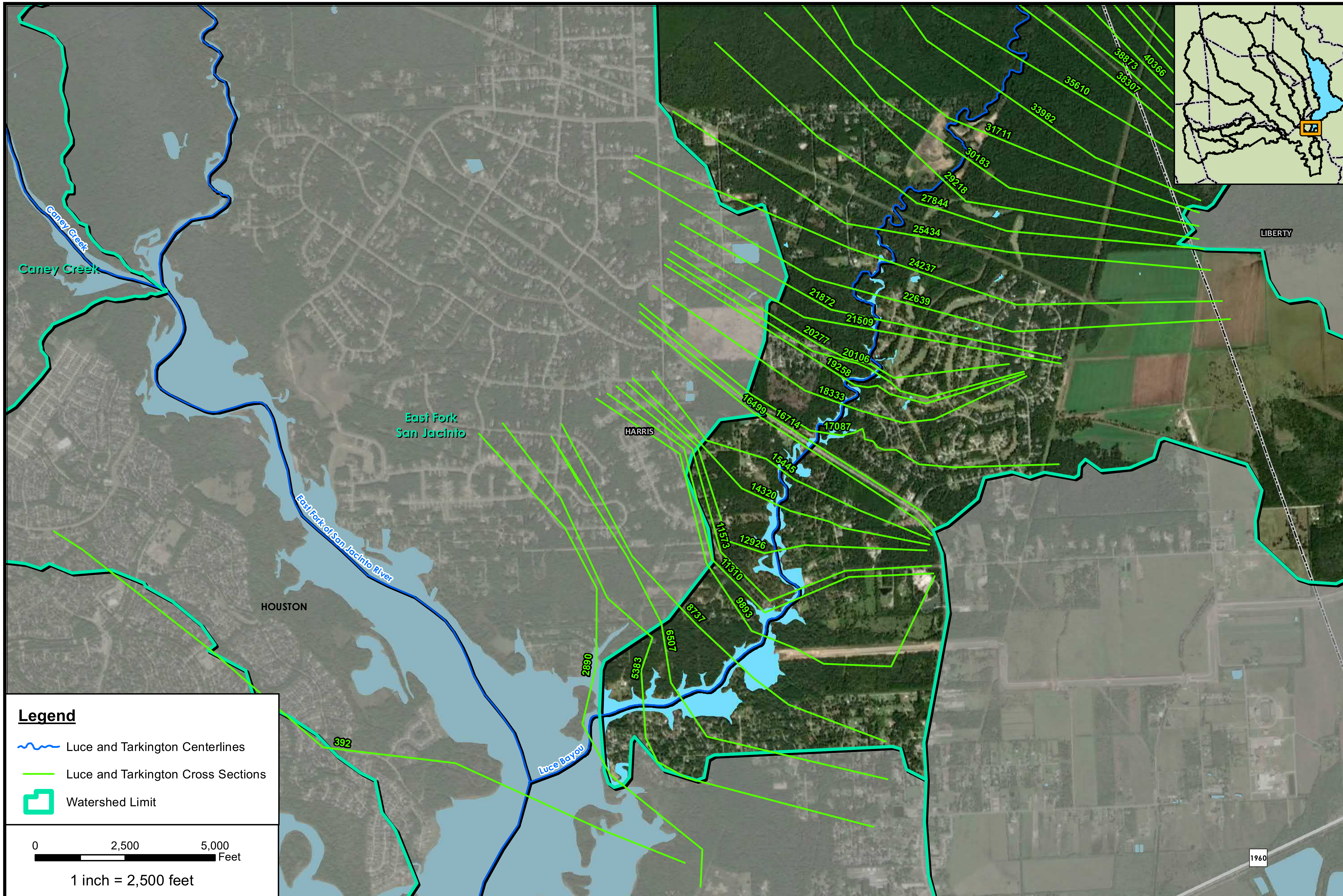
DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

HYDRAULIC WORK MAP | EAST FORK SAN JACINTO

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - H13



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | LUCE AND TARKINGTON BAYOU

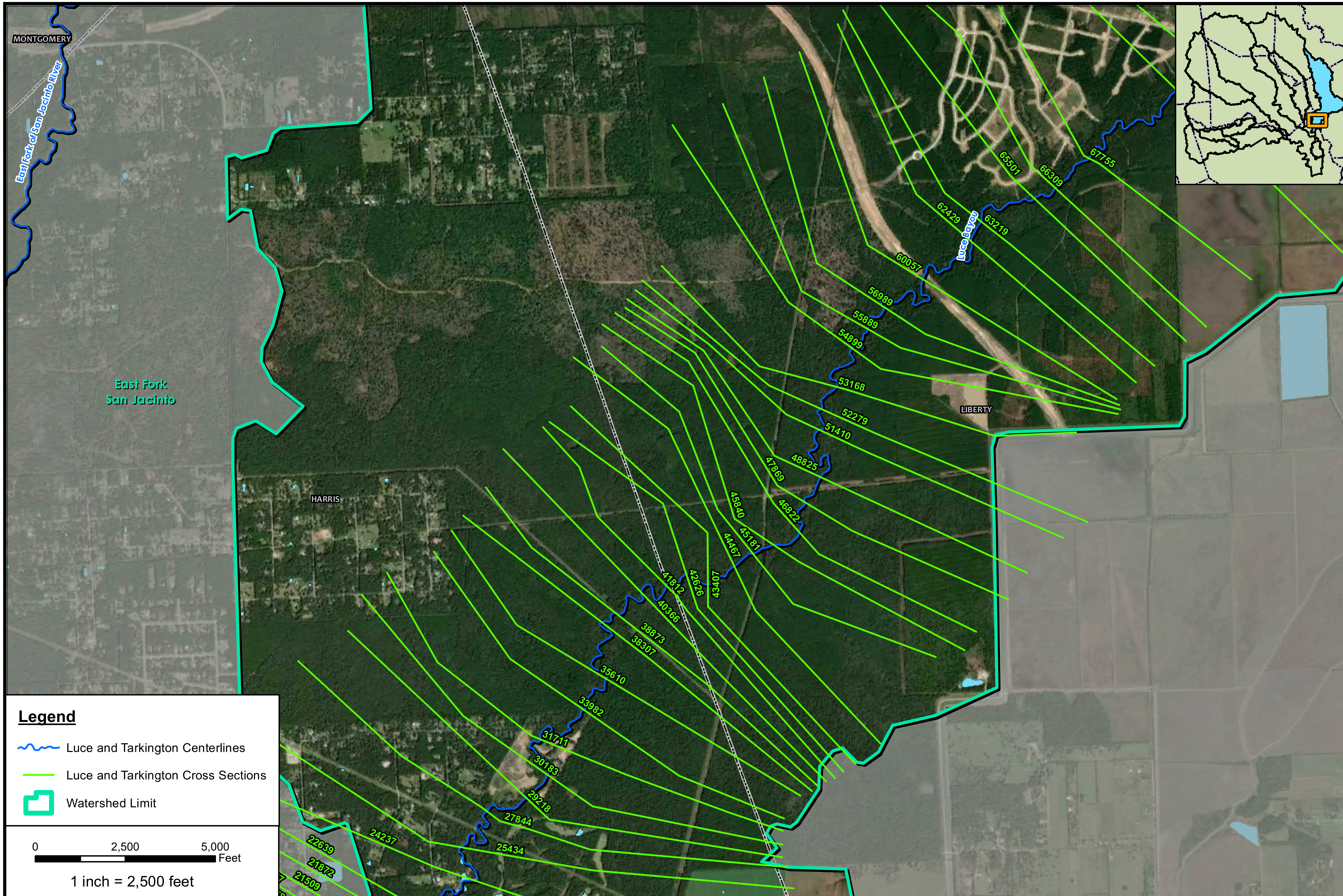
PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

SAN JACINTO
REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - I1



PROJECT AVO
33465

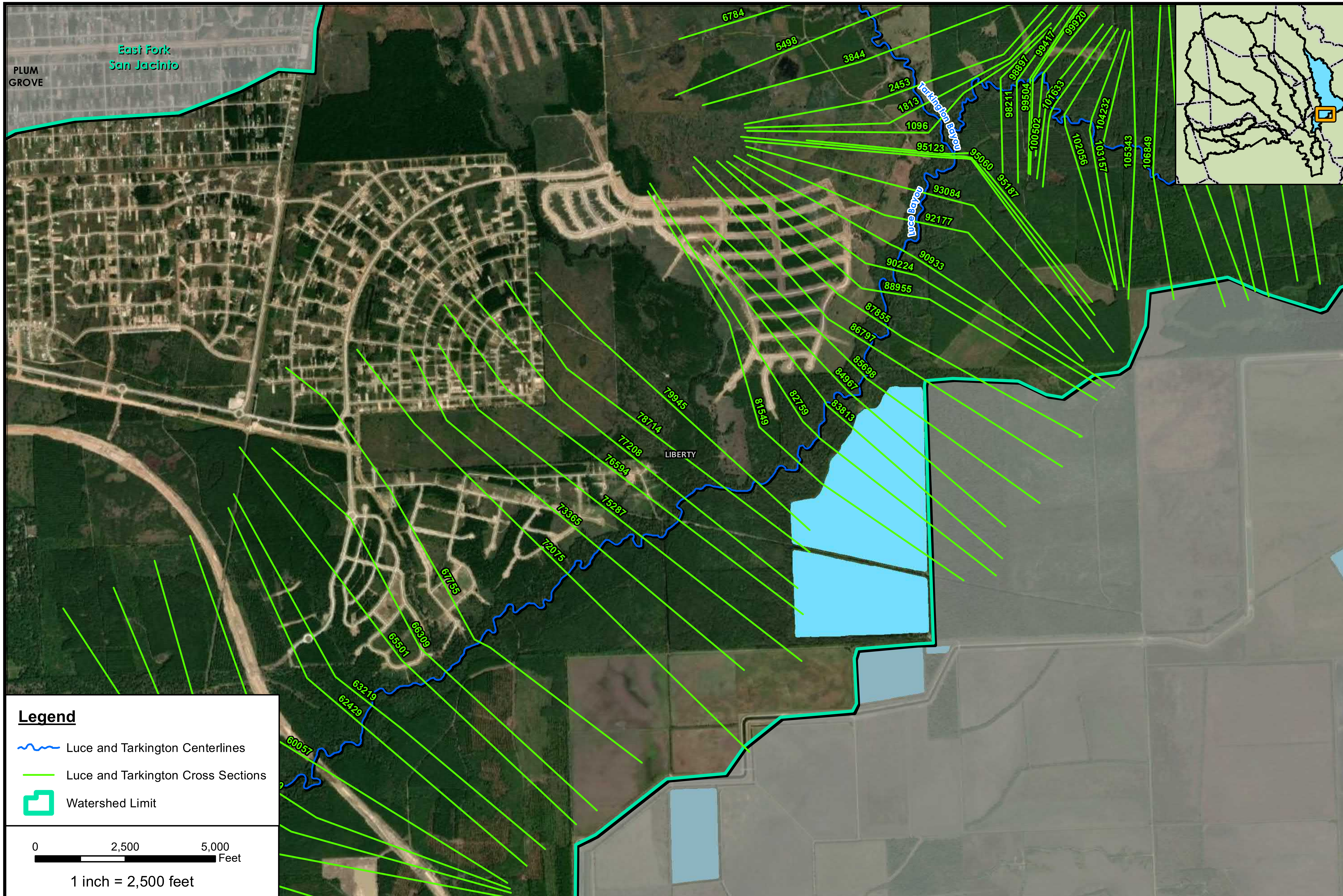
DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ftus

HARRIS COUNTY FLOOD CONTROL DISTRICT
San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | LUCE AND TARKINGTON BAYOU

SAN JACINTO
REGIONAL WATERSHED
MASTER DRAINAGE PLAN

Exhibit
C8 - I2



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | LUCE AND TARKINGTON BAYOU

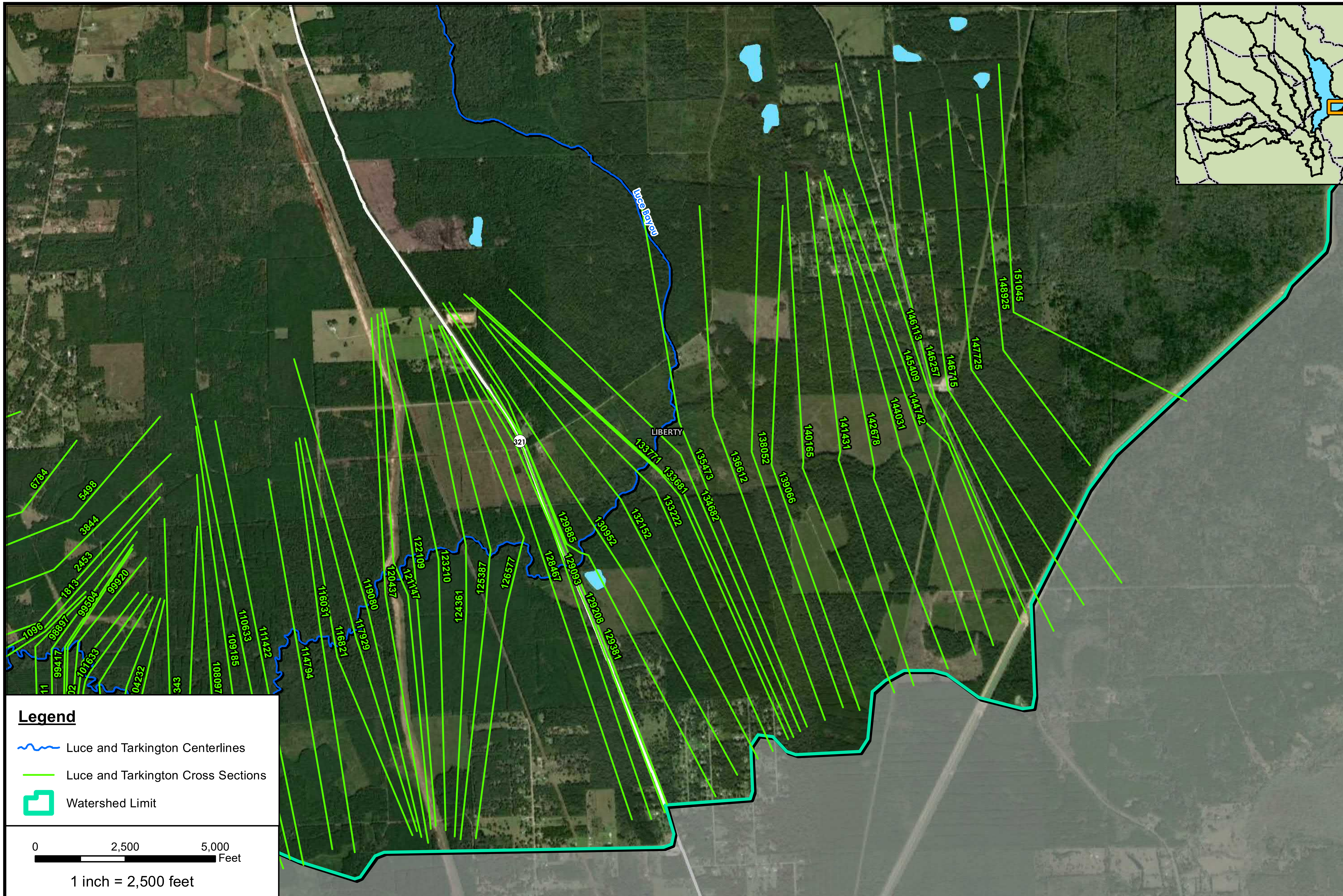
PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - I3



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

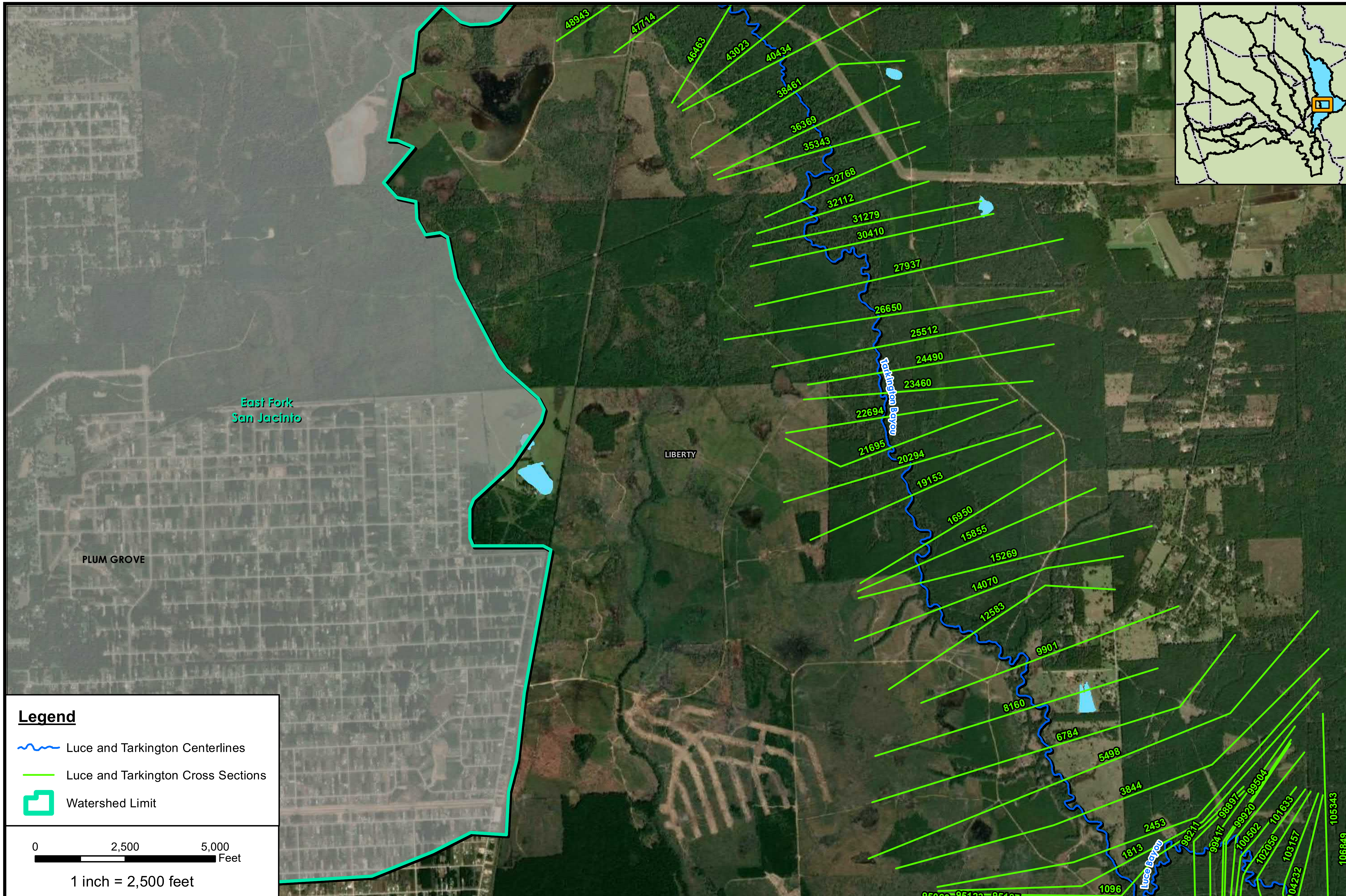
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | LUCE AND TARKINGTON BAYOU

SAN JACINTO
REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - I4



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | LUCE AND TARKINGTON BAYOU

PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

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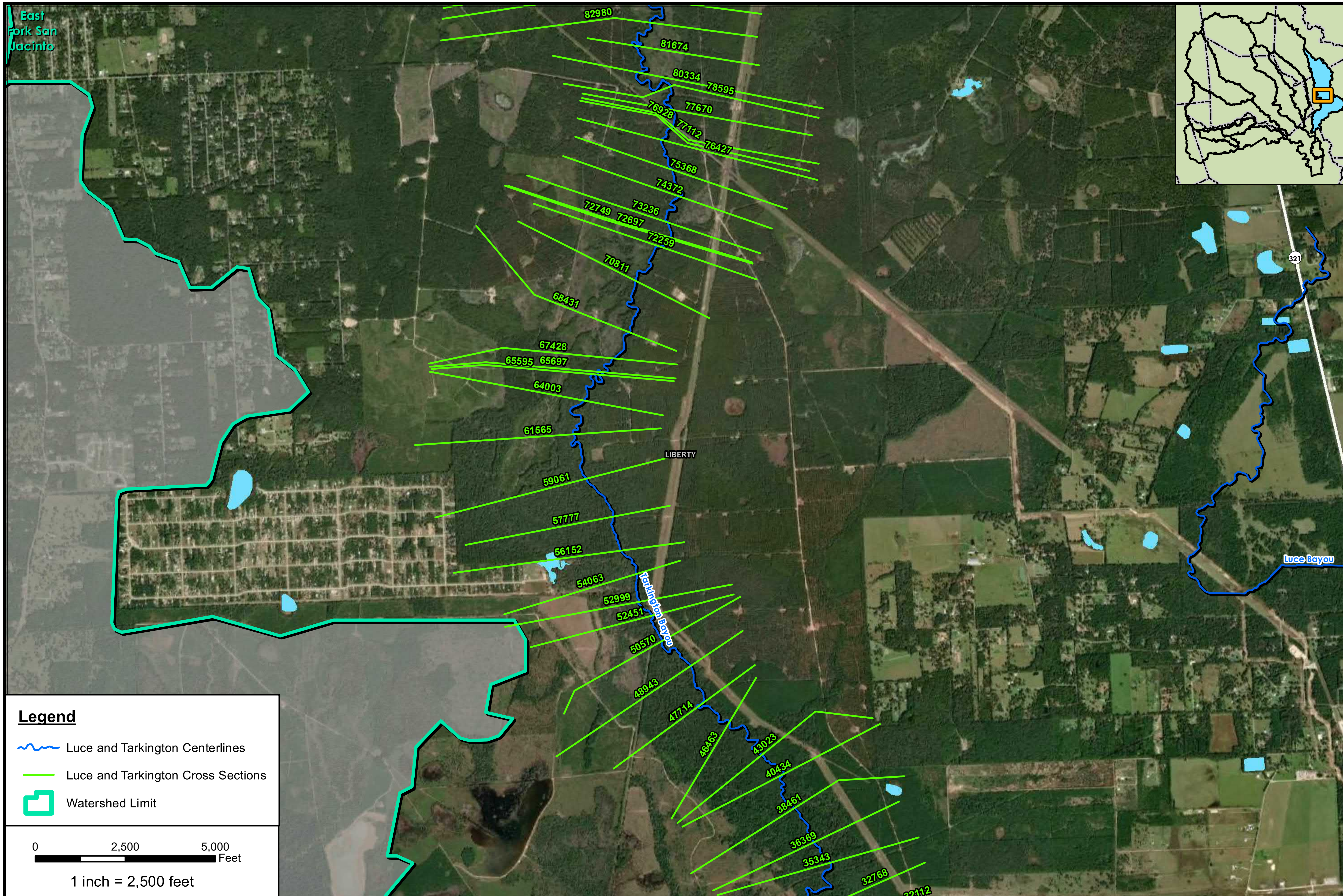
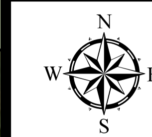
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - I5





PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

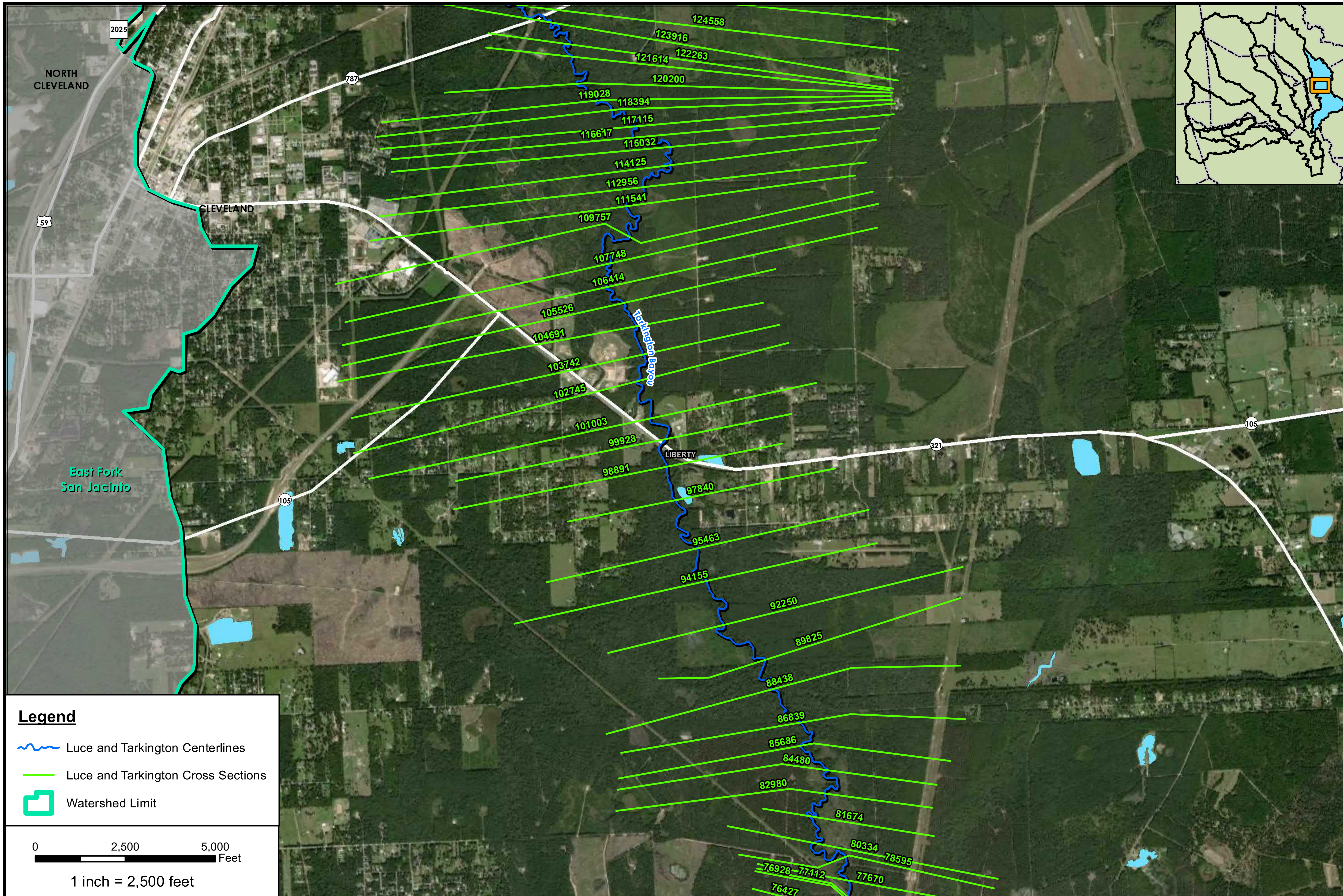
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | LUCE AND TARKINGTON BAYOU

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - I6



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

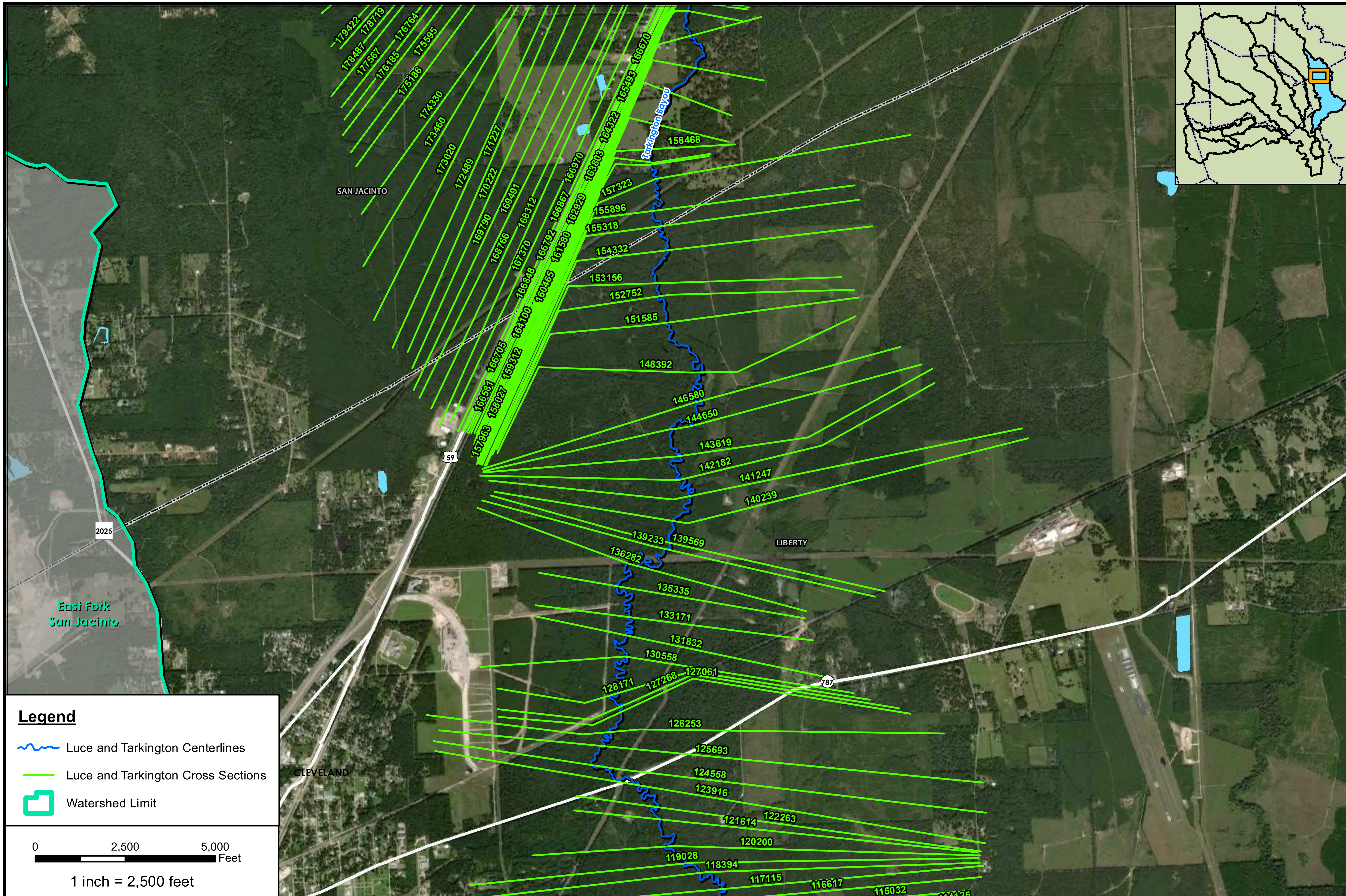
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | LUCE AND TARKINGTON BAYOU

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - I7



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

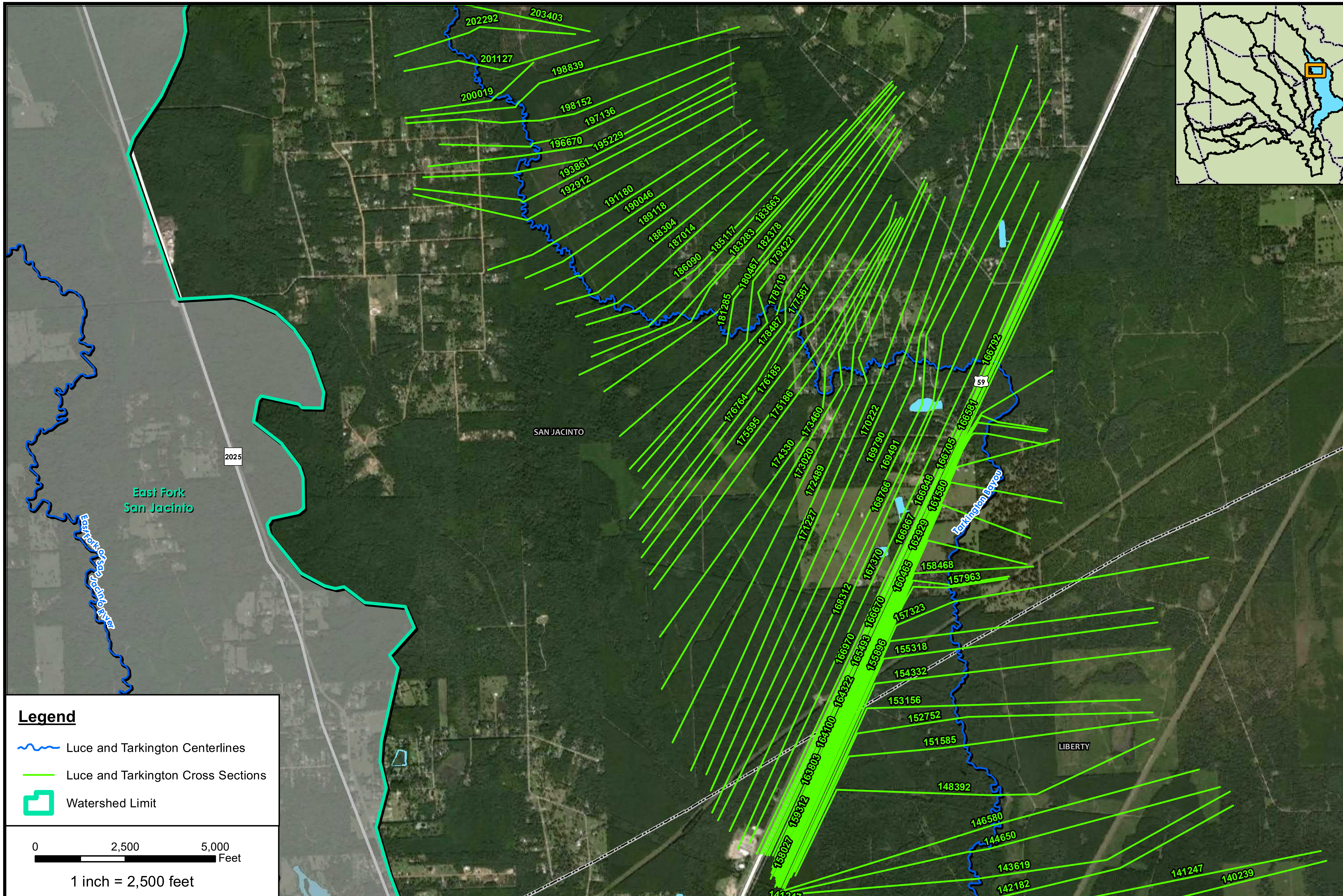
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | LUCE AND TARKINGTON BAYOU

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - I8



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

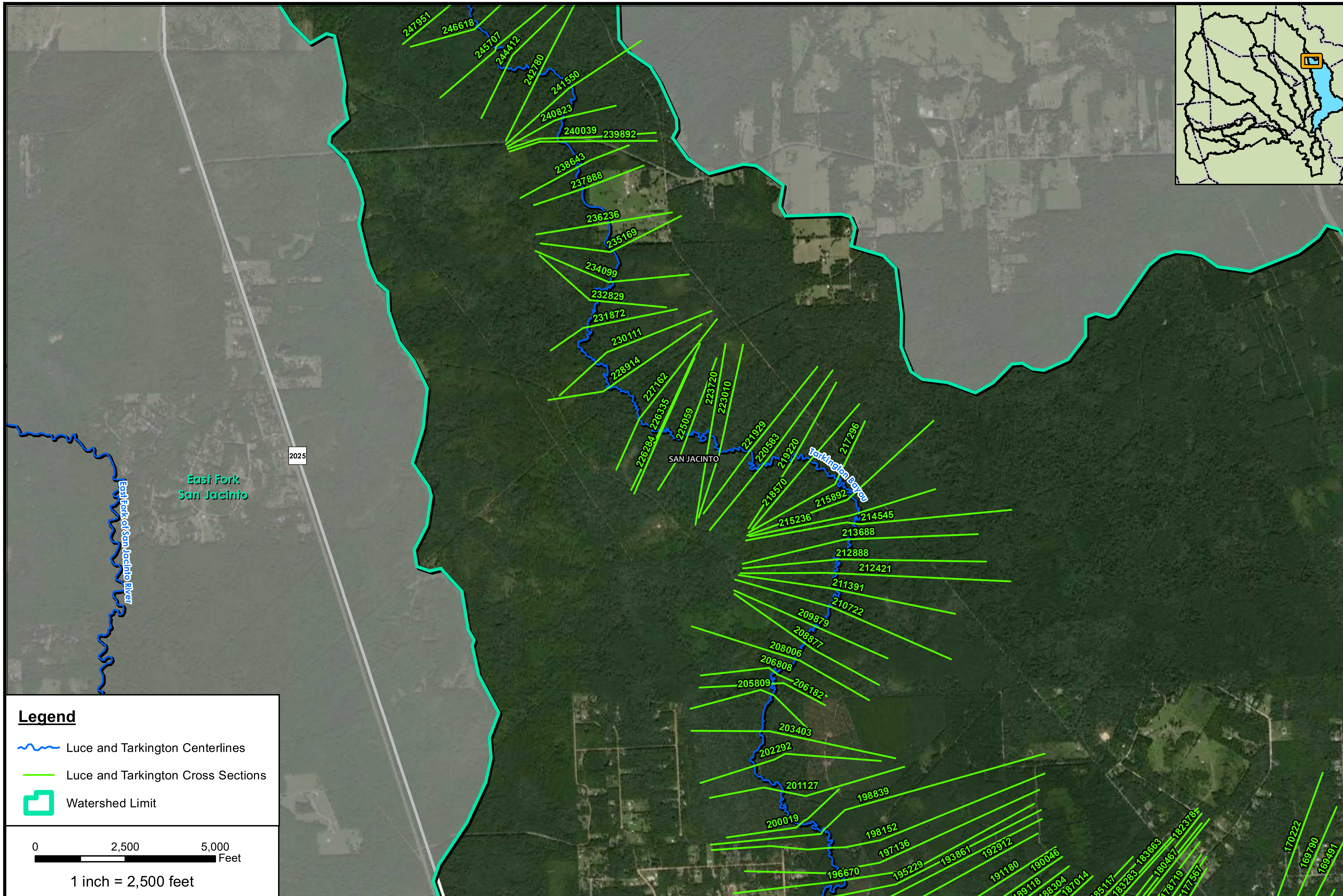
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | LUCE AND TARKINGTON BAYOU

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - I9



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | LUCE AND TARKINGTON BAYOU

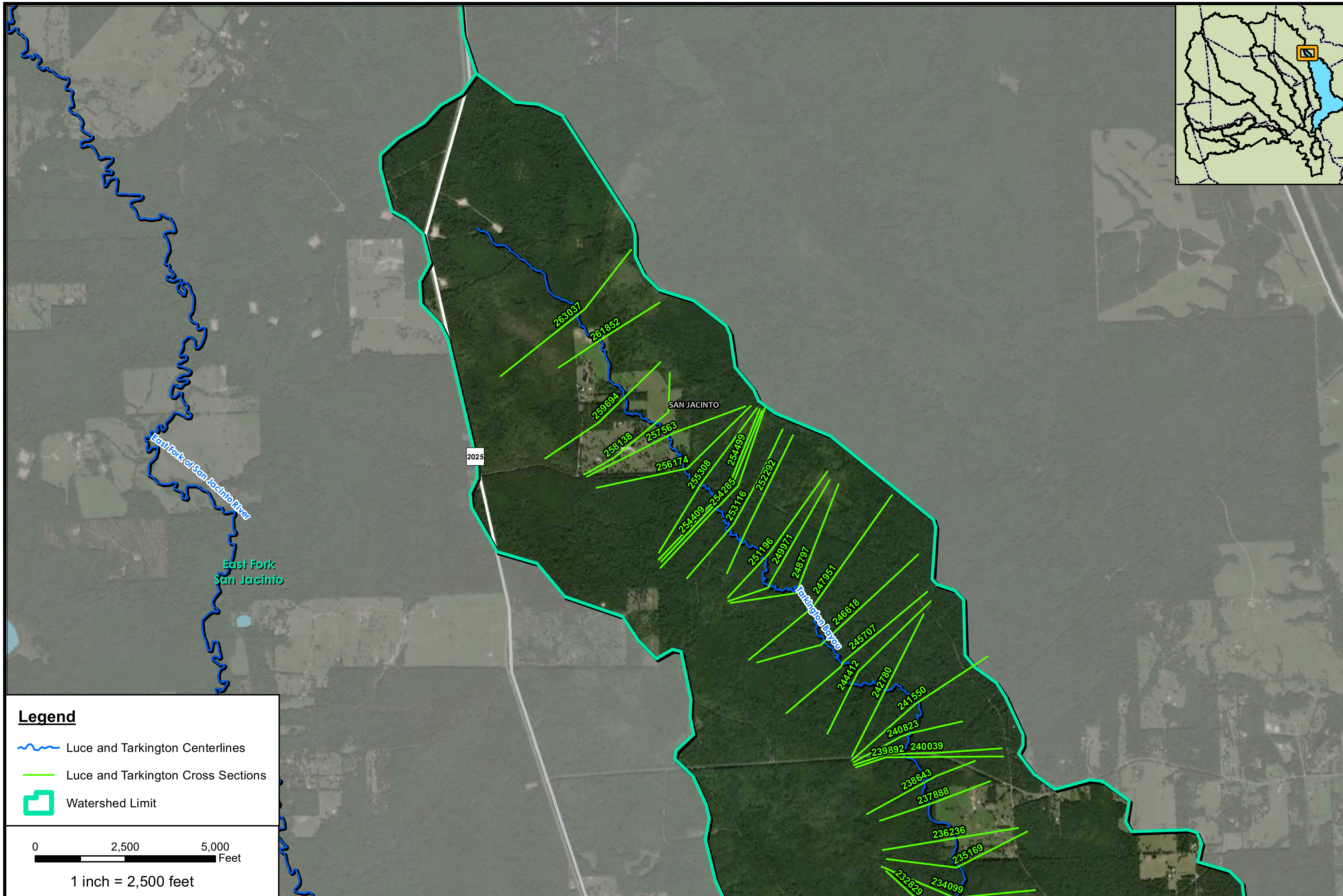
PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FtUS

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - I10



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DATUM & COORDINATE SYSTEM

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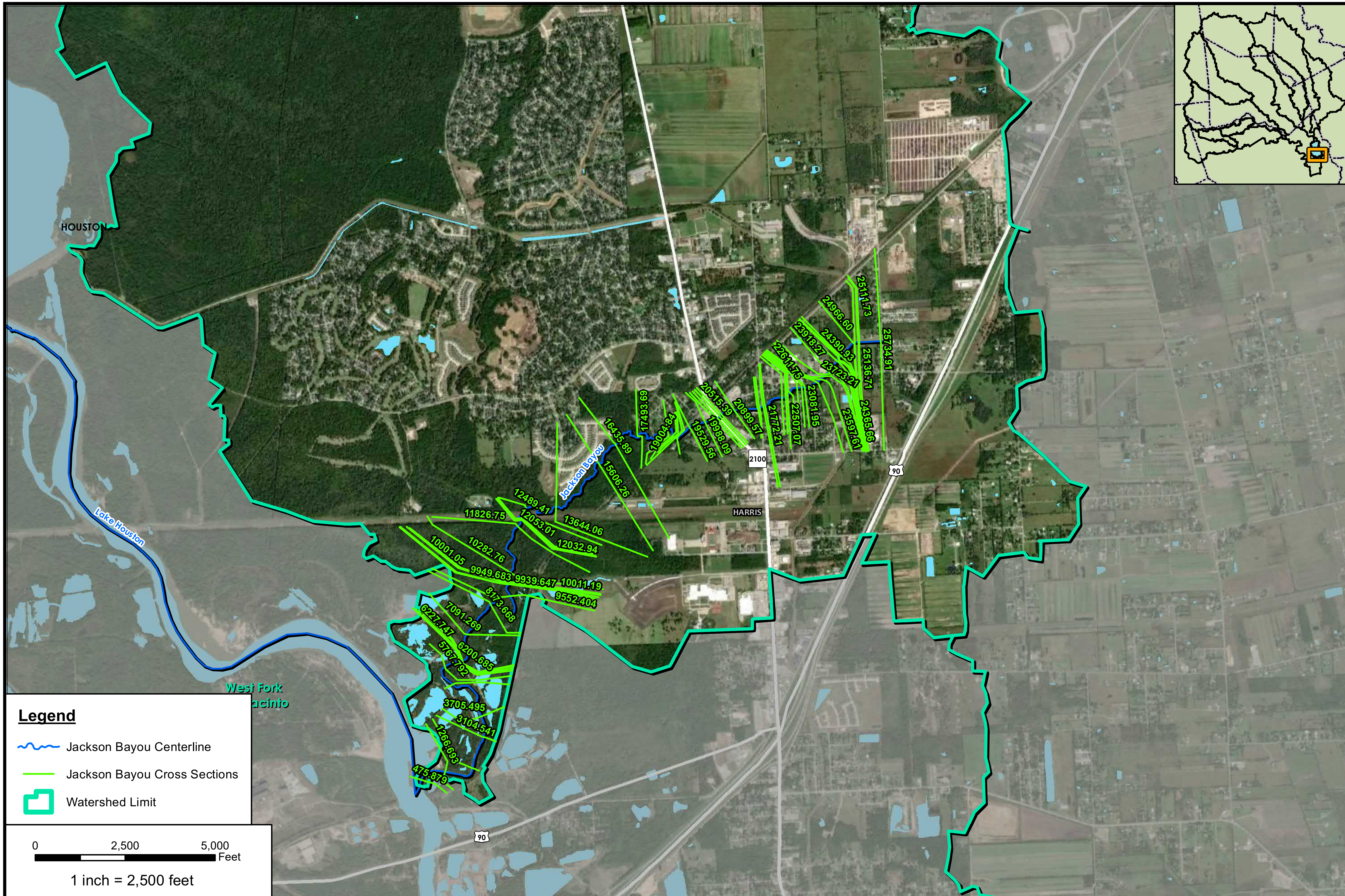
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | LUCE AND TARKINGTON BAYOU

Exhibit C8 - I11



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DATUM & COORDINATE SYSTEM

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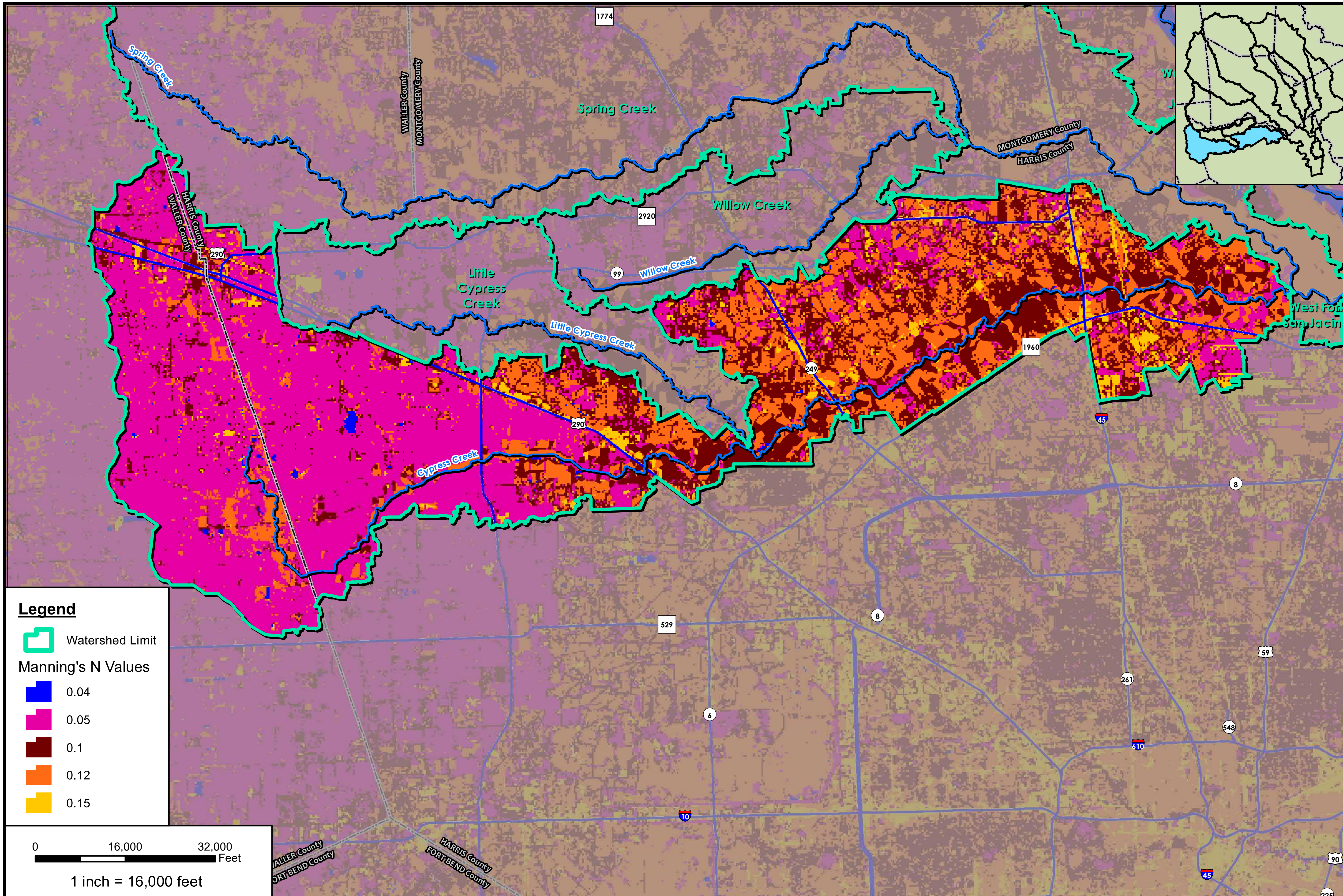
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

HYDRAULIC WORK MAP | JACKSON BAYOU

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C8 - J1



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DATUM & COORDINATE SYSTEM

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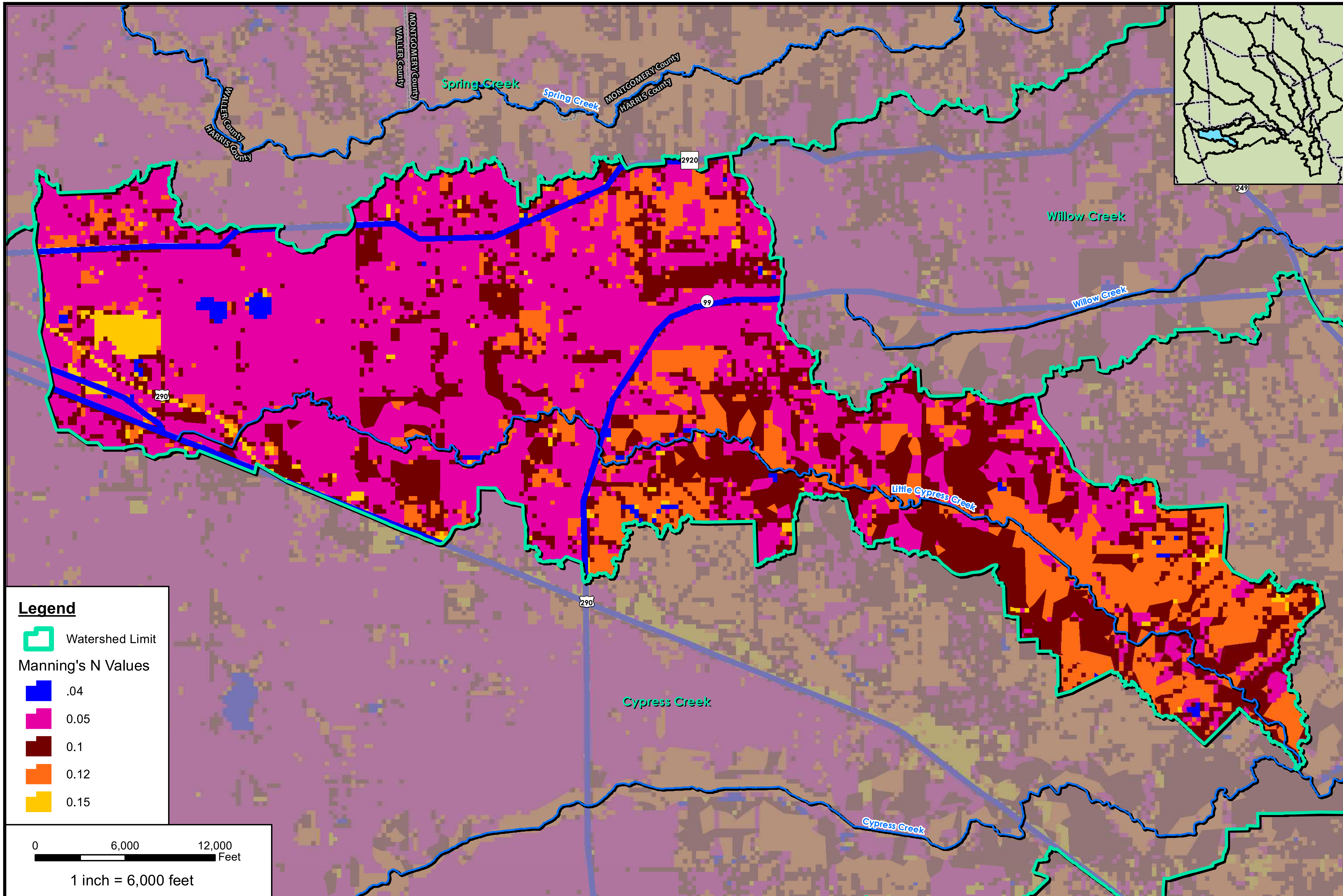
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

MANNING'S N VALUE MAP | CYPRESS CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C9-A



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DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

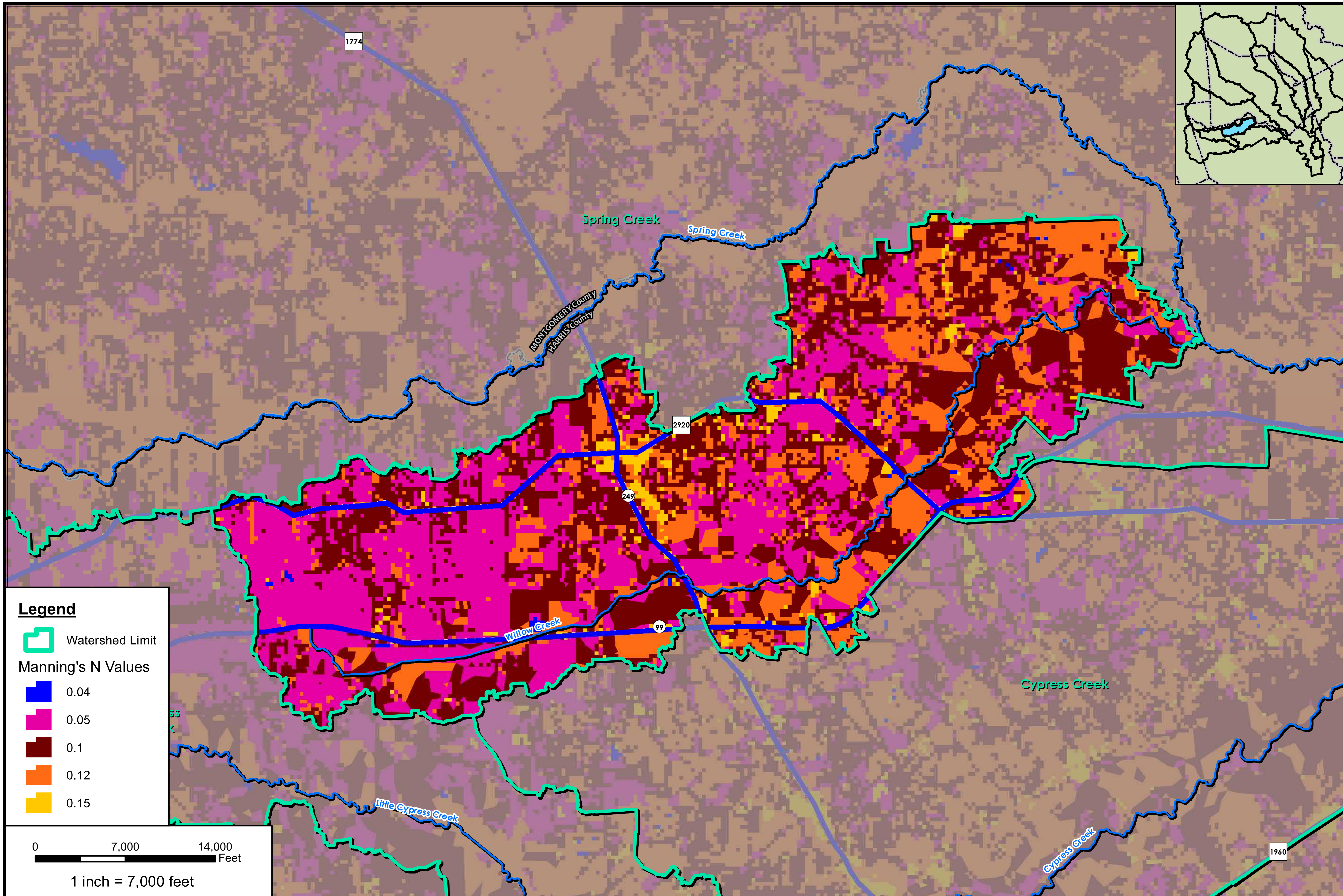
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

MANNING'S N VALUE MAP | LITTLE CYPRESS CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C9-B



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DATUM & COORDINATE SYSTEM

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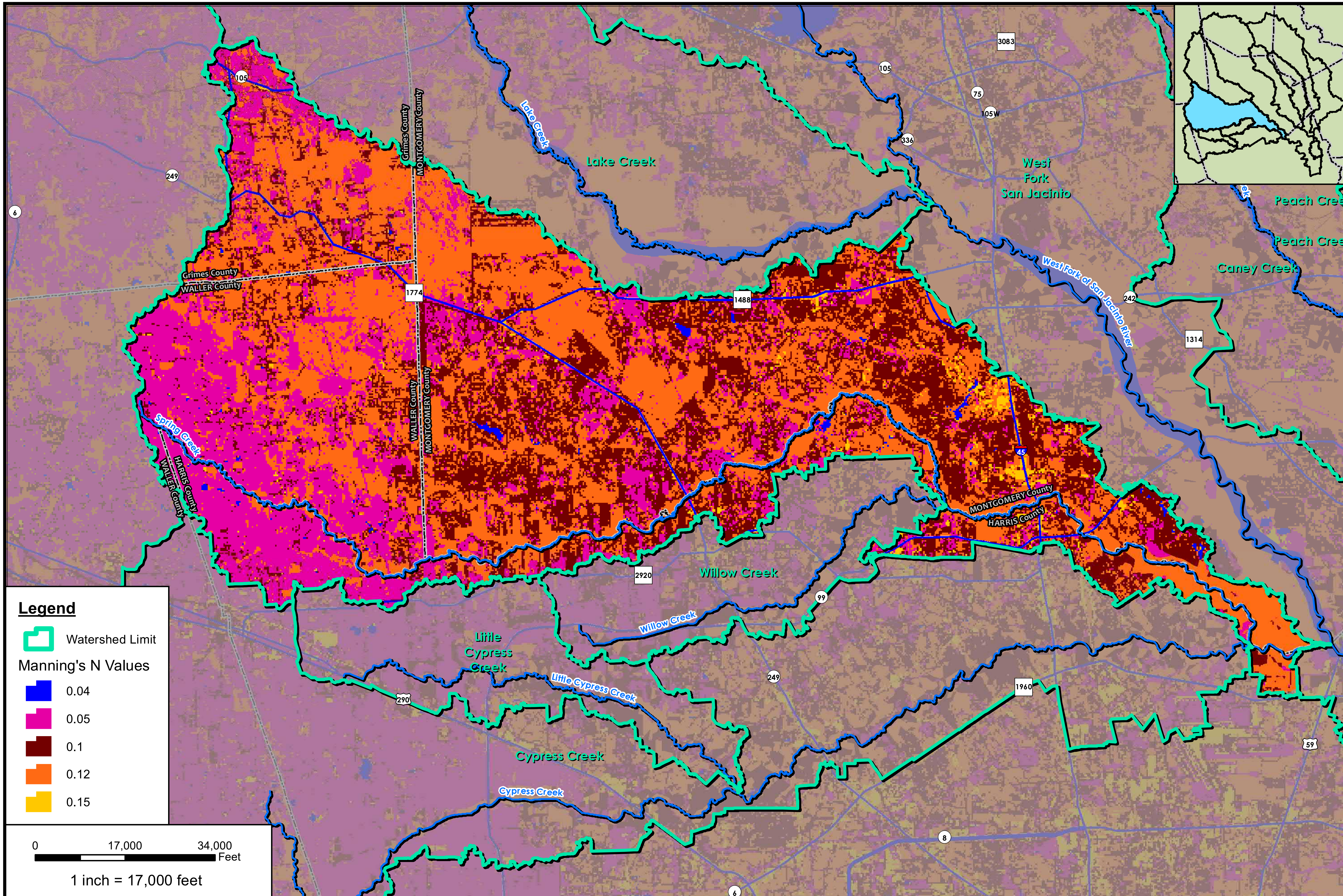
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

MANNING'S N VALUE MAP | WILLOW CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C9-C



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

MANNING'S N VALUE MAP | SPRING CREEK

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DATUM & COORDINATE SYSTEM
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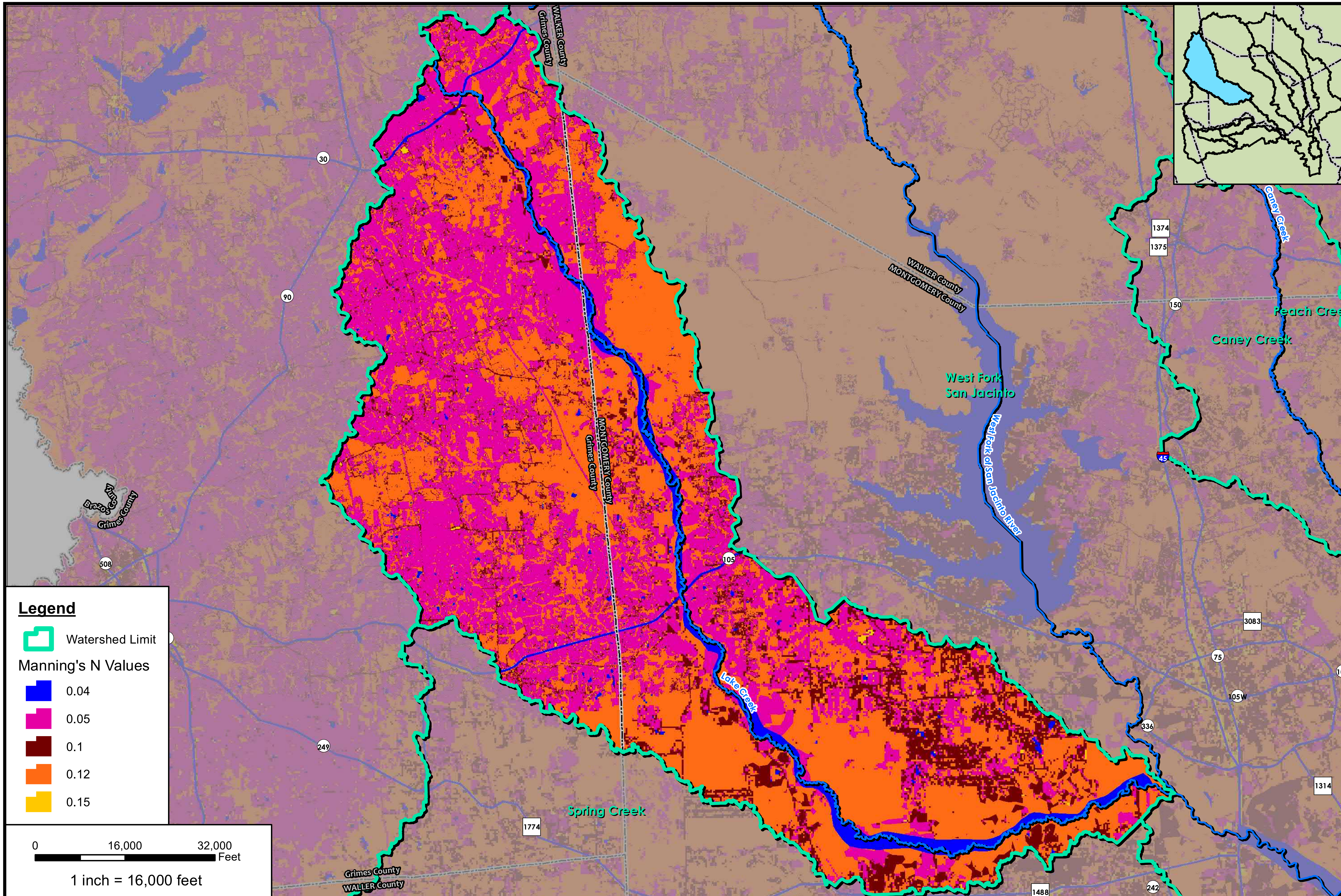
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C9-D



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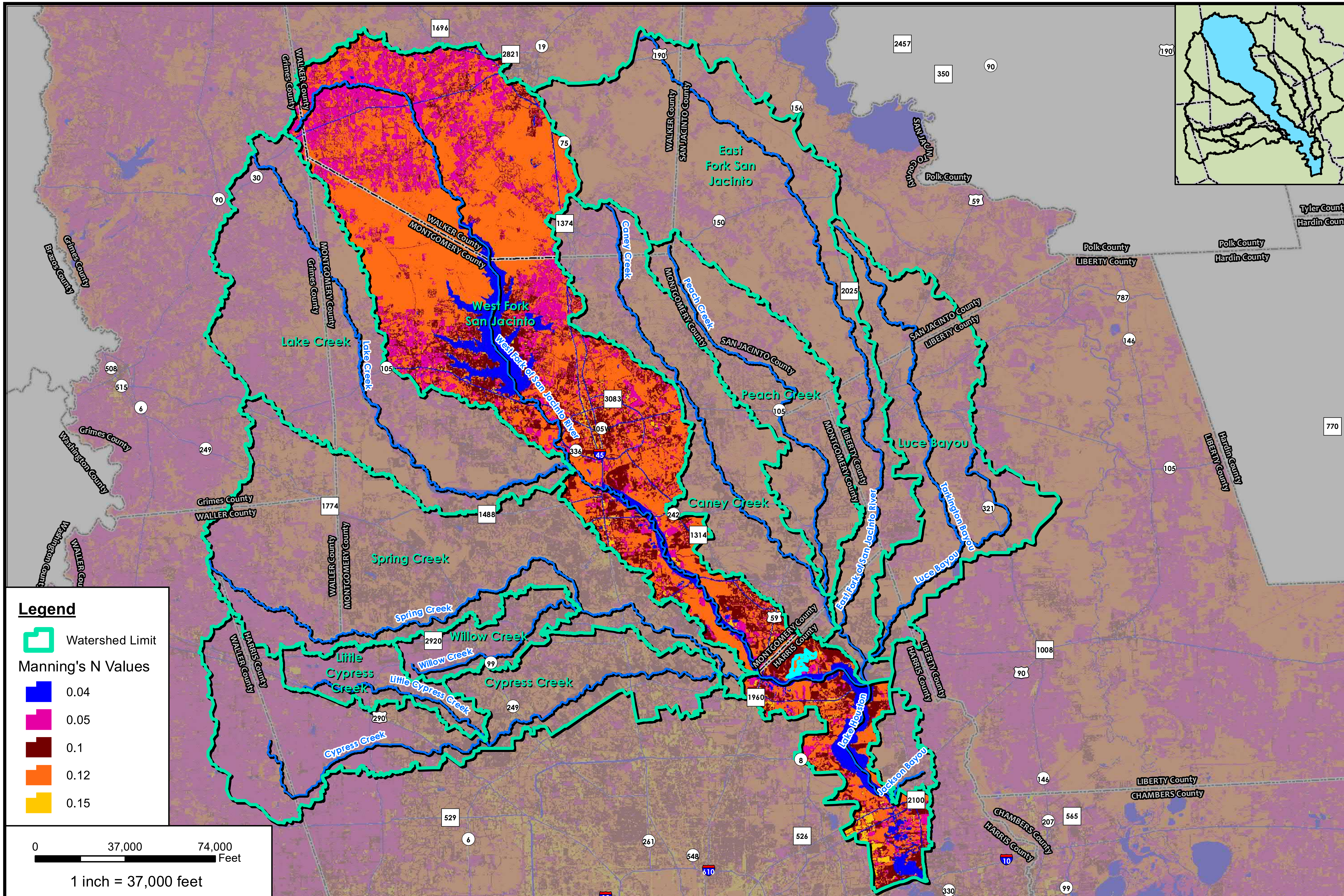
DATUM & COORDINATE SYSTEM NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

HARRIS COUNTY FLOOD CONTROL DISTRICT
San Jacinto Regional Watershed Master Drainage Plan

MANNING'S N VALUE MAP | LAKE CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C9-E



PROJECT AVO
33465

DATUM & COORDINATE SYSTEM
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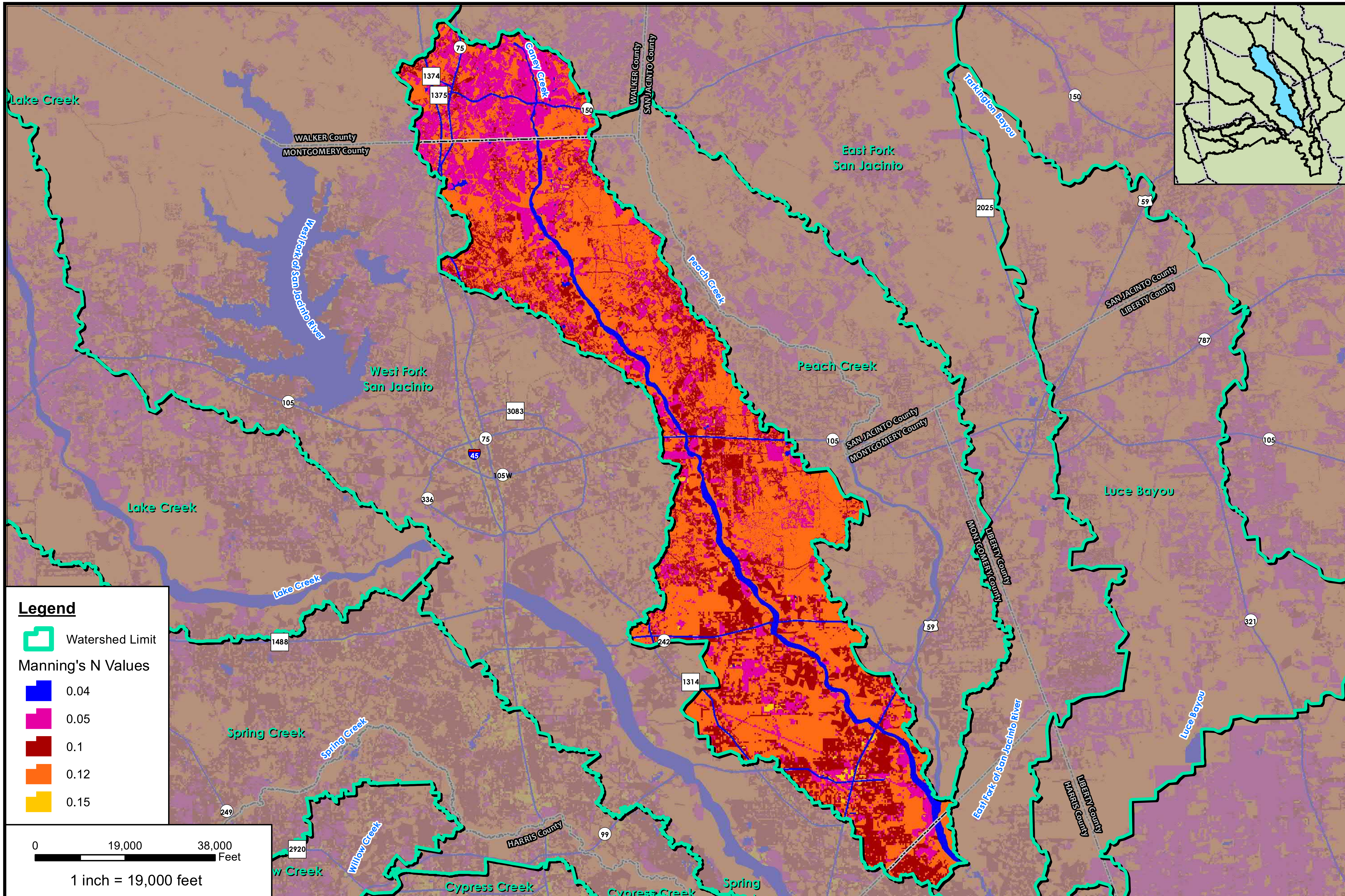
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

MANNING'S N VALUE MAP | WEST FORK SAN JACINTO

SAN JACINTO
REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C9-F



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

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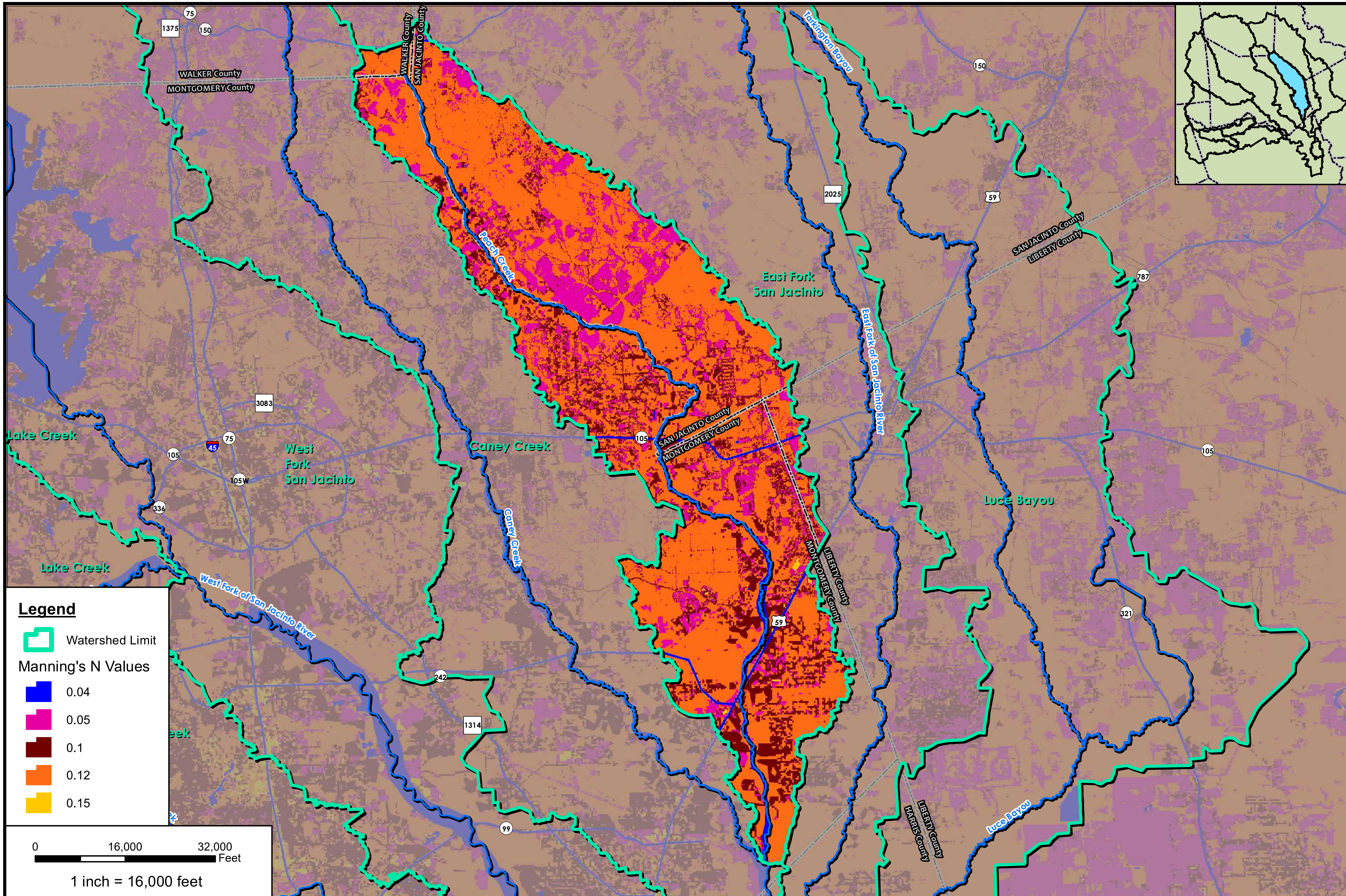
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

MANNING'S N VALUES MAP | CANEY CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C9-G



PROJECT AVO 33465

DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

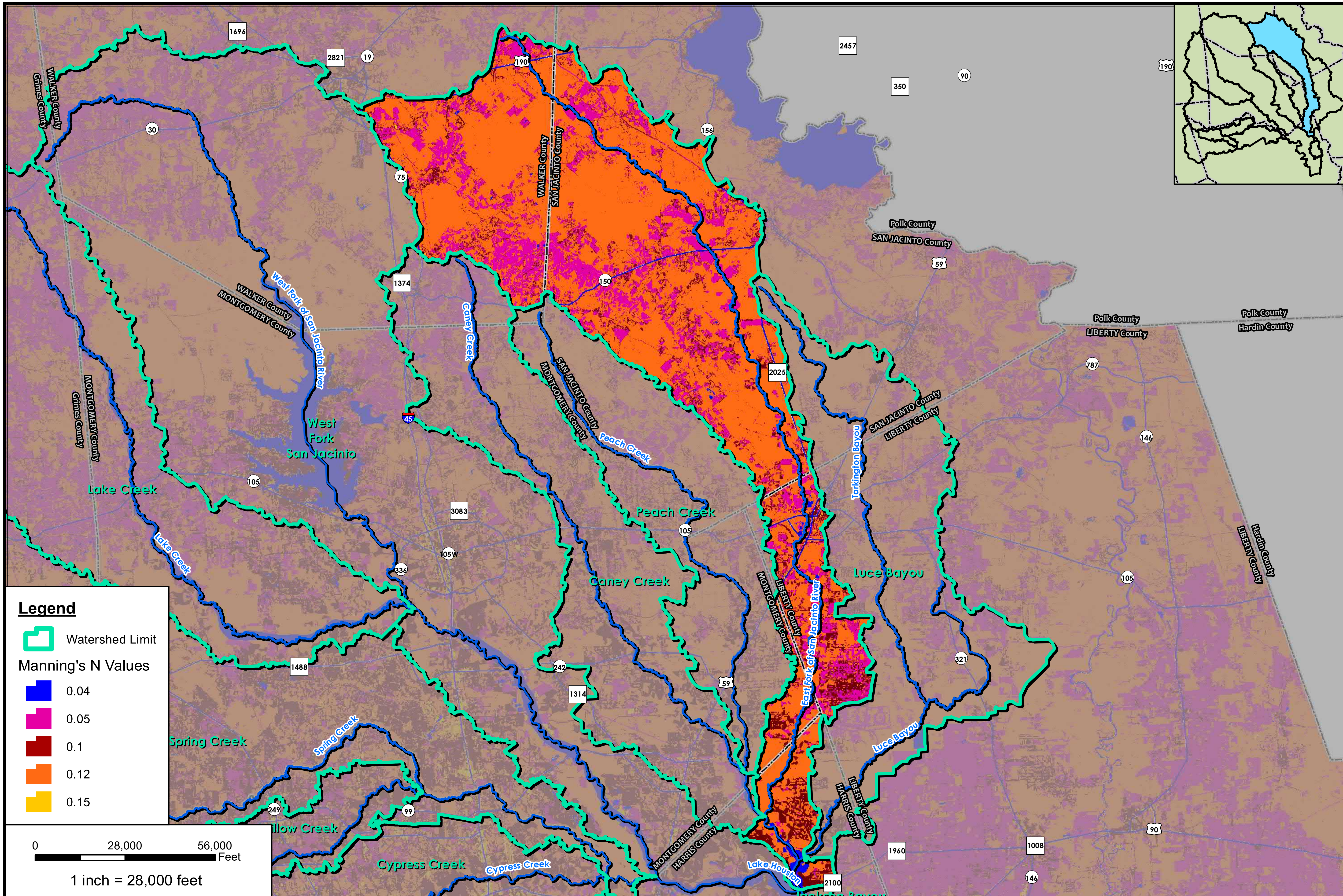
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

MANNING'S N VALUE MAP | PEACH CREEK

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C9-H



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

MANNING'S N VALUE MAP | EAST FORK SAN JACINTO

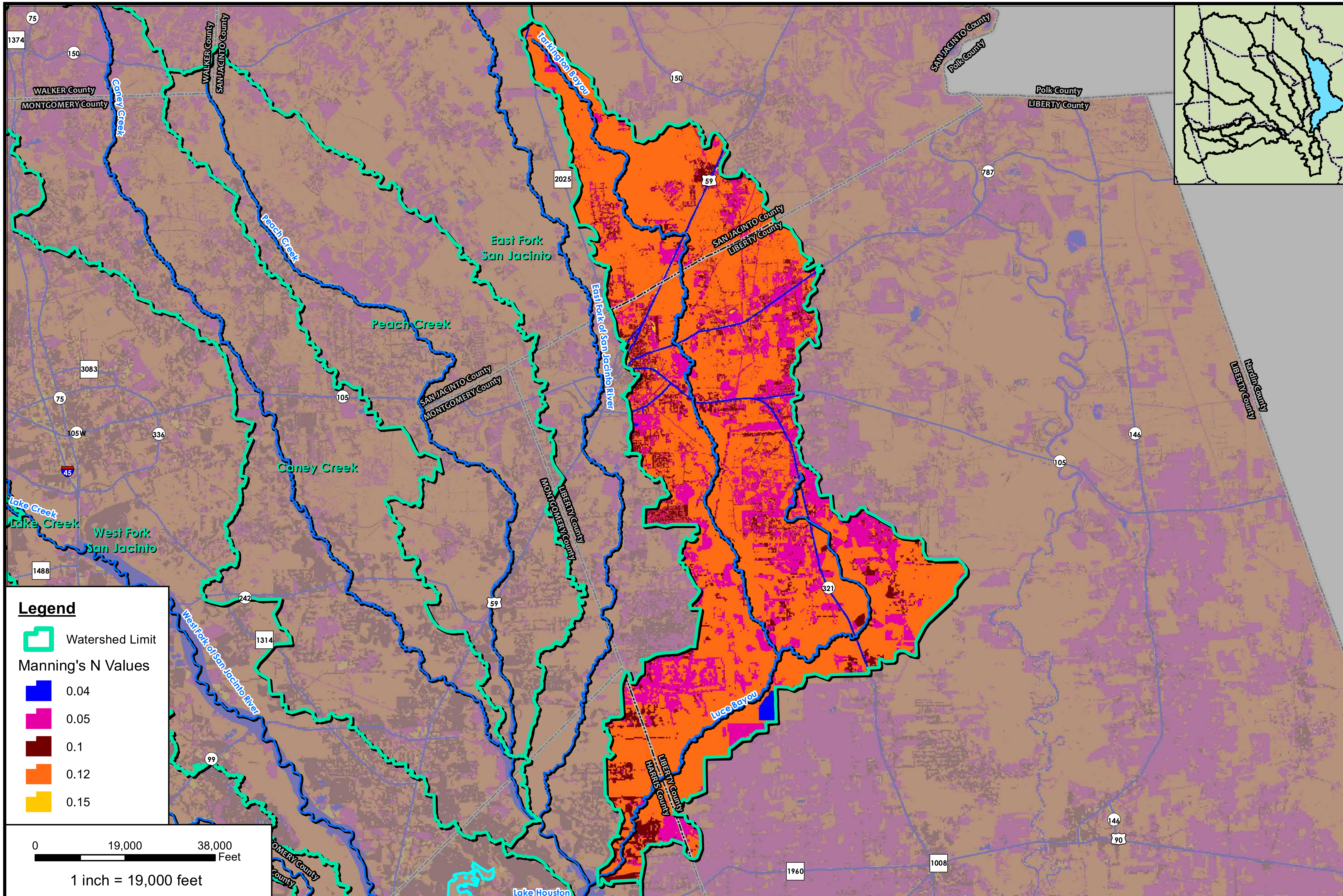
PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 Ft US

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C9-I



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

MANNING'S N VALUE MAP | LUCE AND TARKINGTON

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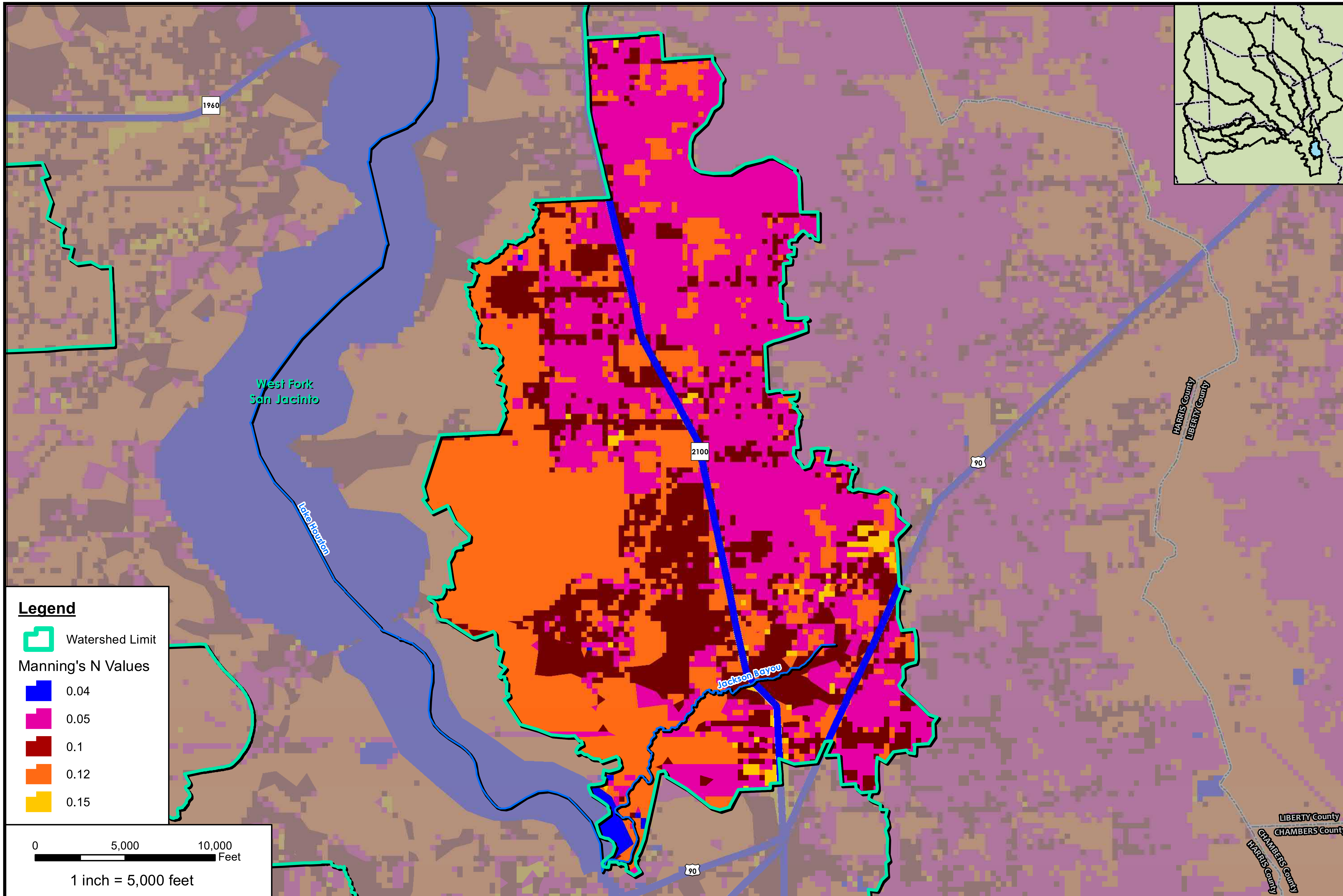
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C9-J



HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

MANNING'S N VALUE MAP | JACKSON BAYOU

PROJECT AVO 33465

DATUM & COORDINATE SYSTEM

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SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

Exhibit C9-K